Mode of Operation extension
draft-jadhav-roll-mopex-02

Abstract

   RPL allows different mode of operations which allows nodes to have a
   consensus on the basic primitives that must be supported to join the
   network. The MOP field in [RFC6550] is of 3 bits and is fast
   depleting. This document extends the MOP for future use.

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1. **Introduction**

   RPL [RFC6550] specifies a proactive distance-vector based routing
   scheme. The protocol creates a DAG-like structure which operates
   with a given "Mode of Operation" (MOP) determining the minimal and
   mandatory set of primitives to be supported by all the participating
   nodes.

   MOP as per [RFC6550] is a 3-bit value carried in DIO messages and is
   specific to the RPL Instance. The receipient of the DIO message can
   join the specified network as a router only when it can support the
   primitives as required by the mode of operation value. For example,
   in case of MOP=3 (Storing MOP with multicast support) the nodes can
   join the network as routers only when they can handle the DAO
   advertisements from the peers and manage routing tables. The 3-bit
   value is already exhausted and requires replenishment. This document
   introduces a mechanism to extend mode of operation values.

1.1. **Requirements Language and Terminology**

   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 RFC 2119 [RFC2119].

MOP: Mode of Operation. Identifies the mode of operation of the RPL
Instance as administratively provisioned at and distributed by the
DODAG root.

MOPex: Extended MOP: This document extends the MOP values over a
bigger range. This extension of MOP is called MOPex.

DAO: DODAG Advertisement Object. An RPL message used to advertise
the target information in order to establish routing adjacencies.

DIO: DODAG Information Object. An RPL message initiated by the root
and is used to advertise the network configuration information.

Current parent: Parent 6LR node before switching to the new path.

This document uses terminology described in [RFC6550]. For the sake
of readability all the known relevant terms are repeated in this
section.

2. Requirements for this document

Following are the requirements considered for this documents:

REQ1: MOP extension. Current MOP of 3-bit is fast depleting. An
       MOP extension needs to extend the possibility of adding new
       MOPs in the future.

REQ2: Backwards compatibility. The new options and new fields in
       the DIO message should be backward compatible i.e. if there
       are nodes which support old MOPs they could still operate in
       their own instances.

3. Extended MOP Control Message Option

This document reserves existing MOP value 7 to be used as an
extender. DIO messages with MOP value of 7 may refer to the Extended
MOP (MOPex) option in the DIO message.

```
         0                   1                   2
         0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
        +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+---------------
        |   Type = TODO |  Opt Length   |    OP-value
        +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+---------------
```
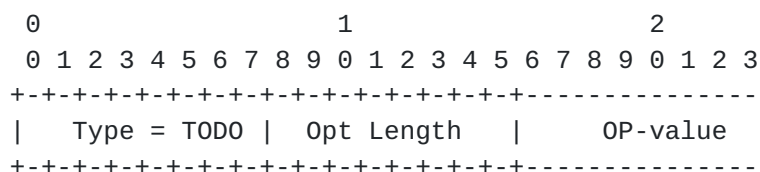
Figure 1: Extended MOP Option

The option length value MUST be less than or equal to 2. An option
length value of zero is invalid and the implementation MUST silently
ignore the DIO on receiving a value of zero.

3.1. Handling MOPex

The MOPex option MUST be used only if the base DIO MOP is 7. If the
base DIO MOP is 7 and if the MOPex option is not present then the DIO
MUST be silently ignored. If the base DIO MOP is less than 7 then
MOPex MUST NOT be used. In case the base MOP is 7 and if the MOPex
option is present, then the implementation MUST use the final MOP
value from the MOPex.

Note that [RFC6550] allows the node who does not support the received
MOP to still join the network as a leaf node. This semantic
continues to be true even in case of MOPex.

3.2. Use of values 0-6 in the MOPex option

The MOPex option could also be allowed to re-use the values 0-6,
which have been used for MOP so far. The use of current MOPs in
MOPex indicates that the MOP is supported with extended set of
semantics for e.g., the capability options
[I-D.ietf-roll-capabilities].

4. Implementation Considerations

[RFC6550], it was possible to discard an unsupported DIO-MOP just by
inspecting the base message. With this document, the MOPex is a
different control message option and thus the discarding of the DIO
message could happen after inspecting the message options.

5. Acknowledgements

6. IANA Considerations

6.1. Mode of operation: MOPex

IANA is requested to assign a new Mode of Operation, named "MOPex"
for MOP extension under the RPL registry. The value of 7 is to be
assigned from the "Mode of Operation" space [RFC6550]

```
+-------+------------+---------------+
| Value | Description |   Reference   |
+-------+------------+---------------+
|   7   |    MOPex   | This document |
+-------+------------+---------------+
```

                         Mode of Operation

6.2. New options: MOPex and Capabilities

   A new entry is required for supporting new option "MOPex" in the "RPL
   Control Message Options" space [RFC6550].

```
+-------+---------+---------------+
| Value | Meaning |   Reference   |
+-------+---------+---------------+
|  TBD1 |  MOPex  | This document |
+-------+---------+---------------+
```

                            New options

6.3. New Registry for Extended-MOP-value

   IANA is requested to create a registry for the extended-MOP-value
   (MOPex). This registry should be located in TODO. New MOPex values
   may be allocated only by an IETF review. Currently no values are
   defined by this document. Each value is tracked with the following
   qualities:

   o MOPex value

   o Description

   o Defining RFC

7. Security Considerations

   The options defined in this document are carried in the base message
   objects as defined in [RFC6550]. The RPL control message options are
   protected by the same security mechanisms that protect the base
   messages.

   Capabilities flag can reveal that the node has been upgraded or is
   running a old feature set. This document assumes that the base
   messages that carry these options are protected by RPL security
   mechanisms and thus are not visible to a malicious node.

8. References

8.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
           Requirement Levels", BCP 14, RFC 2119,
           DOI 10.17487/RFC2119, March 1997,
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[RFC6550] Winter, T., Ed., Thubert, P., Ed., Brandt, A., Hui, J.,
           Kelsey, R., Levis, P., Pister, K., Struik, R., Vasseur,
           JP., and R. Alexander, "RPL: IPv6 Routing Protocol for
           Low-Power and Lossy Networks", RFC 6550,
           DOI 10.17487/RFC6550, March 2012,
           <https://www.rfc-editor.org/info/rfc6550>.

8.2. Informative References

[I-D.ietf-roll-capabilities]
           Jadhav, R., Thubert, P., Richardson, M., and R. Sahoo,
           "RPL Capabilities", draft-ietf-roll-capabilities-00 (work
           in progress), February 2020.

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