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OSPFv2 Link Traffic Engineering (TE) Attribute Reuse
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Abstract

Various link attributes have been defined in OSPFv2 in the context of the MPLS Traffic Engineering (TE) and GMPLS. Many of these link attributes can be used for purposes other than MPLS Traffic Engineering or GMPLS. This documents defines how to distribute such attributes in OSPFv2 for applications other than MPLS Traffic Engineering or GMPLS purposes.

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1. Introduction

Various link attributes have been defined in OSPFv2 [RFC2328] in the context of the MPLS traffic engineering and GMPLS. All these

attributes are distributed by OSPFv2 as a sub-TLVs of the Link-TLV advertised in the OSPFv2 TE Opaque LSA [RFC3630].

Many of these link attributes are useful outside of the traditional MLPLS Traffic Engineering or GMPLS. This brings its own set of problems, in particular how to distribute these link attributes in OSPFv2 when MPLS TE or GMPLS are not deployed or are deployed in parallel with other applications that use these link attributes.

1.1. Requirements notation

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. Link attributes examples

This section lists some of the link attributes originally defined for MPLS Traffic Engineering that can be used for other purposes in OSPFv2. The list doesn't necessarily contain all the required attributes.

1. Remote Interface IP address [RFC3630] - OSPFv2 currently cannot distinguish between parallel set of links between two remote OSPFv2 routers. As a result, the two-way connectivity check performed during SPF may succeed when the two routers disagree on which of the links to use for data traffic.

2. Link Local/Remote Identifiers - [RFC4203] - Used for the two-way connectivity check for parallel unnumbered links. Also used for identifying adjacencies for unnumbered links in Segment Routing traffic engineering.

3. Shared Risk Link Group (SRLG) [RFC4203] - In IPFRR, the SRLG is used to compute diverse backup paths [RFC5714].

4. Unidirectional Link Delay/Loss Metrics [RFC7471] - Could be used for the shortest path first (SPF) computation using alternate metrics within an OSPF area.

3. Advertising Link Attributes

This section outlines possible approaches for advertising link attributes originally defined for MPLS Traffic Engineering purposes or GMPLS when they are used for other applications.

3.1. TE Opaque LSA

One approach for advertising link attributes is to continue to use TE Opaque LSA ([RFC3630]). There are several problems with this approach:

1. Whenever the link is advertised in a TE Opaque LSA, the link becomes a part of the TE topology, which may not match IP routed topology. By making the link part of the TE topology, remote nodes may mistakenly believe that the link is available for MPLS TE or GMPLS, when, in fact, MPLS is not enabled on the link.

2. The TE Opaque LSA carries link attributes that are not used or required by MPLS TE or GMPLS. There is no mechanism in TE Opaque LSA to indicate which of the link attributes should be passed to MPLS TE application and which should be used by OSPFv2 and other applications.

3. Link attributes used for non-TE purposes is partitioned across multiple LSAs - the TE Opaque LSA and the Extended Link Opaque LSA. This partitioning will require implementations to lookup multiple LSAs to extract link attributes for a single link, bringing needless complexity to the OSPFv2 implementations.

The advantage of this approach is that there is no additional standardization requirement to advertise the TE/GMPL attributes for other applications. Additionally, link attributes are only advertised once when both OSPF TE and other applications are deployed on the same link. This is not expected to be a common deployment

scenario.

3.2. Extended Link Opaque LSA

An alternative approach for advertising link attributes is to use Extended Link Opaque LSAs as defined in [RFC7684]. This LSA was defined as a generic container for distribution of the extended link attributes. There are several advantages in using Extended Link LSA:

1. Advertisement of the link attributes does not make the link part of the TE topology. It avoids any conflicts and is fully compatible with the [RFC3630].

2. The TE Opaque LSA remains truly opaque to OSPFv2 as originally defined in [RFC3630]. Its content is not inspected by OSPFv2 and OSPFv2 acts as a pure transport.

3. There is clear distinction between link attributes used by TE and link attributes used by other OSPFv2 applications.

4. All link attributes that are used by OSPFv2 applications are advertised in a single LSA, the Extended Link Opaque LSA.

The disadvantage of this approach is that in rare cases, the same link attribute is advertised in both the TE Opaque and Extended Link Attribute LSAs. Additionally, there will be additional standardization effort. However, this could also be viewed as an advantage as the non-TE use cases for the TE link attributes are documented and validated by the OSPF working group.

3.3. Proposed solution

It is RECOMMENDED to use the Extended Link Opaque LSA ([RFC7684] to advertise any link attributes used for non-TE purposes in OSPFv2, including those that have been originally defined for TE purposes. TE link attributes used for TE purposes continue to use TE Opaque LSA ([RFC3630]).

Is is also RECOMMENDED to keep the format of the link attribute TLVs that have been defined for TE purposes unchanged even when they are used for non-TE purposes.

Finally, it is RECOMMENDED to allocate unique code points for link attribute TLVs that have been defined for TE purposes for the OSPFv2 Extended Link TLV Sub-TLV Registry as defined in [RFC7684]. For each reused TLV, the code point will be defined in an IETF document along with the expected usecase(s).

4. Reused TE link attributes

This section defines the use case and code points for the OSPFv2 Extended Link TLV Sub-TLV Registry for some of the link attributes that have been originally defined for TE or GMPLS purposes.

4.1. Remote interface IP address

The OSPFv2 description of an IP numbered point-to-point adjacency does not include remote IP address. As described in Section 2, this makes the two-way connectivity check ambiguous in the presence of the parallel point-to-point links between two OSPFv2 routers.

The Remote IP address of the link can also be used for Segment Routing traffic engineering to identify the link in a set of parallel links between two OSPFv2 routers [I-D.ietf-ospf-segment-routing-extensions]. Similarly, the remote IP address is useful in identifying individual parallel OSPF links advertised in BGP Link-State as described in [I-D.ietf-idr-ls-distribution].

To advertise the Remote interface IP address in the OSPFv2 Extended Link TLV, the same format of the sub-TLV as defined in section 2.5.4. of [RFC3630] is used and TLV type 4 is used.

4.2. Link Local/Remote Identifiers

The OSPFv2 description of an IP unnumbered point-to-point adjacency does not include remote link identifier. As described in Section 2, this makes the two-way connectivity check ambiguous in the presence of the parallel point-to-point IP unnumbered links between two OSPFv2 routers.

The local and remote link identifiers can also be used for Segment Routing traffic engineering to identify the link in a set of parallel IP unnumbered links between two OSPFv2 routers

[I-D.ietf-ospf-segment-routing-extensions]. Similarly, these identifiers are useful in identifying individual parallel OSPF links advertised in BGP Link-State as described in [I-D.ietf-idr-ls-distribution].

To advertise the link Local/Remote identifiers in the OSPFv2 Extended Link TLV, the same format of the sub-TLV as defined in section 1.1. of [RFC4203] is used and TLV type 5 is used.

4.3. Shared Risk Link Group (SRLG)

The SRLG of a link can be used in IPFRR to compute a backup path that does not share any SRLG group with the protected link.

To advertise the SRLG of the link in the OSPFv2 Extended Link TLV, the same format of the sub-TLV as defined in section 1.3. of [RFC4203] is used and TLV type 6 is used.

4.4. Extended Metrics

[RFC3630] defines several link bandwidth types. [RFC7471] defines extended link metrics that are based on link bandwidth, delay and loss characteristics. All these can be used to compute best paths within an OSPF area to satisfy requirements for bandwidth, delay (nominal or worst case) or loss.

To advertise extended link metrics in the OSPFv2 Extended Link TLV, the same format of the sub-TLVs as defined in [RFC7471] is used with following TLV types:

7 - Unidirectional Link Delay

8 - Min/Max Unidirectional Link Delay

9 - Unidirectional Delay Variation

10 - Unidirectional Link Loss

11 - Unidirectional Residual Bandwidth

12 - Unidirectional Available Bandwidth

13 - Unidirectional Utilized Bandwidth

To advertise link maximum bandwidth, maximum reservable bandwidth an unreserved bandwidth in the OSPFv2 Extended Link TLV, the same format of the sub-TLVs as defined in [RFC3630] is used with following TLV types:

7 - Maximum bandwidth

8 - Maximum reservable bandwidth

9 - Unreserved bandwidth

5. Backward Compatibility

It is allowed to advertise the same link attribute in TE Opaque LSA [RFC3630] as well as in the Extended Link Opaque LSA [RFC7684] at the same time. If the same link attribute is advertised in both LSAs, it is expected that the information in these LSA would be identical. If they are different, TE will use the information in the TE Opaque LSA and the non-TE applications will use the information in the OSPFv2 Extended Link Opaque LSA.

Even though there is no IETF specification documenting the usage of TE link attributes beyond the traffic engineering, some deployments may rely on link attributes being carried in the TE Opaque LSA. For example, some implementations of LFA and remote LFA currently rely on link attributes such as SRLG and admin groups to be carried in the TE Opaque LSA. These applications are described in [RFC5286], [RFC7490], [I-D.ietf-rtgwg-lfa-manageability] and [I-D.psarkar-rtgwg-rlfa-node-protection].

When a network is using an application that relies on link attributes being carried in the TE Opaque LSA, care should be taken to continue to advertise the appropriate link attributes in the TE Opaque LSA. Note that by doing so, the link will continue to be considered part of the traffic engineering topology as defined in [RFC3630].

Note that a node that does not directly participate in remote LFA by originating repair tunnels itself may still need to continue

originating link attributes in the TE Opaque LSA for use by other

nodes in the network. Therefore, when evaluating software upgrades or configuration changes which may result in changes to which link attributes are being advertised in the TE Opaque LSA, even for a subset of routers in the network, care should be taken to evaluate the impact of that change across the entire network.

6. Security Considerations

Implementations must assure that malformed TLV and Sub-TLV permutations do not result in errors that cause hard OSPFv2 failures.

7. IANA Considerations

This specification updates the OSPFv2 Extended Link TLV sub-TLV registry that is defined in [RFC7684] with the following TLV types:

4 - Remote interface IP address

5 - Link Local/Remote Identifiers

6 - Shared Risk Link Group

7 - Unidirectional Link Delay

8 - Min/Max Unidirectional Link Delay

9 - Unidirectional Delay Variation

10 - Unidirectional Link Loss

11 - Unidirectional Residual Bandwidth

12 - Unidirectional Available Bandwidth

13 - Unidirectional Utilized Bandwidth

8. Acknowledgments

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