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       The Direction Field in Routing Metric/Constraint Objects Used in RPL
                    draft-goyal-roll-metrics-direction-00

Abstract

   This document specifies a Direction field in the Routing Metric/
   Constraint objects used in RPL operation in low power and lossy
   networks.

Status of this Memo

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1. Introduction

Asymmetric links are a common observation in low power and lossy
networks (LLNs) [sang_2010]. Many link-level routing metrics have a
directional aspect. Although such routing metrics can be defined in
a bidirectional manner so as to account for the link properties in
both directions, this is not always desirable. In the context of RPL
[I-D.ietf-roll-rpl], the IPv6 routing protocol for LLNs, it may be
necessary to measure a link-level routing metric in a particular
direction. For example, if the intent is to build a directional
acyclic graph (DAG) specifically for the purpose of low latency
communication to the DAG root, the routing metric must measure the
link latency in Up direction, i.e., towards the DAG root, as defined
in [I-D.ietf-roll-rpl]. Similarly, if a temporary DAG is being
constructed to discover a point-to-point route towards a destination
[I-D.ietf-roll-p2p-rpl], the routing metric must calculate the
relevant link characteristic in Down direction, i.e., away from the
DAG root, as defined in [I-D.ietf-roll-rpl]. Thus, there is a need
to specify the directional aspect of a link-level routing metric.

Accordingly, this document defines a Direction field inside the
Routing Metric/Constraint object header, defined in
[I-D.ietf-roll-routing-metrics]. The Direction field is defined in
two previously reserved bits inside the Routing Metric/Constraint
object header. The modified Routing Metric/Constraint object header
is backward compatible with its definition in
[I-D.ietf-roll-routing-metrics].

2. Terminology

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
[RFC2119].

Additionally, this document uses terminology from
[I-D.ietf-roll-terminology] and [I-D.ietf-roll-rpl]. Specifically,
the term RPL node refers to an RPL router or an RPL host as defined
in [I-D.ietf-roll-rpl].

3. The Direction Field

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Routing-MC-Type| Res | D |P|C|O|R| A   | Prec | Length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
//                        (object body)                         |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
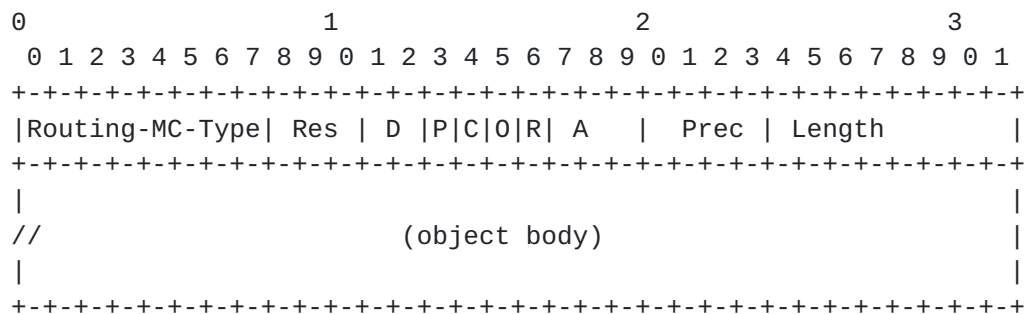
Figure 1: Routing Metric/Constraint object generic format

The modified Routing Metric/Constraint object header is illustrated
in Figure 1. The Direction (or D) field is a 2-bit field that
indicates the direction associated with the routing metric/
constraint:

o D = 0x00: undefined;

o D = 0x01: Up;

o D = 0x02: Down;

o D = 0x03: Bidirectional.

If the D field has value 0x00, the direction associated with the
routing metric/constraint is undefined as in
[I-D.ietf-roll-routing-metrics]. A value 0x00 for the D field may be
suitable for node-level routing metrics/constraints defined in
[I-D.ietf-roll-routing-metrics]. The D field value in link-level
routing metrics/constraints SHOULD NOT be set to 0x00.

This document does not specify how to measure/evaluate a routing
metric/constraint object in the direction specified by the D field.
The measurement/evaluation methodology for specific routing metrics/
constraints, taking in account the D field, may be specified in a
separate document.

A routing metric/constraint object MUST be measured/evaluated in
accordance with its D field value if defined. In case, an RPL node
can not measure/evaluate the routing metric/constraint object in the
specified direction, the following rules MUST be applied:

o If the object is a recorded metric, i.e., has C=0 and R=1 fields,
   the RPL node MUST set the P flag inside the object, thereby

indicating the partial nature of the recorded metric.

o If the object is an aggregated metric, i.e., has C=0 and R=0
   fields, the RPL node MUST drop the DIO containing the object.

o If the object is a mandatory constraint, i.e., has C=1 and O=0
   fields, the RPL node MUST drop the DIO containing the object.

o If the object is an optional constraint, i.e., has C=1 and O=1
   fields, the RPL node MAY drop the DIO containing the object or it
   MAY continue processing rest of the DIO ignoring this object.

4. Security Considerations

TBA

5. IANA Considerations

This document does not have any IANA considerations.

6. References

6.1. Normative References

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[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
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6.2. Informative References

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J., and C. Perkins, "Reactive Discovery of Point-to-Point Routes in Low Power and Lossy Networks", draft-ietf-roll-p2p-rpl-02 (work in progress), February 2011.

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