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IGP Reverse SPF Algorithm
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Abstract

IANA has set up a subregistry called "IGP Algorithm Type" under the "Interior Gateway Protocol (IGP) Parameters" registry. This draft introduces a new algorithm type which utilizes the cost in the reverse direction on each link.

This document also discusses using this new algorithm type in combination with IGP Flexible Algorithm to compute constraint-based paths.

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1. Introduction

Existing IGP Algorithm types as defined in the IANA IGP Algorithm Types registry created by [RFC8665] utilize metrics in the forward direction on each link. But there are use cases (discussed later in this document) where utilizing the metric in the reverse direction on each link is desirable.

This document defines a new IGP Algorithm type which uses link metrics in the reverse direction.

An IGP Flexible Algorithm as specified in [RFC9350] computes a constraint-based path. It supports various metric types, including native Interior Gateway Protocol (IGP) metric, Min Unidirectional Link Delay, Traffic Engineering Default Metric, all defined in [RFC9350]. In addition, Bandwidth Metric and User defined metrics are defined in [I-D.ietf-lsr-flex-algo-bw-con].

Existing IGP Flexible Algorithm use cases specify an IGP Algorithm Type where all these link metric types are used by Flexible Algorithm in the forward direction, e.g., the direction in which the link is added to the topology during the computation.

This document extends IGP Flexible Algorithm to be able to use the IGP Algorithm Type which specifies using the link metric in a reverse direction.

Usage of the Reverse Shortest Path First (RSPF) algorithm outside of the IGP Flexible Algorithm is outside of the scope of this draft.

2. 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.

3. Use Case Example

A multicast tree is typically established from the receivers (R) towards the multicast source (S). When determining the path for traffic originating from S towards R, a shortest path from R to S is often used. When the metric on all links is symmetric, e.g. equal in both directions, this provides the correct outcome.

With the introduction of IGP Flexible Algorithms, additional metrics become available for calculating the shortest path. One commonly employed metric is latency, which often exhibits asymmetry. Multicast traffic is frequently required to take the path with the minimal latency. In the presence of the asymmetric link latency, the usage of the reverse link latency is required for multicast tree calculation. Failure to use the reverse link latency can result in multicast traffic not taking the least latency path across the network.

4. Flexible Algorithm Usage of Reverse Shortest Path First Algorithm

Flexible Algorithm Definition Sub-TLV [RFC9350] defines the Calc-Type field, that carries the calculation-type used by the Flexible Algorithm. Values are defined in IANA "IGP Algorithm Types" registry defined under the "Interior Gateway Protocol (IGP) Parameters" registry.

We define a new IGP Algorithm Type - Reverse Shortest Path First (SPF) algorithm based on link metric. It is equivalent to the IGP Algorithm Type 0, but the link metric is taken from the reverse direction of the link.

If the winning Flexible Algorithm Definition signals the Reverse SPF algorithm calculation-type, defines the metric-type other than IGP metric and such metric is not advertised for the link in the reverse direction in a topology for which the computation is done, such link MUST be pruned from the computation. A metric of value 0 MUST NOT be assumed in such a case. This is the application of the rule (5), as specified in section 13 of [RFC9350], in a reverse direction.

5. IANA Considerations

5.1. IGP Algorithm Types Registry

This document defines a new algorithm type in the IANA "IGP Algorithm Types" registry defined under the "Interior Gateway Protocol (IGP) Parameters" registry. The "value" is suggested - to be assigned by IANA.

Value	Description
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2	Shortest Path First (SPF) algorithm based on reverse link metric. It's equivalent to standard (SPF) algorithm (IGP Algorithm Type 0), but uses the metric from the reverse direction of the link.

6. Security Considerations

This document inherits security considerations from the [RFC9350]

7. Normative References

[I-D.ietf-lsr-flex-algo-bw-con]

Hegde, S., Britto, W., Shetty, R., Decraene, B., Psenak, P., and T. Li, "IGP Flexible Algorithms: Bandwidth, Delay, Metrics and Constraints", Work in Progress, Internet-Draft, draft-ietf-lsr-flex-algo-bw-con-22, 13 February 2025, <<https://datatracker.ietf.org/doc/html/draft-ietf-lsr-flex-algo-bw-con-22>>.

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[RFC8665] Psenak, P., Ed., Previdi, S., Ed., Filsfils, C., Gredler, H., Shakir, R., Henderickx, W., and J. Tantsura, "OSPF Extensions for Segment Routing", RFC 8665, DOI 10.17487/RFC8665, December 2019, <<https://www.rfc-editor.org/info/rfc8665>>.

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