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IS-IS TE Attributes per application
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Abstract

Existing traffic engineering related link attribute advertisements have been defined and are used in RSVP-TE deployments. In cases where multiple applications wish to make use of these link attributes the current advertisements do not support application specific values for a given attribute nor do they support indication of which applications are using the advertised value for a given link.

This draft introduces new link attribute advertisements which address both of these shortcomings. It also discusses backwards compatibility issues and how to minimize duplicate advertisements in the presence of routers which do not support the extensions defined in this document.

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 RFC 2119 [RFC2119].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on December 9, 2017.

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1. Introduction

Advertisement of link attributes by the Intermediate-System-to-Intermediate-System (IS-IS) protocol in support of traffic engineering (TE) was introduced by [RFC5305] and extended by [RFC5307], [RFC6119], and [RFC7810]. Use of these extensions has been associated with deployments supporting Traffic Engineering over Multiprotocol Label Switching (MPLS) in the presence of Resource Reservation Protocol (RSVP) - more succinctly referred to as RSVP-TE.

In recent years new applications have been introduced which have use cases for many of the link attributes historically used by RSVP-TE. Such applications include Segment Routing Traffic Engineering (SRTE) and Loop Free Alternates (LFA). This has introduced ambiguity in that if a deployment includes a mix of RSVP-TE support and SRTE support (for example) it is not possible to unambiguously indicate which advertisements are to be used by RSVP-TE and which advertisements are to be used by SRTE. If the topologies are fully congruent this may not be an issue, but any incongruence leads to ambiguity.

An additional issue arises in cases where both applications are supported on a link but the link attribute values associated with each application differ. Current advertisements do not support advertising application specific values for the same attribute on a specific link.

This document defines extensions which address these issues. Also, as evolution of use cases for link attributes can be expected to continue in the years to come, this document defines a solution which is easily extensible to the introduction of new applications and new use cases.

2. Requirements Discussion

As stated previously, evolution of use cases for link attributes can be expected to continue - so any discussion of existing use cases is limited to requirements which are known at the time of this writing. However, in order to determine the functionality required beyond what already exists in IS-IS, it is only necessary to discuss use cases which justify the key points identified in the introduction - which are:

1. Support for indicating which applications are using the link attribute advertisements on a link

2. Support for advertising application specific values for the same attribute on a link

[RFC7855] discusses use cases/requirements for SR. Included among these use cases is SRTE. If both RSVP-TE and SRTE are deployed in a network, link attribute advertisements can be used by one or both of these applications. As there is no requirement for the link attributes advertised on a given link used by SRTE to be identical to the link attributes advertised on that same link used by RSVP-TE, there is a clear requirement to indicate independently which link attribute advertisements are to be used by each application.

As the number of applications which may wish to utilize link attributes may grow in the future, an additional requirement is that the extensions defined allow the association of additional applications to link attributes without altering the format of the advertisements or introducing new backwards compatibility issues.

Finally, there may still be many cases where a single attribute value can be shared among multiple applications, so the solution must minimize advertising duplicate link/attribute pairs whenever possible.

3. Legacy Advertisements

There are existing advertisements used in support of RSVP-TE. These advertisements include sub-TLVs for TLVs 22, 23, 141, 222, and 223 and TLVs for SRLG advertisement.

3.1. Legacy sub-TLVs

Sub-TLVs for TLVs 22, 23, 141, 222, and 223

Code Point	Attribute Name
3	Administrative group (color)
9	Maximum link bandwidth
10	Maximum reservable link bandwidth
11	Unreserved bandwidth
14	Extended Administrative Group
33	Unidirectional Link Delay
34	Min/Max Unidirectional Link Delay
35	Unidirectional Delay Variation
36	Unidirectional Link Loss
37	Unidirectional Residual Bandwidth
38	Unidirectional Available Bandwidth
39	Unidirectional Utilized Bandwidth

3.2. Legacy SRLG Advertisements

TLV 138 GMPLS-SRLG
Supports links identified by IPv4 addresses and unnumbered links

TLV 139 IPv6 SRLG
Supports links identified by IPv6 addresses

Note that [RFC6119] prohibits the use of TLV 139 when it is possible to use TLV 138.

4. Advertising Application Specific Link Attributes

Two new code points are defined in support of Application Specific Link Attribute Advertisements:

1) Application Specific Link Attributes sub-TLV for TLVs 22, 23, 141, 222, and 223

2)Application Specific Shared Risk Link Group (SRLG) TLV

In support of these new advertisements, an application bit mask is defined which identifies the application(s) associated with a given advertisement.

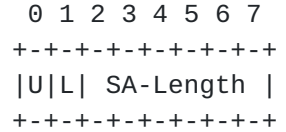
The following sections define the format of these new advertisements.

4.1. Application Identifiers

Identification of the set of standard applications associated with the link attribute advertisements utilizes a bit mask where the definition of each bit is defined in a new IANA controlled registry. There is also support for non-standard User Defined Applications(UDAs) which may be optionally included.

This encoding is used by both the Application Specific Link Attributes sub-TLV and the Application Specific SRLG TLV.

Standard Application Bit Mask Length/Flags: Non-zero (1 octet)
If this octet is 0 the entire sub-TLV/TLV in which it is contained MUST be ignored.



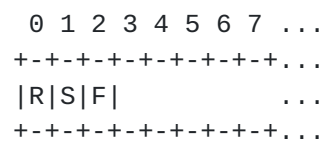
U-flag: When set indicates the presence of a
UDA length/Bit Mask.

L-flag: Applications listed (both Standard and
User Defined) MUST use the legacy advertisements
for the corresponding link found in TLVs 22, 23,
141, 222, and 223 or TLV 138 or TLV 139 as appropriate.

SA-Length: Indicates the length in octets (0-63) of the Bit Mask
for Standard Applications in octets. The length MAY be 0
if the U-flag is set and there are no Standard
Applications being advertised.

Standard Application Bit Mask
This is omitted if SA-Length is 0.

(SA-Length * 8) bits



R-bit: RSVP-TE

S-bit: Segment Routing Traffic Engineering

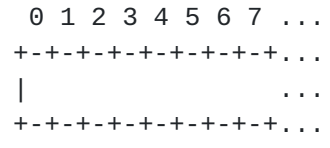
F-bit: Loop Free Alternate

If the U-flag is set then the following fields are
included:

User Defined Application Bit Mask Length
in octets: Non-zero (1 octet)

User Defined Application Bit Mask

(UDA Length * 8) bits



Standard Application Bits are defined/sent starting with Bit 0. Additional bit definitions that may be defined in the future SHOULD be assigned in ascending bit order so as to minimize the number of octets that will need to be transmitted. Undefined bits MUST be transmitted as 0 and MUST be ignored on receipt. Bits that are NOT transmitted MUST be treated as if they are set to 0 on receipt.

User Defined Application bits have no relationship to Standard Application bits and are NOT managed by IANA or any other standards body. It is recommended that bits are used starting with Bit 0 so as to minimize the number of octets required to advertise all UDAs.

4.2. Application Specific Link Attributes sub-TLV

A new sub-TLV for TLVs 22, 23, 141, 222, and 223 is defined which supports specification of the applications and application specific attribute values.

Type: 15 (suggested value - to be assigned by IANA)
Length: Variable (1 octet)
Value:

Application Bit Mask (as defined in Section 3.1)

Link Attribute sub-sub-TLVs - format matches the existing formats defined in [RFC5305] and [RFC7810]

When the L-flag is set in the Application Identifiers, all of the applications specified in the bit mask MUST use the link attribute sub-TLV advertisements listed in Section 3.1 for the corresponding link. Application specific link attribute sub-sub-TLVs for the corresponding link attributes MUST NOT be advertised for the set of applications specified in the Standard/User Application Bit Masks and all such advertisements MUST be ignored on receipt.

Multiple sub-TLVs for the same link MAY be advertised. When multiple sub-TLVs for the same link are advertised, they SHOULD advertise non-conflicting application/attribute pairs. A conflict exists when the same application is associated with two different values of the same link attribute for a given link. In cases where conflicting values for the same application/attribute/link are advertised all the conflicting values MUST be ignored.

For a given application, the setting of the L-flag MUST be the same in all sub-TLVs for a given link. In cases where this constraint is violated, the L-flag MUST be considered set for this application.

A new registry of sub-sub-TLVs is to be created by IANA which defines the link attribute sub-sub-TLV code points. A sub-sub-TLV is defined for each of the existing sub-TLVs listed in Section 3.1. Format of the sub-sub-TLVs matches the format of the corresponding legacy sub-TLV and IANA is requested to assign the legacy sub-TLV identifer to the corresponding sub-sub-TLV.

4.3. Application Specific SRLG TLV

A new TLV is defined to advertise application specific SRLGs for a given link. Although similar in functionality to TLV 138 (defined by [RFC5307]) and TLV 139 (defined by [RFC6119], a single TLV provides support for IPv4, IPv6, and unnumbered identifiers for a link. Unlike TLVs 138/139, it utilizes sub-TLVs to encode the link identifiers in order to provide the flexible formatting required to support multiple link identifier types.

Type: 238 (Suggested value - to be assigned by IANA)
Length: Number of octets in the value field (1 octet)
Value:
  Neighbor System-ID + pseudo-node ID (7 octets)
  Application Bit Mask (as defined in Section 3.1)
  Length of sub-TLVs (1 octet)
  Link Identifier sub-TLVs (variable)
  0 or more SRLG Values (Each value is 4 octets)

The following Link Identifier sub-TLVs are defined. The type values are suggested and will be assigned by IANA - but as the formats are identical to existing sub-TLVs defined for TLVs 22, 23, 141, 222, and 223 the use of the suggested sub-TLV types is strongly encouraged.

Type	Description
4	Link Local/Remote Identifiers (see [RFC5307])
6	IPv4 interface address (see [RFC5305])
8	IPv4 neighbor address (see [RFC5305])
12	IPv6 Interface Address (see [RFC6119])
13	IPv6 Neighbor Address (see [RFC6119])

At least one set of link identifiers (IPv4, IPv6, or unnumbered) MUST be present. TLVs which do not meet this requirement MUST be ignored.

Multiple TLVs for the same link MAY be advertised.

When the L-flag is set in the Application Identifiers, SRLG values MUST NOT be included in the TLV. Any SRLG values which are advertised MUST be ignored. Based on the link identifiers advertised the corresponding legacy TLV (see Section 3.2) can be identified and

the SRLG values advertised in the legacy TLV MUST be used by the set of applications specified in the Application Bit Mask.

For a given application, the setting of the L-flag MUST be the same in all TLVs for a given link. In cases where this constraint is violated, the L-flag MUST be considered set for this application.

5. Attribute Advertisements and Enablement

This document defines extensions to support the advertisement of application specific link attributes. The presence or absence of link attribute advertisements for a given application on a link does NOT indicate the state of enablement of that application on that link. Enablement of an application on a link is controlled by other means.

For some applications, the concept of enablement is implicit. For example, SRTE implicitly is enabled on all links which are part of the Segment Routing enabled topology. Advertisement of link attributes supports constraints which may be applied when specifying an explicit path through that topology.

For other applications enablement is controlled by local configuration. For example, use of a link as an LFA can be controlled by local enablement/disablement and/or the use of administrative tags.

It is an application specific policy as to whether a given link can be used by that application even in the abscence of any application specififc link attributes.

6. Interoperability, Backwards Compatibility and Migration Concerns

Existing deployments of RSVP-TE utilize the legacy advertisements listed in Section 3. Routers which do not support the extensions defined in this document will only process legacy advertisements and are likely to infer that RSVP-TE is enabled on the links for which legacy advertisements exist. It is expected that deployments using the legacy advertisements will persist for a significant period of time - therefore deployments using the extensions defined in this document must be able to co-exist with use of the legacy advertisements by routers which do not support the extensions defined in this document. The following sub-sections discuss interoperability and backwards compatibility concerns for a number of deployment scenarios.

Note that in all cases the defined strategy can be employed on a per link basis.

6.1. RSVP-TE only deployments

In deployments where RSVP-TE is the only application utilizing link attribute advertisements, use of the the legacy advertisements can continue without change.

6.2. Multiple Applications: Common Attributes with RSVP-TE

In cases where multiple applications are utilizing a given link, one of the applications is RSVP-TE, and all link attributes for a given link are common to the set of applications utilizing that link, interoperability is achieved by using legacy advertisements and sending application specific advertisements with L-bit set and no link attribute values. This avoids duplication of link attribute advertisements.

6.3. Multiple Applications: All Attributes Not Shared w RSVP-TE

In cases where one or more applications other than RSVP-TE are utilizing a given link and one or more link attribute values are NOT shared with RSVP-TE, it is necessary to use application specific advertisements as defined in this document. Attributes for applications other than RSVP-TE MUST be advertised using application specific advertisements which have the L-bit clear. In cases where some link attributes are shared with RSVP-TE, this requires duplicate advertisements for those attributes.

The discussion in this section applies to cases where RSVP-TE is NOT using any advertised attributes on a link and to cases where RSVP-TE is using some link attribute advertisements on the link but some link attributes cannot be shared with RSVP-TE.

6.4. Deprecating legacy advertisements

The extensions defined in this document support RSVP-TE as one of the supported applications - so a long term goal for deployments would be to deprecate use of the legacy advertisements in support of RSVP-TE. This can be done in the following step-wise manner:

1)Upgrade all routers to support extensions in this document

2)Readvertise all legacy link attributes using application specific advertisements with L-bit clear and R-bit set.

3)Remove legacy advertisements

7. IANA Considerations

This document defines a new sub-TLV for TLVs 22, 23, 141, 222, and 223.

Type	Description	22	23	141	222	223
15	Application Specific Link Attributes	y	y	y	y	y

This document defines one new TLV:

Type	Description	IIH	SNP	LSP	Purge
238	Application Specific SRLG	n	n	y	n

This document requests a new IANA registry be created to control the assignment of sub-sub-TLV codepoints for the Application Specific Link Attributes sub-TLV. The suggested name of the new registry is "sub-sub-TLV code points for application link attributes". The registration procedure is "Expert Review" as defined in [RFC5226]. The following assignments are made by this document:

Type	Description
3	Administrative group (color)
9	Maximum link bandwidth
10	Maximum reservable link bandwidth
11	Unreserved bandwidth
14	Extended Administrative Group
33	Unidirectional Link Delay
34	Min/Max Unidirectional Link Delay
35	Unidirectional Delay Variation
36	Unidirectional Link Loss
37	Unidirectional Residual Bandwidth
38	Unidirectional Available Bandwidth
39	Unidirectional Utilized Bandwidth

This document requests a new IANA registry be created to control the assignment of application bit identifiers. The suggested name of the new registry is "Link Attribute Applications". The registration procedure is "Expert Review" as defined in [RFC5226]. The following assignments are made by this document:

Bit #	Name
0	RSVP-TE (R-bit)
1	Segment Routing Traffic Engineering (S-bit)
2	Loop Free Alternate (F-bit)

This document requests a new IANA registry be created to control the assignment of sub-TLV types for the application specific SRLG TLV. The suggested name of the new registry is "Sub-TLVs for TLV 238". The registration procedure is "Expert Review" as defined in [RFC5226]. The following assignments are made by this document:

Value	Description
4	Link Local/Remote Identifiers (see [RFC5307])
6	IPv4 interface address (see [RFC5305])
8	IPv4 neighbor address (see [RFC5305])
12	IPv6 Interface Address (see [RFC6119])
13	IPv6 Neighbor Address (see [RFC6119])

8. Security Considerations

Security concerns for IS-IS are addressed in [ISO10589, [RFC5304], and [RFC5310].

9. Acknowledgements

The authors would like to thank John Drake and Acee Lindem for their careful review and content suggestions.

10. References

10.1. Normative References

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10.2. Informative References

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