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Metric Normalize for IGP Flex-algo
draft-gl-lsr-metric-normalize-00

Abstract

When multiple links in a network have the same metric, they can serve as ECMP equivalent links for load balancing during forwarding. However, slight fluctuations in metric values can prevent the formation of ECMP equivalent links, leading to the idle state of suboptimal links and thus wasting bandwidth resources.

This document proposes a method for normalizing metrics, allowing the slight fluctuations across multiple links to be adjusted so that the resulting calculated metrics become identical. This enables the formation of ECMP equivalent links, facilitating load distribution during forwarding.

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 April 23, 2026.

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1. Introduction

When there are slight differences in metrics among multiple paths in a network, these paths cannot be computed as ECMP routes, resulting in suboptimal paths being unused for traffic forwarding and leading to inefficient bandwidth utilization. To eliminate these slight metric differences, this document proposes a method for normalizing metric calculations.

This document does not specify a concrete method for measuring link metrics; common IGP metrics, link delay, link packet loss rate, link bandwidth, and link congestion level can all serve as measures of link metric.

The specific calculation method is as follows:

(1) Set two parameters for metric calculation: metric-step and metric-offset.

(2) Calculate a.

a = metric / metric-step, with the result rounded down (floor function).

The metric is the actual metric of the link.

(2) Calculate b.

b = a * metric-step + metric-offset.

(3) Calculate normal-metric (the final advertised metric):

If metric <= b, then normal-metric = b;

If metric > b, then normal-metric = b + metric-step.

By using this method, the results standardized within the metric-step range will be the same when the Metric difference falls within this range.

[RFC9350] describes types of link metrics, including IGP-Metric, Link Delay, Link Loss, and Bandwidth. Different normalization parameters need to be set for each type of metric. For instance, parameters such as metric-step and metric-offset must be specifically set for link delay and link loss respectively.

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. Terminology

TBD.

3. Usecase

As shown in Figure 4, due to different link delay metrics between R2<->R3 and R4<->R5, but the difference is not significant. The final computed path from R1 to R6 is R1->R4->R5->R6, and the link between R3 and R6 is idle.
To solve the above issue, link delay metrics can be standardized, where metric-step is 10 and metric-offset is 3.
The standardization process for the link R2->R3 with link delay metric value 31 is as follows:
(1) Calculate a. a = 31 / 10; the result after floor operation is 3.
(2) Calculate b. b = 3 * 10 + 3; the result is 33.
(3) Calculate normal-metric. Since 31 is less than 33, normal-metric = 33. The link delay metric finally advertised is 33.

The standardization process for the link R4->R5 with link delay metric value 29 is as follows:
(1) Calculate a. a = 29 / 10; the result after floor operation is 2.
(2) Calculate b. b = 2 * 10 + 3; the result is 23.
(3) Calculate normal-metric. Since 29 is greater than 23, normal-metric = 23 + 10. The link delay metric finally advertised is 33.

After completing the above standardization, Flex-Algo finally computes two paths from R1 to R6: R1->R2->R3->R6 and R1->R4->R5->R6, thereby achieving the goal of fully utilizing link resources.

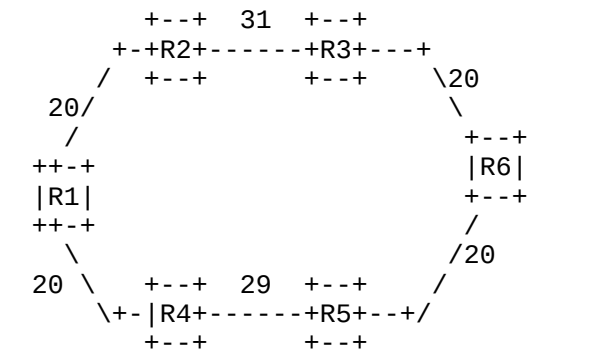


Figure 4: Link delay Metric Normalize

4. Extensions

4.1. Flex-Algo Extensions

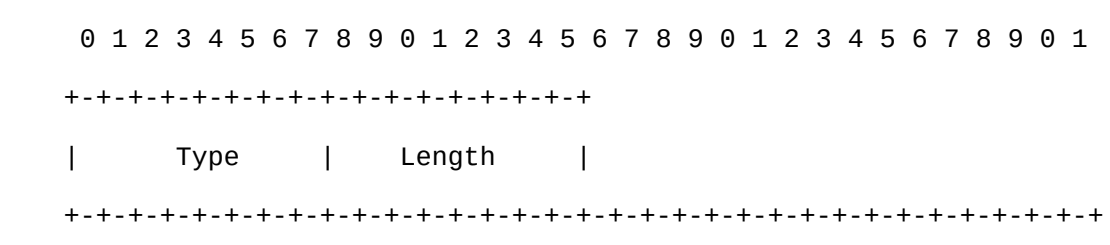
[RFC9350] defines constraints and parameters in Flex-Algo to better control network path computations.

[RFC9350] Section 5.1 defines the ISIS Flexible Algorithm Definition Advertisement, and Section 5.2 defines the OSPF Flexible Algorithm Definition Advertisement. Based on this, this document extends new Sub-TLV types within the Flexible Algorithm Definition Sub-TLV to advertise Metric Normalize information for the ISIS and OSPF protocols, these constraints to allow multiple paths with metric differences within a certain range to be used as ECMP routes.

[draft-ietf-idr-bgp-generic-metric] provides a method for carrying generic metric attributes to transmit various types of metrics.

This document refers to this method, using generic metric attributes to advertise various types of Metrics' Metric Normalize attributes.

4.1.1. ISIS Flex-Algo Metric Normalize Sub-TLV



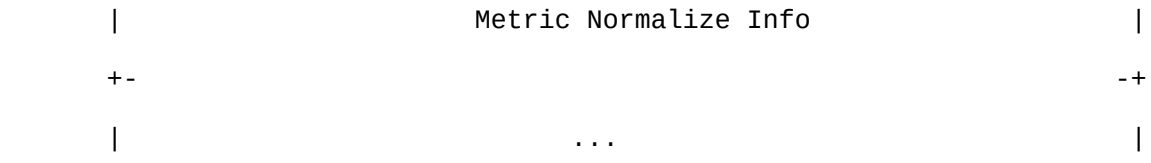


Figure 3: ISIS Flexible Algorithm Metric Normalize Sub-TLV

where:

Type(1 octet): TBD1

Length(1 octet): variable, dependent on the size of the Metric Normalize Info.

Metric Normalize Info: Multiple Metric Normalize Data, See below.

Figure 2: Metric Normalize Data

1. Metric-type (1 octet): Value of metric-type from IGP-Protocol registry for metric-types. [draft-ietf-idr-bgp-generic-metric]

2. Metric-Step (2 octets): Value of metric-step

3. Metric-Offset(2octets): Value of metric-offset

4.1.2. OSPF Flexible Algorithm Metric Normalize Sub-TLV

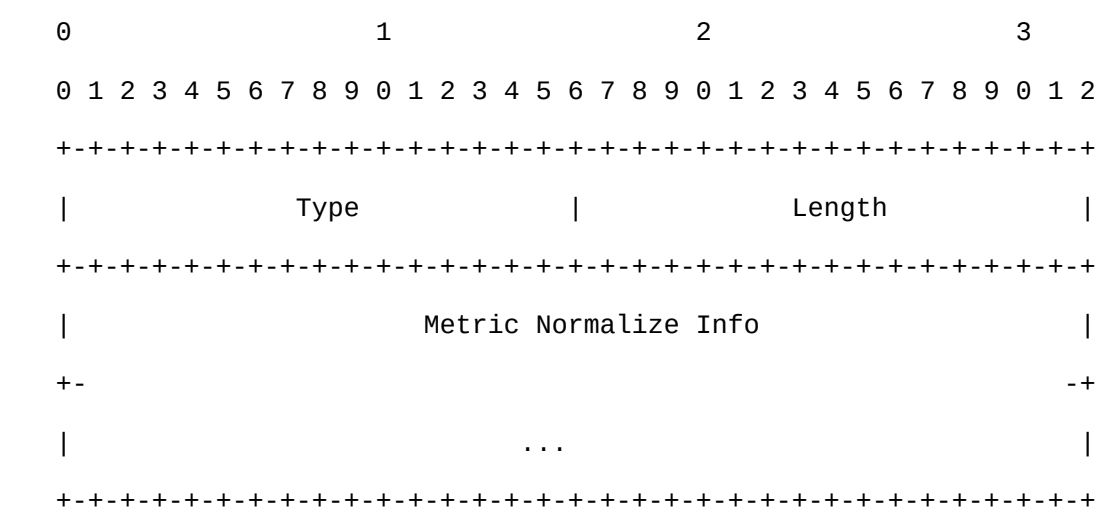


Figure 3: OSPF Flexible Algorithm Metric Normalize Sub-TLV

where:

Type(2 octetes): TBD2

Length(2 octetes): variable, dependent on the size of the Metric Normalize Info.

Metric Normalize Info: Multiple Metric Normalize Data: Same as 3.1.1 of ISIS.

5. Security Considerations

TBD.

6. IANA Considerations

6.1. ISIS Flex-Algo Metric Normalize

IANA is requested to assign a code point for "Metric Normalize" from "IS-IS Sub-Sub-TLVs for Flexible Algorithm Definition Sub-TLV" registry.[RFC9350, Sec 18.3.3]

Value	Description	Reference
TBD1	Metric Normalize	This Document

6.2. OSPF Flex-Algo Metric Normalize

IANA is requested to assign a code point for "Metric Normalize" from "OSPF Sub-Sub-TLVs for Flexible Algorithm Definition Sub-TLV" registry. [RFC9350, Sec 18.4.8]

Value	Description	Reference
TBD2	Metric Normalize	This Document

7. Security Considerations

TBD.

8. References

8.1. Normative References

[RFC9350] P. Psenak, Ed., Cisco Systems, Inc., S. Hegde, Juniper Networks, Inc., C. Filsfils, Cisco Systems, Inc., K. Talaulika, Cisco Systems, Inc, A. Gulko, Edward Jones, "IGP Flexible Algorithm", RFC 9350, DOI 10.17487/RFC9350, February 2023, <https://www.rfc-editor.org/info/rfc9350>.

[draft-ietf-idr-bgp-generic-metric-00] S. Sangli, S. Hegde, R. Das, Juniper Networks Inc., B. Decraene, Orange, B. Wen, M. Kozak, Comcast, J. Dong, Huawei, L. Jalil, Verizon, K. Talaulikar, Cisco, "Accumulated Metric in NHC attribute", draft-ietf-idr-bgp-generic-metric-00, DOI 10.17487/draft-ietf-idr-bgp-generic-metric-00, August 2024, <https://www.rfc-editor.org/info/draft-ietf-idr-bgp-generic-metric-00>.

8.2. Informational References

TBD

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