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BGP Link Bandwidth Extended Community
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Abstract

This document specifies a type of BGP Extended Community that enables routers to perform weighted load-balancing in multipath scenarios.

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].

Status of This Memo

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1. Introduction

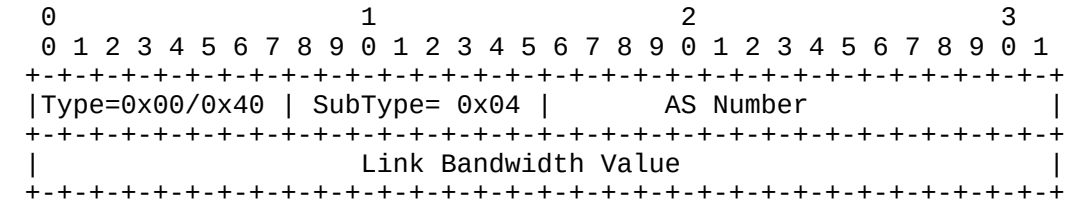
Load balancing is a critical aspect of network design, enabling efficient utilization of available bandwidth and improving overall network performance. Traditional equal-cost multi-path (ECMP) routing does not account for the varying capacities of different paths. This document suggests that the link bandwidth be carried in the network using one of two new extended communities [RFC4360] - the transitive and non-transitive Link Bandwidth Extended Community. The Link Bandwidth Extended Community provides a mechanism for routers to advertise the bandwidth of their downstream path that may either be a

directly connected link or multi-hop/multipath nexthop. This mechanism facilitates maximizing utilization of network resources.

2. Link Bandwidth Extended Community

The Link Bandwidth Extended Community is defined as a BGP extended community that carries the bandwidth information of a router, represented by BGP Next Hop, connecting to a remote network. This community can be used to inform other routers about the available bandwidth through a given route.

The Link Bandwidth Extended Community can be either transitive or non-transitive. Therefore the value of the high-order octet of the extended Type Field can be 0x00 or 0x40, respectively. The value of the low-order octet of the extended type field for this communities is 0x04. The value of the Global Administrator subfield in the Value Field SHOULD represent the Autonomous System of the router that attaches the Link Bandwidth Extended Community, but it can be set to any 2-byte value. If the Autonomous System number cannot be represented in two octets, AS_TRANS [RFC6793], SHOULD be used in the Global Administrator subfield. The encoding of 4-octet ASN is out of scope of this document. The bandwidth of the link is expressed as 4 octets in [IEEE.754-2019] floating point format, units being bytes (not bits!) per second. It is carried in the Local Administrator subfield of the Value Field.



Type: 1-octet field MUST be set to 0x00 or 0x40 to indicate transitive/non-transitive.

SubType: 1-octet field MUST be set to 0x04 to indicate 'Link-Bandwidth'.

Global Administrator sub-field: 2-octet represent the Autonomous System.

Local Administrator sub-field: Bandwidth value (bytes per sec) encoded as 4 octets in IEEE floating point format.

Figure 1: Link Bandwidth Extended Community

3. Protocol Procedures

The procedures cover both the transitive and non-transitive variants of the Link Bandwidth Extended Community so that implementations can handle both variants in a way that supports existing deployments. Please refer to Section 5 and Appendix A for more details.

3.1. Sender (Originating Link Bandwidth Extended Community)

A BGP speaker that attaches a Link Bandwidth Extended Community SHOULD be able to advertise either a transitive or a non-transitive Link Bandwidth Extended Community. Implementations SHOULD provide configuration to set the transitivity type of the Link Bandwidth Extended Community, as well as the Global Administrator and bandwidth values in the Local Administrator field, using local policy. Different implementations MAY use different default values for the transitivity type of the Link Bandwidth Extended Community. The provided configuration SHOULD allow operators to override the default transitivity value as needed. An implementation MAY advertise a link bandwidth value as zero.

Generally, a single Link Bandwidth Extended Community of the transitivity type that is desired in a deployment is attached to a route. However during transition (refer Section 7 for details), a BGP speaker MAY attach one Link Bandwidth Extended Community per transitivity (transitive/non-transitive) both having the same ’Link Bandwidth Value’ field.

A Link Bandwidth Extended Community MAY be attached or updated for a BGP route upon receipt during Adj-RIB-In processing. The Link Bandwidth Extended Community MAY be attached or updated for a BGP route’s Adj-RIB-Out entry while being advertised to a neighboring BGP speaker.

Implementations MAY provide a configuration option to send non-transitive Link Bandwidth Extended Communities on external BGP sessions.

3.2. Receiver (Receiving Link Bandwidth Extended Community)

A BGP receiver MUST be able to process Link Bandwidth Extended Community of both transitive and non-transitive types. The receiver MUST NOT flap or treat the route as malformed based on the transitivity of the Link Bandwidth Extended Community and/or BGP session type (internal vs. external).

Implementations MAY provide configuration to accept non-transitive Link Bandwidth Extended Communities from external BGP sessions.

A BGP update with an attached Link Bandwidth Extended Community with a bandwidth value of zero is valid. Weighted ECMP (WECMP) described in section 6.3 [RFC7938] can be utilized when all contributing paths have a non-zero value in the Link Bandwidth Extended Community. However, in the case where the paths have a mix of zero and non-zero values, or all zero values, the behavior is determined by local policy. For example, implementations MAY exclude the paths with zero value from WECMP formation as long as at least one path with non-zero value exists or they MAY fallback to ECMP.

3.3. Re-advertisement Procedures

This section describes the procedures to be followed when a BGP speaker receives a route with an attached Link Bandwidth Extended Community and subsequently re-advertises that route.

3.3.1. Re-advertisement with Next hop Self

When a BGP speaker re-advertises a route with Link Bandwidth Extended Community and sets the next hop to itself, it SHOULD follow the same procedures as outlined in Section 3.1.

In the absence of any route policies that alter the Link Bandwidth Extended Community, any received Link Bandwidth Extended Community on the route will be re-advertised unchanged. Please also refer to Section 3.4 for use in a BGP multipath environment.

3.3.2. Re-advertisement with Next Hop Unchanged

A BGP speaker that receives a route with a Link Bandwidth Extended Community and re-advertises or reflects the same without changing its next hop, SHOULD NOT change the Link Bandwidth Extended Community in any way.

3.4. Link Bandwidth Extended Community Arithmetic and BGP Multipath

In a BGP multipath ECMP environment, the link bandwidth value that is sent or re-advertised may be calculated based on the Link Bandwidth Extended Community of the routes contributing to multipath in the Local Routing Information Base (Local-RIB). This topic is beyond the scope of this document.

4. Error Handling

If a BGP speaker receives a route with more than one Link Bandwidth Extended Communities and uses the route to compute WECMP, it SHOULD use the extended community with the lowest "Link Bandwidth Value", ignoring the transitivity. Implementations MAY provide configuration to change the above preference.

Between transitive and non-transitive types of Link Bandwidth Extended Communities that have the same 'Link Bandwidth Value', the transitivity doesn't matter for purpose of computing WECMP or programming to FIB (Forwarding Information Base).

Note that these procedures mean that a BGP speaker reflecting a route with next hop unchanged (e.g. RR) will re-advertise the Link Bandwidth Extended Communities received on the route as-is without any modification, while following the extended community transitivity rules.

Link Bandwidth Extended Communities with a negative value SHALL be ignored and MUST NOT be advertised.

Link Bandwidth Extended Communities with a zero value MUST NOT be considered malformed.

If any of the paths lack a valid Link Bandwidth Extended Community, ECMP (Equal-Cost Multi-Path) MUST be used instead.

5. IANA Considerations

IANA is requested to update the Transitive Two-Octet AS-Specific Extended Community Sub-Types registry (Type 0x00) and Sub-Type 0x04 to:

Name
transitive Link Bandwidth Extended Community

IANA is requested to update the Non-Transitive Two-Octet AS-Specific Extended Community Sub-Types registry (Type 0x40) and Sub-Type 0x04 to:

Name
non-transitive Link Bandwidth Extended Community

Both updates are to reference this document.

6. Security Considerations

This extension to BGP has similar security implications as BGP Extended Communities [RFC4360]

The Link Bandwidth Extended Community conveys bandwidth and capacity information that may be sensitive. Exporting this community outside of an administrative domain can expose private network resource details. When propagating the routes with Link Bandwidth Extended Community towards an untrusted network or outside of an administrative domain, it is recommended operators use policy to filter out this community.

7. Operational Considerations

7.1. Inconsistent Deployment

Prior deployments of the feature specified in this document have involved implementations that only understood one of the two extended community transitivity types. As a result, such implementations would treat the use of the other transitivity type in a "ships in the night" fashion. The procedures in this document govern how multiple transitivity types for link bandwidth should operate.

In circumstances where networks have deployed a mixture of implementations supporting this document’s procedures for both transitivity types, and older implementations that only understand one transitivity type, inconsistent behavior could result. A prime example is when a route received by a BGP speaker contains both a transitive and a non-transitive Link Bandwidth Extended Community and that BGP speaker performs an operation that updates only one of the Link Bandwidth Extended Communities, the other community may have an inconsistent value. As a result, downstream BGP speakers that may receive such routes may perform inappropriate WECMP load balancing.

To mitigate such issues, when operators are aware that older implementations are present in their networks, they may wish to take actions to address such inconsistencies. One option would be to filter either at advertisement time on the older BGP speaker the unsupported transitivity type of Link Bandwidth Extended Community - if the implementation is capable of such filtering. Alternatively, a receiving BGP speaker, knowing that the sending speaker is incapable of doing such operations, could strip the Link Bandwidth Extended Community type that is unsupported by the sender.

Ideally this operational consideration is short-lived until all the routers in the network have been upgraded to implementations that consistently support the procedures in this document.

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Appendix A. Document History

BGP Link Bandwidth Extended Community has evolved over several versions of the IETF draft. In the earlier versions up to draft-ietf-idr-link-bandwidth-08, only the non-transitive version of Link Bandwidth Extended Community was supported. However, starting from draft-ietf-idr-link-bandwidth-09, both transitive and non-transitive versions of Link Bandwidth Extended Community are supported.

A BGP speaker (Sender or Receiver) needs to be upgraded to support the procedures defined in this document to provide full interoperability for both transitive and non-transitive versions of Link Bandwidth Extended Community. In order to simplify implementations, it is not a goal to provide interoperability by upgrading only the RR.

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