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**Application-Specific Attributes Advertisement with BGP Link-State  
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**Abstract**

Extensions have been defined for link-state routing protocols that enable distribution of application-specific link attributes for existing as well as newer applications such as Segment Routing. This document defines extensions to BGP-LS to enable the advertisement of these application-specific attributes as a part of the topology information from the network.

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## [1.](#) Introduction

BGP Link-State [[RFC7752](#)] enables the distribution of the link-state topology information from link-state routing protocols (viz., IS-IS [[RFC1195](#)], OSPFv2 [[RFC2328](#)] and OSPFv3 [[RFC5340](#)]) to an application like a controller or Path Computation Engine (PCE) via BGP. The controller/PCE gets the end-to-end topology information across IGP domains so it can perform path computations for use cases like end-to-end traffic engineering (TE).

The link-state topology information distributed via BGP-LS includes link attributes that were originally defined for MPLS Traffic Engineering (i.e., using RSVP-TE [[RFC3209](#)]) or GMPLS [[RFC4202](#)]) applications. In recent years applications, such as Segment Routing (SR) Policy [[RFC8402](#)] and Loop-Free Alternates (LFA) [[RFC5286](#)], which also make use of link attributes have been introduced. [[RFC8919](#)] and [[RFC8920](#)] define extensions for IS-IS and OSPF respectively that enable advertising application-specific link attributes for these and other future applications. This has resulted in the need for a similar BGP-LS extension to include this additional link-state topology information from the link-state routing protocols.

This document defines the BGP-LS extensions for the advertisement of application-specific link attributes. It describes the advertisement of these link attributes as top-level TLVs (i.e., as TLVs of the BGP-LS Attribute) and as sub-TLVs of the (top-level) Application Specific



Link Attributes TLV. The document also describes the procedures for the advertisement of these attributes from the underlying IGP and discusses their deployment aspects.

### 1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

## 2. Application Specific Link Attributes TLV

The BGP-LS [[RFC7752](#)] specifies the Link Network Layer Reachability Information (NLRI) for the advertisement of links and their attributes using the BGP-LS Attribute. The Application-Specific Link Attributes (ASLA) TLV is an optional top-level BGP-LS Attribute TLV that is introduced for Link NLRIs. It is defined such that it may act as a container for certain existing and future link attributes that require application-specific definition.

The format of this TLV is as follows and is similar to the corresponding ASLA sub-TLVs defined for OSPF and IS-IS in [[RFC8920](#)] and [[RFC8919](#)] respectively.

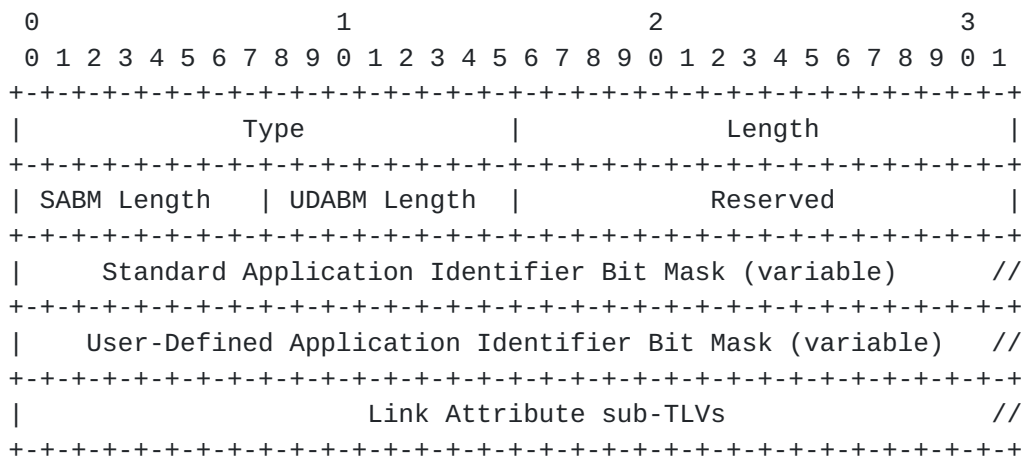


Figure 1: Application-Specific Link Attributes TLV

where:

- o Type: 1122
- o Length: variable.



- o SABM Length : 1 octet field carrying the Standard Application Identifier Bit Mask Length in octets as defined in [\[RFC8920\]](#).
- o UDABM Length : 1 octet field carrying the User-Defined Application Identifier Bit Mask Length in octets as defined in [\[RFC8920\]](#).
- o Reserved: 2 octet field that MUST be set to zero on transmission and MUST be ignored on reception.
- o Standard Application Identifier Bit Mask : An optional set of bits (of size 0, 4, or 8 octets as indicated by the SABM Length), where each bit represents a single standard application as defined in [\[RFC8919\]](#).
- o User-Defined Application Identifier Bit Mask : An optional set of bits (of size 0, 4, or 8 octets as indicated by the UDABM Length), where each bit represents a single user-defined application as defined in [\[RFC8919\]](#).
- o Link Attribute sub-TLVs : BGP-LS Attribute TLVs corresponding to the Link NLRI that are application-specific (including existing ones as specified in [Section 3](#)) are included as sub-TLVs of the ASLA TLV.

The semantics associated with the standard and user-defined bit masks as well as the encoding scheme for application-specific attributes are as specified in [\[RFC8920\]](#).

The ASLA TLV and its sub-TLVs can only be added to the BGP-LS Attribute associated with the Link NLRI of the node that originates the underlying IGP link attribute TLVs/sub-TLVs. The procedures for originating link attributes in the ASLA TLV from underlying IGP are specified in [Section 4](#).

### **3. Application-Specific Link Attributes**

Several BGP-LS Attribute TLVs corresponding to the Link NLRI are defined in BGP-LS and more may be added in the future. Those attributes that have been determined to be, and advertised as application-specific in the underlying IGP are also encoded similarly in BGP-LS.

The following table lists the currently defined BGP-LS Attributes TLVs corresponding to Link NLRI that can have application-specific semantics based on the underlying IGP specifications [\[RFC8919\]](#) [\[RFC8920\]](#). These were originally defined with semantics for RSVP-TE and GMPLS applications in BGP-LS by the respective reference documents.



| TLV Code<br>Point | Description                           | Reference<br>Document |
|-------------------|---------------------------------------|-----------------------|
| 1088              | Administrative group (color)          | [RFC7752]             |
| 1092              | TE Default Metric                     | [RFC7752]             |
| 1096              | Shared Risk Link Group                | [RFC7752]             |
| 1114              | Unidirectional Link Delay             | [RFC8571]             |
| 1115              | Min/Max Unidirectional Link<br>Delay  | [RFC8571]             |
| 1116              | Unidirectional Delay<br>Variation     | [RFC8571]             |
| 1117              | Unidirectional Link Loss              | [RFC8571]             |
| 1118              | Unidirectional Residual<br>Bandwidth  | [RFC8571]             |
| 1119              | Unidirectional Available<br>Bandwidth | [RFC8571]             |
| 1120              | Unidirectional Utilized<br>Bandwidth  | [RFC8571]             |
| 1173              | Extended Administrative Group         | [RFC9104]             |

Table 1: Existing BGP-LS TLVs identified as Application-Specific

All the BGP-LS Attribute TLVs listed in the table above are REQUIRED to be advertised as a top-level TLV in the BGP-LS Attribute when used to carry link attributes specific to RSVP-TE.

BGP-LS Attribute TLVs corresponding to Link NLRI that are identified as application-specific are REQUIRED to be encoded within an ASLA TLV.

Link attributes that do not have application-specific semantics MUST NOT be advertised within the ASLA TLV.

When the same application-specific link attributes are advertised both within the ASLA TLV and as top-level TLVs in the BGP-LS Attribute, the attributes advertised within the ASLA TLV take precedence for the applications indicated in the ASLA TLV encoding.

#### 4. Procedures

The BGP-LS originator learns of the association of an application-specific attribute to one or more applications from the underlying IGP protocol LSA/LSPs from which it is advertising the topology information. [RFC8920] and [RFC8919] specify the mechanisms for advertising application-specific link attributes in OSPF and IS-IS respectively.





Application-specific link attributes received from an IGP node without the use of ASLA encodings continue to be encoded using the respective BGP-LS top-level TLVs listed in Table 1 as specified in their respective reference documents.

While the ASLA encoding in OSPF is similar to that of BGP-LS, the encoding in IS-IS differs and requires additional procedures while conveying information into BGP-LS. One of these differences arises from the presence of the L-bit in the IS-IS encoding. Another difference arises due to the requirement to collate information from two types of IS-IS encodings for application-specific link information (i.e., the IS-IS ASLA sub-TLV and the ISIS Application-Specific SRLG TLV) [[RFC8919](#)] and to carry them together in the BGP-LS ASLA TLV.

A BGP-LS originator node that is advertising link-state information from the underlying IGP using ASLA encodings determines their BGP-LS encoding based on the following rules:

1. Application-specific link attributes received from an OSPF node using ASLA sub-TLV or from an IS-IS node using either ASLA sub-TLV or Application-Specific SRLG TLV MUST be encoded in the BGP-LS ASLA TLV as sub-TLVs. Exceptions to this rule are specified in (2)(F) and (2)(G) below.
2. In the case of IS-IS, the following specific procedures are to be followed:
  - A. When application-specific link attributes are received from a node with the L bit set in the IS-IS ASLA sub-TLV and application bits other than RSVP-TE are set in the application bit masks then the application-specific link attributes advertised in the corresponding legacy IS-IS TLVs/sub-TLVs MUST be encoded within the BGP-LS ASLA TLV as sub-TLVs with the application bits, other than the RSVP-TE bit, copied from the IS-IS ASLA sub-TLV. The link attributes advertised in the legacy IS-IS TLVs/sub-TLVs are also advertised in BGP-LS top-level TLVs as per [[RFC7752](#)] [[RFC8571](#)] [[RFC9104](#)]. The same procedure also applies for the advertisement of the SRLG values from the IS-IS Application-Specific SRLG TLV.
  - B. When the IS-IS ASLA sub-TLV has the RSVP-TE application bit set, then the link attributes for the corresponding IS-IS ASLA sub-TLVs MUST be encoded using the respective BGP-LS top-level TLVs as per [[RFC7752](#)] [[RFC8571](#)] [[RFC9104](#)]. Similarly, when the IS-IS Application-Specific SRLG TLV has the RSVP-TE application bit set, then the SRLG values within



it MUST be encoded using the top-level BGP-LS SRLG TLV (1096) as per [\[RFC7752\]](#).

- C. The SRLGs advertised in IS-IS Application-Specific SRLG TLV(s) and the other link attributes advertised in IS-IS ASLA sub-TLV(s) are REQUIRED to be collated, on a per-application basis, only for those applications whose bit is set in the SABM/UDABM in one of the two types of IS-IS encodings, and the other encoding type has an advertisement with zero-length application bit masks (i.e., there is no corresponding advertisement of that other encoding type with that specific application bit set). For each such application, it's collated information MUST be carried in a BGP-LS ASLA TLV with that application's bit set in the SABM/UDABM.
- D. If the resulting set of collated link attributes and SRLG values is common across multiple applications, they MAY be advertised in a common BGP-LS ASLA TLV instance where the bits for all such applications would be set in the application bit mask.
- E. Both the SRLG values from IS-IS Application-Specific SRLG TLVs and the link attributes from IS-IS ASLA sub-TLVs, with the zero-length application bit mask, MUST be advertised into a BGP-LS ASLA TLV with a zero-length application bit mask, independent of the collation described above.
- F. [\[RFC8919\]](#) allows the advertisement of the Maximum Link Bandwidth within an IS-IS ASLA sub-TLV even though it is not an application-specific attribute. However, when originating the Maximum Link Bandwidth into BGP-LS, the attribute MUST be encoded only in the top-level BGP-LS Maximum Link Bandwidth TLV (1089) and MUST NOT be advertised within the BGP-LS ASLA TLV.
- G. [\[RFC8919\]](#) also allows the advertisement of the Maximum Reservable Link Bandwidth and the Unreserved Bandwidth within an IS-IS ASLA sub-TLV even though these attributes are specific to RSVP-TE application. However, when originating the Maximum Reservable Link Bandwidth and Unreserved Bandwidth into BGP-LS, these attributes MUST be encoded only in the BGP-LS top-level Maximum Reservable Link Bandwidth TLV (1090) and Unreserved Bandwidth TLV (1091) respectively and not within the BGP-LS ASLA TLV.

These rules ensure that a BGP-LS originator performs the advertisement for all application-specific link attributes from the IGP nodes that support the ASLA extension. Furthermore, it also



ensures that the top-level BGP-LS TLVs defined for RSVP-TE and GMPLS applications continue to be used for advertisement of their application-specific attributes.

A BGP-LS speaker would normally advertise all the application-specific link attributes corresponding to RSVP-TE and GMPLS applications as existing top-level BGP-LS TLVs while for other applications they are encoded in ASLA TLV(s) with appropriate applicable bit mask setting. An application-specific attribute value received via a sub-TLV within the ASLA TLV has precedence over the value received via a top-level TLV.

## 5. Deployment Considerations

BGP-LS sources the link-state topology information (including the extensions introduced by this document) from the underlying link-state IGP protocols. The various deployment aspects related to the advertisement and use of application-specific link attributes are discussed in the Deployment Considerations sections of [\[RFC8920\]](#) and [\[RFC8919\]](#). The IGP backward compatibility aspects described in those documents associated with application-specific link attributes along with the BGP-LS procedures specified in this document enable backward compatibility in deployments of existing implementations of [\[RFC7752\]](#) [\[RFC8571\]](#) [\[RFC9104\]](#) for applications such as RSVP-TE, SR Policy, and LFA.

It is recommended that only nodes supporting this specification are selected as originators of BGP-LS information when advertising the link-state information from the IGPs in deployments supporting application-specific link attributes.

BGP-LS consumers that do not support this specification can continue to use the existing top-level TLVs for link attributes for existing applications as discussed above. They would, however, be able to support neither the application-specific link attributes nor newer applications that may be encoded only using the ASLA TLV.

## 6. IANA Considerations

IANA has assigned, through the early allocation process, the following code-point from the "BGP-LS Node Descriptor, Link Descriptor, Prefix Descriptor, and Attribute TLVs" registry. This document requests that the allocation be made permanent. The column "IS-IS TLV/Sub-TLV" defined in the registry does not require any value and should be left empty.



| Code Point | Description                          | Reference     |
|------------|--------------------------------------|---------------|
| 1122       | Application-Specific Link Attributes | this document |

Table 2: ASLA TLV Code-Point Allocation

## 7. Manageability Considerations

The protocol extensions introduced in this document augment the existing IGP topology information defined in [RFC7752]. Procedures and protocol extensions defined in this document do not affect the BGP protocol operations and management other than as discussed in the Manageability Considerations section of [RFC7752]. Specifically, the malformed NLRI attribute tests in the Fault Management section of [RFC7752] now encompasses the BGP-LS TLVs defined in this document.

The extensions specified in this document do not specify any new configuration or monitoring aspects in BGP or BGP-LS. The specification of BGP models is an ongoing work based on [I-D.ietf-idr-bgp-model].

## 8. Security Considerations

Security considerations for acquiring and distributing BGP-LS information are discussed in [RFC7752]. Specifically, the considerations related to topology information related to traffic engineering apply.

The TLVs introduced in this document are used to propagate the application-specific link attributes IGP extensions defined in [RFC8919] and [RFC8920]. It is assumed that the IGP instances originating these TLVs will support all the required security (as described in [RFC8919] and [RFC8920]).

This document defines a new way to advertise link attributes. Tampering with the information defined in this document may affect applications using it, including impacting traffic engineering, which uses various link attributes for its path computation. As the advertisements defined in this document limit the scope to specific applications, the impact of tampering is similarly limited in scope. The advertisement of the link attribute information defined in this document presents no significant additional risk beyond that associated with the existing link attribute information already supported in [RFC7752].





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