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**IS-IS Extensions in Support of Generalized
Multi-Protocol Label Switching**

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Abstract

This document specifies encoding of extensions to the IS-IS routing protocol in support of Generalized Multi-Protocol Label Switching.

Specification of Requirements

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 2119](#) [[RFC2119](#)].

Changes since last revision

(RFC Editor: remove this section before publication.)

Incorporated IESG comments: updated Security Considerations and IANA Considerations.

[1. Introduction](#)

This document specifies extensions to the IS-IS routing protocol in support of carrying link state information for Generalized Multi-Protocol Label Switching (GMPLS). The set of required enhancements to IS-IS are outlined in [[GMPLS-ROUTING](#)]. Support for unnumbered interfaces assumes support for the "Point-to-Point Three-Way Adjacency" IS-IS Option type [[ISIS-3way](#)].

In this section we define the enhancements to the Traffic Engineering (TE) properties of GMPLS TE links that can be announced in IS-IS Link State Protocol Data Units.

In this document, we enhance the sub-TLVs for the extended IS reachability TLV (see [[ISIS-TE](#)]) in support of GMPLS. Specifically, we add the following sub-TLVs:

Sub-TLV Type	Length	Name
4	8	Link Local/Remote Identifiers
20	2	Link Protection Type
21	variable	Interface Switching Capability Descriptor

We further add one new TLV to the TE TLVs:

TLV Type	Length	Name
138	variable	Shared Risk Link Group

1.1. Link Local/Remote Identifiers

A Link Local Interface Identifiers is a sub-TLV of the extended IS reachability TLV. The type of this sub-TLV is 4, and length is eight octets. The value field of this sub-TLV contains four octets of Link Local Identifier followed by four octets of Link Remote Identifier (see Section "Support for unnumbered links" of [\[GMPLS-ROUTING\]](#)). If the Link Remote Identifier is unknown, it is set to 0.

The following illustrates encoding of the Value field of the Link Local/Remote Identifiers sub-TLV.

```

      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
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                               Link Local Identifier                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                               Link Remote Identifier                               |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

The Link Local/Remote Identifiers sub-TLV MUST NOT occur more than once within the extended IS reachability TLV. If the Link Local/Remote Identifier sub-TLV occurs more than once within the extended IS reachability TLV, the receiver SHOULD ignore all these sub-TLVs.

1.2. Link Protection Type

The Link Protection Type is a sub-TLV (of type 20) of the extended IS reachability TLV, with length two octets.

The following illustrates encoding of the Value field of the Link Protection Type sub-TLV.

```

      0                               1
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|Protection Cap |   Reserved   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

The first octet is a bit vector describing the protection capabilities of the link (see Section "Link Protection Type" of [\[GMPLS-ROUTING\]](#)). They are:

0x01 Extra Traffic

0x02 Unprotected


```

|           Switching Capability-specific information           |
|           (variable)                                         |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

The Switching Capability (Switching Cap) field contains one of the following values:

- 1 Packet-Switch Capable-1 (PSC-1)
- 2 Packet-Switch Capable-2 (PSC-2)
- 3 Packet-Switch Capable-3 (PSC-3)
- 4 Packet-Switch Capable-4 (PSC-4)
- 51 Layer-2 Switch Capable (L2SC)
- 100 Time-Division-Multiplex Capable (TDM)
- 150 Lambda-Switch Capable (LSC)
- 200 Fiber-Switch Capable (FSC)

The Encoding field contains one of the values specified in [Section 3.1.1](#) of [\[GMPLS-SIG\]](#).

Maximum LSP Bandwidth is encoded as a list of eight 4 octet fields in the IEEE floating point format [\[IEEE\]](#), with priority 0 first and priority 7 last. The units are bytes (not bits!) per second.

The content of the Switching Capability specific information field depends on the value of the Switching Capability field.

When the Switching Capability field is PSC-1, PSC-2, PSC-3, or PSC-4, the Switching Capability specific information field includes Minimum LSP Bandwidth and Interface MTU.

```

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
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|           Minimum LSP Bandwidth           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|           Interface MTU                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

The Minimum LSP Bandwidth is encoded in a 4 octets field in the IEEE floating point format. The units are bytes (not bits!) per second. The Interface MTU is encoded as a 2 octets integer, and carries the MTU value in the units of bytes.

When the Switching Capability field is L2SC, there is no Switching Capability specific information field present.

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
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                                     System ID                          |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      System ID (cont.)  | Pseudonode num|      Flags      |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      IPv4 interface address/Link Local Identifier                  |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      IPv4 neighbors address/Link Remote Identifier                 |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      Shared Risk Link Group Value                                  |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      .....                                                         |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|      Shared Risk Link Group Value                                  |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

The neighbor is identified by its System Id (6-octets), plus one octet to indicate the pseudonode number if the neighbor is on a LAN interface.

The Least Significant Bit of the Flag octet indicates whether the interface is numbered (set to 1), or unnumbered (set to 0). All other bits are reserved and should be set to 0.

The length of this TLV is $16 + 4 * (\text{number of SRLG values})$.

This TLV carries the Shared Risk Link Group information (see Section "Shared Risk Link Group Information" of [\[GMPLS-ROUTING\]](#)).

The SRLG TLV MAY occur more than once within the IS-IS Link State Protocol Data Units.

1.5. Link Identifier for Unnumbered Interfaces

Link Identifiers are exchanged in the Extended Local Circuit ID field of the "Point-to-Point Three-Way Adjacency" IS-IS Option type [\[ISIS-3way\]](#).

2. Implications on Graceful Restart

The restarting node SHOULD follow the ISIS restart procedures [[ISIS-RESTART](#)], and the RSVP-TE restart procedures [[GMPLS-RSVP](#)].

When the restarting node is going to originate its IS-IS Link State Protocol data units for TE links, these Link State Protocol data units SHOULD be originated with 0 unreserved bandwidth, Traffic Engineering Default metric set to 0xffffffff, and if the link has LSC or FSC as its Switching Capability then also with 0 as Max LSP Bandwidth, until the node is able to determine the amount of unreserved resources taking into account the resources reserved by the already established LSPs that have been preserved across the restart. Once the restarting node determines the amount of unreserved resources, taking into account the resources reserved by the already established LSPs that have been preserved across the restart, the node SHOULD advertise these resources in its Link State Protocol data units.

In addition in the case of a planned restart prior to restarting, the restarting node SHOULD originate the IS-IS Link State Protocol data units for TE links with 0 as unreserved bandwidth, and if the link has LSC or FSC as its Switching Capability then also with 0 as Max LSP Bandwidth. This would discourage new LSP establishment through the restarting router.

Neighbors of the restarting node SHOULD continue advertise the actual unreserved bandwidth on the TE links from the neighbors to that node.

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5. Security Considerations

This document specifies the contents of GMPLS TE TLVs in ISIS. As these TLVs are not used for SPF computation or normal routing, the extensions specified here have no direct effect on IP routing. Tampering with GMPLS TE TLVs may have an effect on the underlying transport (optical and/or SONET-SDH) network. Mechanisms to secure ISIS Link State PDUs and/or the TE TLVs can be used to secure the GMPLS TE TLVs as well.

6. IANA Considerations

This document defines the following new ISIS TLV type that needs to be reflected in the ISIS TLV code-point registry:

Type	Description	IIH	LSP	SNP
----	-----	---	---	---
138	Shared Risk Link Group	n	y	n

This document also defines the following new sub-TLV types of top-level TLV 22 that need to be reflected in the ISIS sub-TLV registry for TLV 22:

Type	Description	Length
----	-----	-----
4	Link Local/Remote Identifiers	8
20	Link Protection Type	2
21	Interface Switching Capability Descriptor	variable

Normative References

- [GMPLS-ROUTING] Kompella, K., and Rekhter, Y. (Editors), "Routing Extensions in Support of Generalized Multi-Protocol Label Switching", (work in progress) [[draft-ietf-ccamp-gmpls-routing-08.txt](#)]
- [GMPLS-RSVP] Berger, L., (Editor), "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", [RFC 3473](#), January 2003
- [GMPLS-SIG] Berger, L. (Editor), "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", [RFC 3471](#), January 2003
- [IEEE] IEEE, "IEEE Standard for Binary Floating-Point Arithmetic", Standard 754-1985, 1985 (ISBN 1-5593-7653-8)
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- [ISIS-RESTART] Shand, M. and L. Ginsburg, "Restart signaling for ISIS", (work in progress) [[draft-ietf-isis-restart-04.txt](#)]
- [ISIS-TE] Smit, H., Li, T., "IS-IS Extensions for Traffic Engineering", (work in progress) [[draft-ietf-isis-traffic-05.txt](#)]

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

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