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IS-IS Flooding Scope Link State PDUs (LSPs)

Abstract

Intermediate System to Intermediate System (IS-IS) provides efficient and reliable flooding of information to its peers; however, the current flooding scopes are limited to either area scope or domain scope. There are existing use cases where support of other flooding scopes is desirable. This document defines new Protocol Data Units (PDUs) that provide support for new flooding scopes as well as additional space for advertising information targeted for the currently supported flooding scopes. This document also defines extended Type-Length-Values (TLVs) and sub-TLVs that are encoded using 16-bit fields for Type and Length.

The protocol extensions defined in this document are not backwards compatible with existing implementations and so must be deployed with care.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7356.

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1. Introduction

The Update Process, as defined by [IS-IS], provides reliable and efficient flooding of information to all routers in a given flooding scope. Currently, the protocol supports two flooding scopes and associated PDUs. Level 1 (L1) Link State PDUs (LSPs) are flooded to all routers in an area. Level 2 (L2) LSPs are flooded to all routers in the Level 2 subdomain. The basic operation of the Update Process can be applied to any subset of the routers in a given topology so long as that topology is not partitioned. It is, therefore, possible to introduce new PDUs in support of other flooding scopes and utilize the same Update Process machinery to provide the same reliability and efficiency that the Update Process currently provides for L1 and L2 scopes. This document defines these new PDUs and the modified Update Process rules that are to be used in supporting new flooding scopes.

New deployment cases have introduced the need for reliable and efficient circuit scope flooding. For example, Appointed Forwarder information, as defined in [RFC7176], needs to be flooded reliably and efficiently to all Routing Bridges (RBridges) on a broadcast circuit. Currently, only IS-IS Hellos (IIHs) have the matching scope -- but IIHs are unreliable, i.e., individual IIHs may be lost without affecting correct operation of the protocol. To provide reliability in cases where the set of information to be flooded exceeds the carrying capacity of a single PDU requires sending the information periodically even when no changes in the content have occurred. When the information content is large, this is inefficient and still does not provide a guarantee of reliability. This document defines circuit scope flooding in order to provide a solution for such cases.

Another existing limitation of [IS-IS] is the carrying capacity of an LSP set. It has been noted in [RFC5311] that the set of LSPs that may be originated by a system at each level is limited to 256 LSPs, and the maximum size of each LSP is limited by the minimum Maximum Transmission Unit (MTU) of any link used to flood LSPs. [RFC5311] has defined a backwards-compatible protocol extension that can be used to overcome this limitation if needed. While the [RFC5311] solution is viable, in order to be interoperable with routers that do not support the extension, it imposes some restrictions on what can/cannot be advertised in the Extended LSPs and requires allocation of multiple unique system IDs to a given router. A more flexible and less constraining solution is possible if interoperability with legacy routers is not a requirement. By definition, the introduction of new PDUs required to support new flooding scopes is not interoperable with legacy routers. It is, therefore, possible to simultaneously introduce an alternative solution to the limited LSP set carrying capacity of Level 1 and Level 2 LSPs as part of the extensions defined in this document. This capability is also defined in this document.

Standard IS-IS TLVs are encoded using an 8-bit type and an 8-bit length. In cases where the set of information about a single object exceeds 255 octets, multiple TLVs are required to encode all of the relevant information. This document introduces extended TLVs and extended sub-TLVs that use a 16-bit Type field and a 16-bit Length field.

The PDU Type field in the common header for all IS-IS PDUs is a 5-bit field. Therefore, possible PDU types supported by the protocol are limited to a maximum of 32. In order to minimize the need to introduce additional PDU types in the future, the new PDUs introduced in this document are defined so as to allow multiple flooding scopes to be associated with the same PDU type. This means if new flooding scopes are required in the future, the same PDU type can be used.

1.1. Requirements Language

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. Extended TLVs

Standard TLVs as defined in [IS-IS] as well as standard sub-TLVs (first introduced in [RFC5305]) have an 8-bit Type field and an eight-bit Length field. This constrains the information included in a single TLV or sub-TLV to 255 octets. With the increasing use of sub-TLVs, it becomes more likely that the amount of information about a single object that needs to be advertised may exceed 255 octets. In such cases, the information is encoded in multiple TLVs. This leads to less efficient encoding since the information that uniquely identifies the object must be repeated in each TLV and requires additional implementation complexity when receiving the information to ensure that all information about the object is correctly collected from the multiple TLVs.

This document introduces extended TLVs and extended sub-TLVs. These are encoded using a 16-bit Type field and a 16-bit Length field.

2.1. Use of Extended TLVs and Extended Sub-TLVs

The following restrictions apply to the use of extended TLVs and extended sub-TLVs:

- Extended TLVs and extended sub-TLVs are permitted only in Flooding Scope PDUs that have a flooding scope designated for their use (defined later in this document)

- A given flooding scope supports either the use of standard TLVs and standard sub-TLVs or the use of extended TLVs and extended sub-TLVs, but not both

- Extended TLVs and extended sub-TLVs MUST be used together, i.e., using Standard sub-TLVs within an Extended TLV or using Extended sub-TLVs within a Standard TLV is invalid

- If additional levels of TLVs (e.g., sub-sub-TLVs) are introduced in the future, then the size of the Type and Length fields in these new sub-types MUST match the size used in the parent

- The 16-bit Type and Length fields are encoded in network byte order

- Use of extended TLVs and extended sub-TLVs does not alter in any way the maximum size of PDUs that may sent or received

2.2. Use of Standard Code Points in Extended TLVs and Extended Sub-TLVs

Standard TLV and standard sub-TLV code points as defined in the IANA "IS-IS TLV Codepoints" registry MAY be used in extended TLVs and extended sub-TLVs. Encoding is as specified for each of the standard TLVs and standard sub-TLVs with the following differences:

- The 8-bit Type field is encoded as an unsigned 16-bit integer where the 8 most significant bits (MSBs) are all 0
- The 8-bit Length field is replaced by the 16-bit Length field
- The length MAY take on values greater than 255

3. Definition of New PDUs

In support of new flooding scopes, the following new PDUs are required:

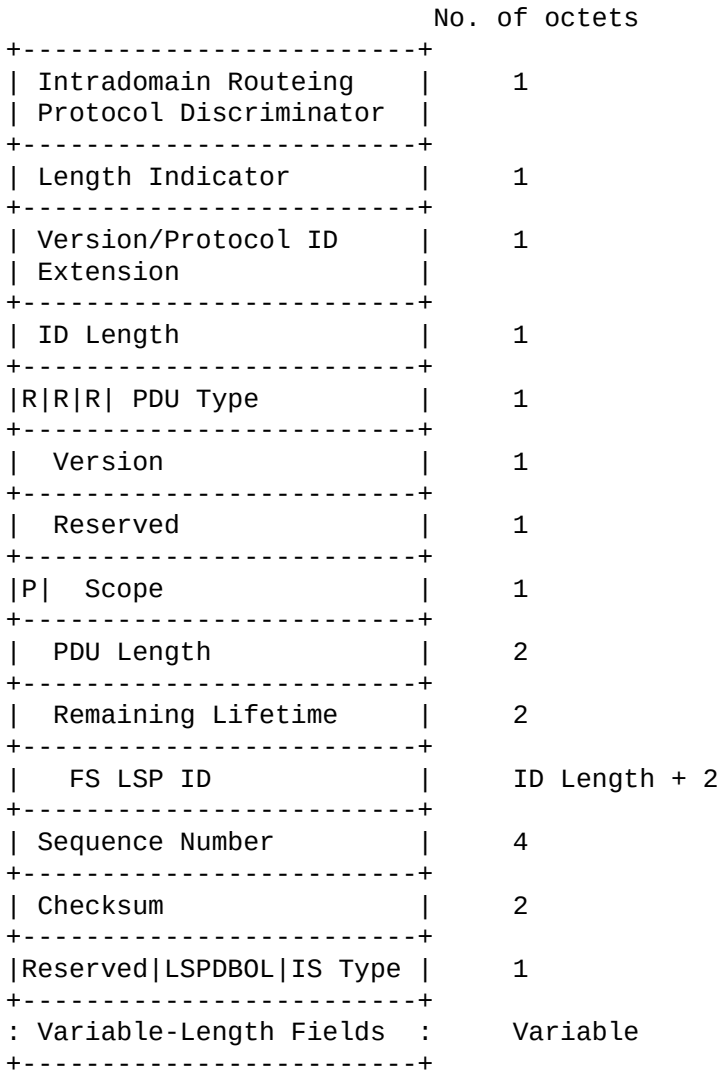
- Flooding Scope LSPs (FS-LSPs)
- Flooding Scope Complete Sequence Number PDUs (FS-CSNPs)
- Flooding Scope Partial Sequence Number PDUs (FS-PSNPs)

Each of these PDUs is intentionally defined with a header as similar in format as possible to the corresponding PDU types currently defined in [IS-IS]. Although it might have been possible to eliminate or redefine PDU header fields in a new way, the existing formats are retained in order to allow maximum reuse of existing PDU processing logic in an implementation.

Note that in the case of all FS PDUs, the Maximum Area Addresses field in the header of the corresponding standard PDU has been replaced with a Scope field. Therefore, maximum area addresses checks specified in [IS-IS] are not performed on FS PDUs.

3.1. Flooding Scoped LSP Format

An FS-LSP has the following format:



Intradomain Routeing Protocol Discriminator: 0x83 (as defined in [IS-IS]).

Length Indicator: Length of the fixed header in octets.

Version/Protocol ID Extension: 1

ID Length: As defined in [IS-IS].

PDU Type: 10 - Format as defined in [IS-IS].

Version: 1

Reserved: Transmitted as zero, ignored on receipt.

Scope: Bits 1-7 define the flooding scope.

The value 0 is reserved and MUST NOT be used. Received FS-LSPs with a scope of 0 MUST be ignored and MUST NOT be flooded.

P: Bit 8 - Priority Bit. If set to 1, this LSP SHOULD be flooded at high priority.

Scopes (1 - 63) are reserved for use with standard TLVs and standard sub-TLVs.

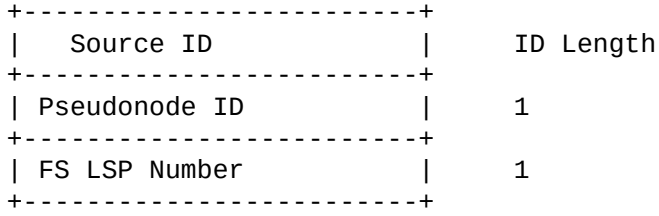
Scopes (64 - 127) are reserved for use with extended TLVs and extended sub-TLVs.

PDU Length: Entire length of this PDU, in octets, including the header.

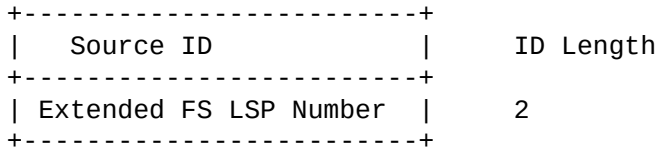
Remaining Lifetime: Number of seconds before this FS-LSP is considered expired.

FS LSP ID: The system ID of the source of the FS-LSP. One of the following two formats is used:

FS LSP ID Standard Format



FS LSP ID Extended Format



Which format is used is specific to the scope and MUST be defined when the specific flooding scope is defined.

Sequence Number: Sequence number of this FS-LSP.

Checksum: Checksum of contents of FS-LSP from the Source ID to the end. Checksum is computed as defined in [IS-IS].

Reserved/LSPDBOL/IS Type

Bits 4-8 are reserved, which means they are transmitted as 0 and ignored on receipt.

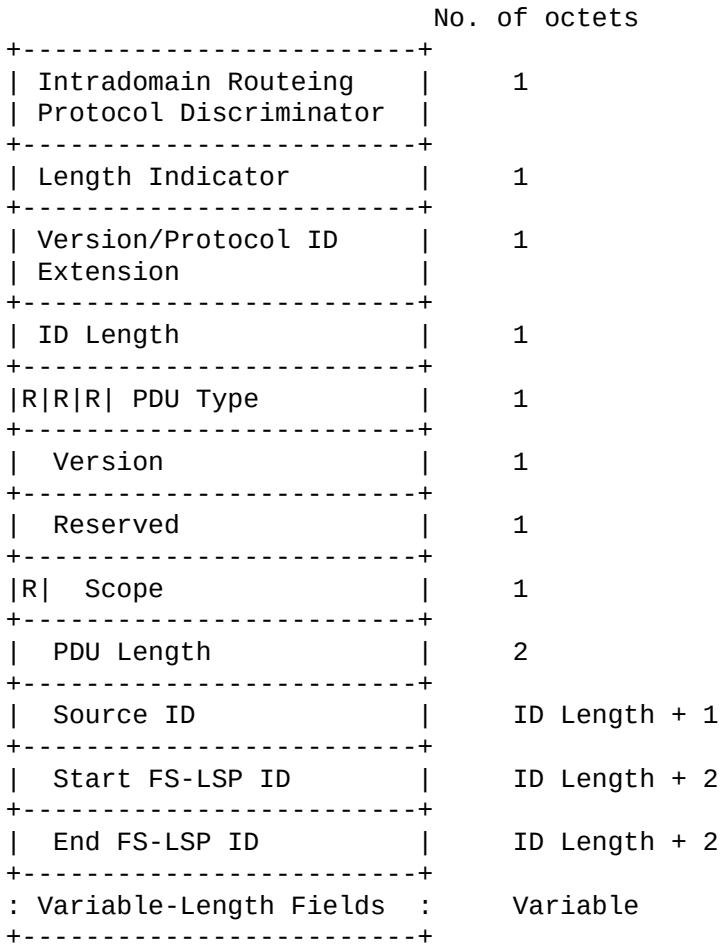
LSPDBOL: Bit 3 - A value of 0 indicates no FS-LSP Database Overload and a value of 1 indicates that the FS-LSP Database is overloaded. The overload condition is specific to FS-LSPs with the scope specified in the Scope field.

IS Type: Bits 1 and 2. The type of Intermediate System as defined in [IS-IS].

Variable-length fields that are allowed in an FS-LSP are specific to the defined scope.

3.2. Flooding Scoped CSNP Format

An FS-CSNP has the following format:



Intradomain Routeing Protocol Discriminator: 0x83 (as defined in [IS-IS]).

Length Indicator: Length of the fixed header in octets.

Version/Protocol ID Extension: 1

ID Length: As defined in [IS-IS].

PDU Type: 11 - Format as defined in [IS-IS].

Version: 1

Reserved: Transmitted as zero, ignored on receipt.

Scope: Bits 1-7 define the flooding scope.

The value 0 is reserved and MUST NOT be used. Received FS-CSNPs with a scope of 0 MUST be ignored.

Bit 8 is Reserved, which means it is transmitted as 0 and ignored on receipt.

Scopes (1 - 63) are reserved for use with standard TLVs and standard sub-TLVs.

Scopes (64 - 127) are reserved for use with extended TLV and extended sub-TLVs.

PDU Length: Entire length of this PDU, in octets, including the header.

Source ID: The system ID of the Intermediate System (with zero Circuit ID) generating this Sequence Number's PDU.

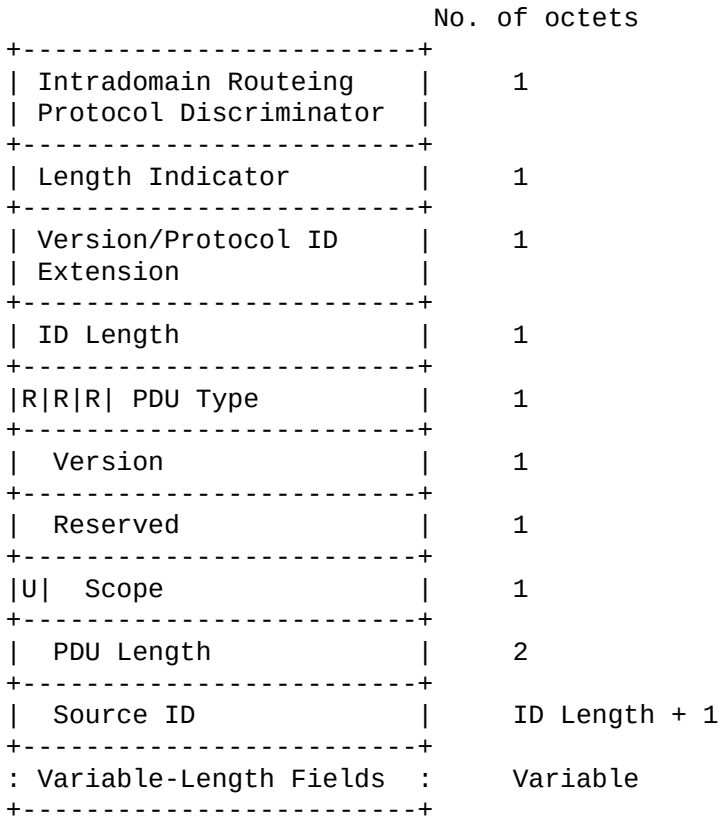
Start FS-LSP ID: The FS-LSP ID of the first FS-LSP with the specified scope in the range covered by this FS-CSNP.

End FS-LSP ID: The FS-LSP ID of the last FS-LSP with the specified scope in the range covered by this FS-CSNP.

Variable-length fields that are allowed in an FS-CSNP are limited to those TLVs that are supported by standard CSNP.

3.3. Flooding Scope PSNP Format

An FS-PSNP has the following format:



Intradomain Routeing Protocol Discriminator: 0x83 (as defined in [IS-IS]).

Length Indicator: Length of the fixed header in octets.

Version/Protocol ID Extension: 1

ID Length: As defined in [IS-IS].

PDU Type: 12 - Format as defined in [IS-IS].

Version: 1

Reserved: Transmitted as zero, ignored on receipt.

Scope: Bits 1-7 define the flooding scope.

The value 0 is reserved and MUST NOT be used. Received FS-PSNPs with a scope of 0 MUST be ignored.

U: Bit 8 - A value of 0 indicates that the specified flooding scope is supported. A value of 1 indicates that the specified flooding scope is unsupported. When U = 1, variable-length fields other than authentication MUST NOT be included in the PDU.

Scopes (1 - 63) are reserved for use with standard TLVs and standard sub-TLVs.

Scopes (64 - 127) are reserved for use with extended TLVs and extended sub-TLVs.

PDU Length: Entire length of this PDU, in octets, including the header.

Source ID: The system ID of the Intermediate System (with zero Circuit ID) generating this Sequence Number's PDU.

Variable-length fields that are allowed in an FS-PSNP are limited to those TLVs that are supported by standard PSNPs.

4. Flooding Scope Update Process Operation

The Update Process, as defined in [IS-IS], maintains a Link State Database (LSDB) for each level supported. Each level-specific LSDB contains the full set of LSPs generated by all routers operating in that level-specific scope. The introduction of FS-LSPs creates additional LSDBs (FS-LSDBs) for each additional scope supported. The set of FS-LSPs in each FS-LSDB consists of all FS-LSPs generated by all routers operating in that scope. Therefore, there is an additional instance of the Update Process for each supported flooding scope.

Operation of the scope-specific Update Process follows the Update Process specification in [IS-IS]. The circuit(s) on which FS-LSPs are flooded is limited to those circuits that are participating in the given scope. Similarly, the sending/receiving of FS-CSNPs and FS-PSNPs is limited to the circuits participating in the given scope.

Consistent support of a given flooding scope on a circuit by all routers operating on that circuit is required.

4.1. Scope Types

A flooding scope may be limited to a single circuit (circuit scope). Circuit scopes may be further limited by level (L1 Circuit Scope / L2 Circuit Scope).

A flooding scope may be limited to all circuits enabled for L1 routing (area scope).

A flooding scope may be limited to all circuits enabled for L2 routing (L2 subdomain scope).

Additional scopes may be defined that include all circuits enabled for either L1 or L2 routing (domain scope).

4.2. Operation on Point-to-Point Circuits

When a new adjacency is formed, synchronization of all FS-LSDBs supported on that circuit is required; therefore, FS-CSNPs for all supported scopes MUST be sent when a new adjacency reaches the UP state. The Send Receive Message (SRM) bit MUST be set for all FS-LSPs associated with the scopes supported on that circuit. Receipt of an FS-PSNP with the U bit equal to 1 indicates that the neighbor does not support that scope (although it does support FS PDUs). This MUST cause the SRM bit to be cleared for all FS-LSPs with the matching scope, which are currently marked for flooding on that circuit.

4.3. Operation on Broadcast Circuits

FS PDUs are sent to the same destination address(es) as standard PDUs for the given protocol instance. For specification of the defined destination addresses, consult [IS-IS], [IEEEaq], [RFC6822], and [RFC6325].

The Designated Intermediate System (DIS) for a broadcast circuit has the responsibility to generate periodic scope-specific FS-CSNPs for all supported scopes. A scope-specific DIS is NOT elected as all routers on a circuit MUST support a consistent set of flooding scopes.

It is possible that a scope may be defined that is not level specific. In such a case, the DIS for each level enabled on a broadcast circuit MUST independently send FS PDUs for that scope to the appropriate level-specific destination address. This may result in redundant flooding of FS-LSPs for that scope.

4.4. Use of Authentication

Authentication TLVs MAY be included in FS PDUs. When authentication is in use, the scope is first used to select the authentication configuration that is applicable. The authentication check is then performed as normal. Although scope-specific authentication MAY be used, sharing of authentication among multiple scopes and/or with the standard LSPs/CSNPs/PSNPs is considered sufficient.

4.5. Priority Flooding

When the FS LSP ID Extended format is used, the set of LSPs generated by an IS may be quite large. It may be useful to identify those LSPs in the set that contain information of higher priority. Such LSPs will have the P bit set to 1 in the Scope field in the LSP header. Such LSPs SHOULD be flooded at a higher priority than LSPs with the P bit set to 0. This is a suggested behavior on the part of the originator of the LSP. When an LSP is purged, the original state of the P bit MUST be preserved.

5. Deployment Considerations

Introduction of new PDU types is incompatible with legacy implementations. Legacy implementations do not support the FS-specific Update process(es) and, therefore, flooding of the FS-LSPs throughout the defined scope is unreliable when not all routers in the defined scope support FS PDUs. Further, legacy implementations will likely treat the reception of an FS PDU as an error. Even when all routers in a given scope support FS PDUs, if not all routers in the flooding domain for a given scope support that scope, then flooding of the FS-LSPs may be compromised. When deploying a new flooding scope, correct operation therefore requires that both FS PDUs and the new scope be supported by all routers in the flooding domain of the new scope.

The U bit in FS-PSNPs provides a means to suppress retransmissions of unsupported scopes. Routers that support FS PDUs SHOULD support the sending of PSNPs with the U bit equal to 1 when an FS-LSP is received with a scope that is unsupported. Routers that support FS PDUs SHOULD trigger management notifications when FS PDUs are received for unsupported scopes and when PSNPs with the U bit equal to 1 are received.

6. Graceful Restart Interactions

[RFC5306] defines protocol extensions in support of graceful restart of a routing instance. Synchronization of all supported FS-LSDBs is required in order for database synchronization to be complete. This involves the use of additional T2 timers. Receipt of a PSNP with the U bit equal to 1 will cause FS-LSDB synchronization with that neighbor to be considered complete for that scope. See [RFC5306] for further details.

7. Multi-instance Interactions

In cases where FS-PDUs are associated with a non-zero instance, the use of Instance Identifier TLVs (IID-TLVs) in FS-PDUs follows the rules for use in LSPs, CSNPs, and PSNPs as defined in [RFC6822].

8. Circuit Scope Flooding

This document defines four circuit scope flooding identifiers:

- Level 1 Circuit Scope (L1CS) -- this uses standard TLVs and standard sub-TLVs
- Level 2 Circuit Scope (L2CS) -- this uses standard TLVs and standard sub-TLVs
- Extended Level 1 Circuit Scope (E-L1CS) -- this uses extended TLVs and extended sub-TLVs
- Extended Level 2 Circuit Scope (E-L2CS) -- this uses extended TLVs and extended sub-TLVs

FS-LSPs with the Scope field set to one of these values contain information specific to the circuit on which they are flooded. When received, such FS-LSPs MUST NOT be flooded on any other circuit. The FS LSP ID Extended format is used in these PDUs. The FS-LSDB associated with circuit scope FS-LSPs consists of the set of FS-LSPs that both have matching circuit scopes and are transmitted (locally generated) or received on a specific circuit.

The set of TLVs that may be included in such FS-LSPs is specific to the given use case and is outside the scope of this document.

9. Extending LSP Set Capacity

The need for additional space in the set of LSPs generated by a single IS has been articulated in [RFC5311]. When legacy interoperability is not a requirement, the use of FS-LSPs meets that need without requiring the assignment of alias system-ids to a single IS. Four flooding scopes are defined for this purpose:

- Level 1 Flooding Scope (L1FS) -- this uses standard TLVs and standard sub-TLVs
- Level 2 Flooding Scope (L2FS) -- this uses standard TLVs and standard sub-TLVs
- Extended Level 1 Flooding Scope (E-L1FS) -- this uses extended TLVs and extended sub-TLVs
- Extended Level 2 Flooding Scope (E-L2FS) -- this uses extended TLVs and extended sub-TLVs

L1FS and E-L1FS LSPs are flooded on all L1 circuits. L2FS and E-L2FS LSPs are flooded on all L2 circuits.

The FS LSP ID Extended format is used in these PDUs. This provides 64 K of additional LSPs that may be generated by a single system at each level.

LxFS and E-LxFS LSPs are used by the level-specific Decision Process (defined in [IS-IS]) in the same manner as standard LSPs (i.e., as additional information sourced by the same IS) subject to the following restrictions:

- A valid version of standard LSP #0 from the same IS at the corresponding level MUST be present in the LSDB in order for the LxFS/E-LxFS set to be usable.
- Information in an LxFS of E-LxFS LSP (e.g., IS-Neighbor information) that supports using the originating IS as a transit node MUST NOT be used when the Overload bit is set in the corresponding standard LSP #0.
- TLVs that are restricted to standard LSP #0 MUST NOT appear in LxFS LSPs.

There are no further restrictions as to what TLVs may be advertised in FS-LSPs.

10. Domain Scope Flooding

Existing support for flooding information throughout a domain (i.e., to L1 routers in all areas as well as to routers in the Level 2 subdomain) requires the use of leaking procedures between levels. For further details, see [RFC4971]. This is sufficient when the data being flooded throughout the domain consists of individual TLVs. If it is desired to retain the identity of the originating IS for the complete contents of a PDU, then support for flooding the unchanged PDU is desirable. This document, therefore, defines two flooding scopes in support of domain flooding. FS-LSPs with this scope MUST be flooded on all circuits regardless of what level(s) is supported on that circuit.

- Domain Flooding Scope (DFS) -- this uses standard TLVs and standard sub-TLVs

- Extended Domain Flooding Scope (E-DFS) -- this uses extended TLVs and extended sub-TLVs

The FS LSP ID Extended format is used in these PDUs.

Use of information in FS-LSPs for a given scope depends on determining the reachability to the IS originating the FS-LSP. This presents challenges for FS-LSPs with domain scopes because no single IS has the full view of the topology across all areas. It is, therefore, necessary for the originator of domain scope DSFS and E-DSFS LSPs to advertise an identifier that will allow an IS who receives such an FS-LSP to determine whether the source of the FS-LSP is currently reachable. The identifier required depends on what "address-families" are being advertised.

When IS-IS is deployed in support of Layer 3 routing for IPv4 and/or IPv6, then FS-LSP #0 with domain scope MUST include at least one of the following TLVs:

- IPv4 Traffic Engineering Router ID (TLV 134)

- IPv6 Traffic Engineering Router ID (TLV 140)

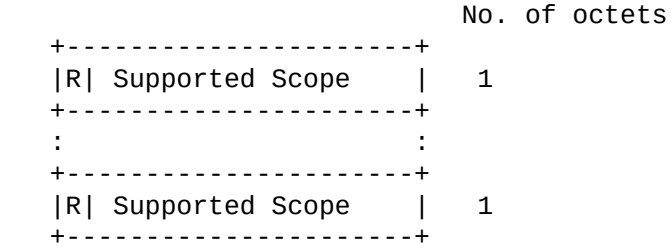
When IS-IS is deployed in support of Layer 2 routing, current standards (e.g., [RFC6325]) only support a single area. Therefore, domain scope is not yet applicable. When the Layer 2 standards are updated to include multi-area support, the identifiers that can be used to support inter-area reachability will be defined -- at which point the use of domain scope for Layer 2 can be fully defined.

11. Announcing Support for Flooding Scopes

Announcements of support for flooding scope may be useful in validating that full support has been deployed and/or in isolating the reasons for incomplete flooding of FS-LSPs for a given scope.

ISs supporting FS-PDUs MAY announce supported scopes in IIH PDUs. To do so, a new TLV is defined.

Scope Flooding Support
Type: 243
Length: 1 - 127
Value



A list of the circuit scopes supported on this circuit and other non-circuit-flooding scopes supported.

R bit MUST be 0 and is ignored on receipt.

In a Point-to-Point IIH, L1, L2, domain, and all circuit scopes MAY be advertised.

In Level 1 LAN IIHs, L1, domain, and L1 Circuit Scopes MAY be advertised. L2 Scopes and L2 Circuit Scopes MUST NOT be advertised.

In Level 2 LAN IIHs, L2, domain, and L2 Circuit Scopes MAY be advertised. L1 Scopes and L1 Circuit Scopes MUST NOT be advertised.

Information in this TLV MUST NOT be considered in adjacency formation.

Whether information in this TLV is used to determine when FS-LSPs associated with a locally supported scope are flooded is an implementation choice.

12. IANA Considerations

This document includes the definition of three new PDU types that are reflected in the "IS-IS PDU Registry".

Value	Description
10	FS-LSP
11	FS-CSNP
12	FS-PSNP

A new IANA registry has been created to control the assignment of scope identifiers in FS-PDUs. The registration procedure is "Expert Review" as defined in [RFC5226]. The registry name is "LSP Flooding Scope Identifier Registry". A scope identifier is a number from 1-127, inclusive. Values 1 - 63 are reserved for PDUs that use standard TLVs and standard sub-TLVs. Values 64 - 127 are reserved for PDUs that use extended TLVs and extended sub-TLVs. The list of Hello PDUs in which support for a given scope MAY be announced (using Scope Flooding Support TLV) is specified for each defined scope.

The following scope identifiers are defined by this document.

Value	Description	FS LSP ID Format/ TLV Format	IIH Announce P2P	L1LAN	L2LAN
1	Level 1 Circuit Flooding Scope	Extended/Standard	Y	Y	N
2	Level 2 Circuit Flooding Scope	Extended/Standard	Y	N	Y
3	Level 1 Flooding Scope	Extended/Standard	Y	Y	N
4	Level 2 Flooding Scope	Extended/Standard	Y	N	Y
5	Domain Flooding Scope	Extended/Standard	Y	Y	Y
(6-63)	Unassigned				
64	Level 1 Circuit Flooding Scope	Extended/Extended	Y	Y	N
65	Level 2 Circuit Flooding Scope	Extended/Extended	Y	N	Y
66	Level 1 Flooding Scope	Extended/Extended	Y	Y	N
67	Level 2 Flooding Scope	Extended/Extended	Y	N	Y
68	Domain Flooding Scope	Extended/Extended	Y	Y	Y
(69-127)	Unassigned				

The definition of a new IS-IS TLV is reflected in the "IS-IS TLV Codepoints" registry:

Value	Name	IIH	LSP	SNP	Purge
243	Scope Flooding Support	Y	N	N	N

The IANA "IS-IS TLV Codepoints" registry has been extended to allow definition of codepoints less than or equal to 65535. Codepoints greater than 255 can only be used in PDUs designated to support extended TLVs. This registry has also been updated to point to this document as a reference (in addition to [RFC3563] and [RFC6233]).

13. Security Considerations

Security concerns for IS-IS are addressed in [IS-IS], [RFC5304], and [RFC5310].

The new PDUs introduced are subject to the same security issues associated with their standard LSP/CSNP/PSNP counterparts. To the extent that additional PDUs represent additional load for routers in the network, this increases the opportunity for denial-of-service attacks.

14. Acknowledgements

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15. References

15.1. Normative References

[IEEEaq] IEEE, "Standard for Local and metropolitan area networks -- Media Access Control (MAC) Bridges and Virtual Bridged Local Area Networks -- Amendment 20: Shortest Path Bridging", IEEE Std 802.1aq-2012, June 2012.

[IS-IS] ISO/IEC 10589:2002, Second Edition, "Information technology -- Telecommunications and information exchange between systems -- Intermediate System to Intermediate System intradomain routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode network service (ISO 8473)", 2002.

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

[RFC4971] Vasseur, JP., Shen, N., and R. Aggarwal, "Intermediate System to Intermediate System (IS-IS) Extensions for Advertising Router Information", RFC 4971, July 2007.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, May 2008.

[RFC5304] Li, T. and R. Atkinson, "IS-IS Cryptographic Authentication", RFC 5304, October 2008.

[RFC5305] Li, T. and H. Smit, "IS-IS Extensions for Traffic Engineering", RFC 5305, October 2008.

[RFC5306] Shand, M. and L. Ginsberg, "Restart Signaling for IS-IS", RFC 5306, October 2008.

[RFC5310] Bhatia, M., Manral, V., Li, T., Atkinson, R., White, R., and M. Fanto, "IS-IS Generic Cryptographic Authentication", RFC 5310, February 2009.

[RFC6822] Previdi, S., Ginsberg, L., Shand, M., Roy, A., and D. Ward, "IS-IS Multi-Instance", RFC 6822, December 2012.

15.2. Informative References

[RFC3563] Zinin, A., "Cooperative Agreement Between the ISOC/IETF and ISO/IEC Joint Technical Committee 1/Sub Committee 6 (JTC1/SC6) on IS-IS Routing Protocol Development", RFC 3563, July 2003.

[RFC5311] McPherson, D., Ginsberg, L., Previdi, S., and M. Shand, "Simplified Extension of Link State PDU (LSP) Space for IS-IS", RFC 5311, February 2009.

[RFC6233] Li, T. and L. Ginsberg, "IS-IS Registry Extension for Purges", RFC 6233, May 2011.

[RFC6325] Perlman, R., Eastlake, D., Dutt, D., Gai, S., and A. Ghanwani, "Routing Bridges (RBridges): Base Protocol Specification", RFC 6325, July 2011.

[RFC7176] Eastlake, D., Senevirathne, T., Ghanwani, A., Dutt, D., and A. Banerjee, "Transparent Interconnection of Lots of Links (TRILL) Use of IS-IS", RFC 7176, May 2014.

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