          An Optimization for the Mobile Ad Hoc Network (MANET)
                 Neighborhood Discovery Protocol (NHDP)

Abstract

   The link quality mechanism of the Mobile Ad Hoc Network (MANET)
   Neighborhood Discovery Protocol (NHDP) enables "ignoring" some 1-hop
   neighbors if the measured link quality from that 1-hop neighbor is
   below an acceptable threshold while still retaining the corresponding
   link information as acquired from the HELLO message exchange. This
   allows immediate reinstatement of the 1-hop neighbor if the link
   quality later improves sufficiently.

   NHDP also collects information about symmetric 2-hop neighbors.
   However, it specifies that if a link from a symmetric 1-hop neighbor
   ceases being symmetric, including while "ignored" (as described
   above), then corresponding symmetric 2-hop neighbors are removed.
   This may lead to symmetric 2-hop neighborhood information being
   permanently removed (until further HELLO messages are received) if
   the link quality of a symmetric 1-hop neighbor drops below the
   acceptable threshold, even if only for a moment.

   This specification updates RFC 6130 "Mobile Ad Hoc Network (MANET)
   Neighborhood Discovery Protocol (NHDP)" and RFC 7181 "The Optimized
   Link State Routing Protocol Version 2 (OLSRv2)" to permit, as an
   option, retaining, but ignoring, symmetric 2-hop information when the
   link quality from the corresponding 1-hop neighbor drops below the
   acceptable threshold. This allows immediate reinstatement of the
   symmetric 2-hop neighbor if the link quality later improves
   sufficiently, thus making the symmetric 2-hop neighborhood more
   "robust".

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1. Introduction

   Section 14 of the MANET Neighborhood Discovery Protocol (NHDP)
   [RFC6130] contains a link admission mechanism known as "link quality"
   that allows a router using that protocol to "take considerations
   other than message exchange into account for determining when a link
   is and is not a candidate for being considered as HEARD or
   SYMMETRIC." Specifically, [RFC6130] permits a router to disallow
   consideration of some of its 1-hop neighbors for as long as the
   quality of the link from that 1-hop neighbor is below an acceptable
   link quality threshold.

   A feature of this mechanism is that while the link quality remains
   too low, the link information, established by the exchange of HELLO
   messages, is retained. Thus, if the link quality later goes above
   the required threshold (note that a hysteresis mechanism means that
   two thresholds are used), then the link is immediately established
   and will be immediately available for use.

   [RFC6130] collects not only 1-hop neighbor information, but also
   information about symmetric 2-hop neighbors. However, [RFC6130]
   specifies that if a 1-hop neighbor was, but no longer is, considered
   symmetric, then the corresponding 2-Hop Tuples that may have been
   recorded for that 2-hop neighbor are to be removed without a
   retention mechanism for a (possibly temporary) loss due to link
   quality.

   This means that if there is a short period in which link quality is
   too low, then when the link quality is re-established all 1-hop
   neighbor information is immediately available for use again.
   However, the corresponding symmetric 2-hop neighbor information has
   been removed and is not available for use until restored by receipt
   of the next corresponding HELLO message.

   This specification describes how [RFC6130] can be modified to avoid
   this situation by retaining (but not using) 2-hop information,
   similar to what is done with 1-hop information. This modification is
   strictly optional, and routers that do and do not implement it can
   interwork entirely successfully (as they also can with different link
   quality specifications). In addition, by a suitable interpretation
   (that ignored 2-Hop Tuples are not externally advertised), this
   change can be invisible to any other protocols using [RFC6130], in
   particular [RFC7181]. However, the impact on [RFC7181] when 2-Hop
   Tuples are not so handled is also described (owing to the existence
   of implementations of that protocol that are not modularly separated
   from [RFC6130]).

   This specification therefore updates [RFC6130] and [RFC7181].

This update to [RFC6130] does not change the definition of a
symmetric 2-hop neighbor but adds new state information to each 2-Hop
Tuple of [RFC6130]. This is to retain some 2-hop neighbor
information while recording it as currently not to be used. The new
state information and retained 2-Hop Tuples are reflected in the
corresponding tables of the updated NHDP-MIB module [NHDP-MIB].

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 the terminology of [RFC6130] and
   [RFC7181].

3. Applicability Statement

   This specification updates [RFC6130]. The optimization presented in
   this specification is simply permissive, as it allows retaining
   information that otherwise would have been removed but does not use
   that information except when it could have been used by [RFC6130].

   This can, in some cases, ensure that the symmetric 2-hop neighborhood
   is more robust against temporary link quality changes and
   consequently yields a more stable network. The only other
   consequence of this optimization is that state for some otherwise
   expired 2-Hop Tuples may be maintained for longer.

   This specification also updates [RFC7181]. This could have been
   avoided had instead [RFC6130] been updated so as to make the changes
   to it invisible to any other protocol using it. However, as it is
   known that some implementations of [RFC7181] are not independent of
   the implementation of [RFC6130] that they use, it is useful to
   indicate the direct impact on [RFC7181].

   A router that implements the optimization described in this
   specification will interoperate successfully with routers that
   implement [RFC6130] but do not implement this optimization.

4. Changes to NHDP

   The following changes are made to [RFC6130] if using this
   specification. Note that while this specification is OPTIONAL, if
   any of these changes are made, then all of these changes MUST be
   made.

4.1. Interface Information Bases

   The 2-Hop Set is modified by adding this additional element to each
   2-Hop Tuple:

      N2_lost is a boolean flag, which indicates the state of the
      corresponding Link Tuple. If L_status = SYMMETRIC (and thus
      L_lost = false), then N2_lost = false. If L_SYM_time has not
      expired, and L_lost = true (and hence L_status = LOST), then
      N2_lost = true.

   In all other cases, including other cases with L_status = LOST, there
   will be no such 2-Hop Tuples.

4.2. HELLO Message Processing

   In Section 12.6 of [RFC6130], make the following changes:

   o In point 2, change "L_status = SYMMETRIC" to "L_SYM_time not
      expired".

   o In point 2, point 1, point 1, under "then create a 2-Hop Tuple
      with:", add a second bullet point "N2_lost: = L_lost". (Note that
      "2-Hop Neighbor Tuple" has been corrected here to "2-Hop Tuple"
      per [Err4276].)

4.3. Information Base Changes

   In Section 13, replace the second bullet point with:

   o A Link Tuple's L_status changes from SYMMETRIC, L_SYM_time
      expires, or the Link Tuple is removed. In this case, the actions
      specified in Section 13.2 are performed.

   Replace the paragraph after the bullet points with:

   If a Link Tuple is removed, or if L_HEARD_time expires and either
   L_status changes from SYMMETRIC or L_SYM_time expires, then the
   actions specified in Section 13.2 MUST be performed before the
   actions specified in Section 13.3 are performed for that Link Tuple.

In Section 13.2 of [RFC6130], add the following before all other
text:

For each Link Tuple that has L_SYM_time not expired:

1. If L_SYM_time then expires, or if the Link Tuple is removed:

    1. Remove each 2-Hop Tuple for the same MANET interface with:

        + N2_neighbor_iface_addr_list contains one or more network
           addresses in L_neighbor_iface_addr_list.

2. If L_status then changes from SYMMETRIC to LOST because L_lost is
    set to true:

    1. For each 2-Hop Tuple for the same MANET interface with:

        + N2_neighbor_iface_addr_list contains one or more network
           addresses in L_neighbor_iface_addr_list;

        set N2_lost := true.

Also, in Section 13.2 of [RFC6130], remove point 1 and renumber point
2 as point 1.

4.4. Constraints

In Appendix B of [RFC6130], under "In each 2-Hop Tuple:", change the
first bullet point to:

o There MUST be a Link Tuple associated with the same MANET
   interface with:

   * L_neighbor_iface_addr_list = N2_neighbor_iface_addr_list; AND

   * L_SYM_time not expired; AND

   * L_lost = N2_lost.

5. Changes to OLSRv2

If the implementation of [RFC6130] conceals from any protocol using
it the existence of all 2-Hop Tuples with N2_lost = true, then no
changes are required to any protocol using [RFC6130]; in particular,
no changes are required to [RFC7181].

However, if instead the implementation of [RFC6130] makes all 2-Hop
Tuples visible, including those with N2_lost = true, then protocols
using [RFC6130] MUST ignore such 2-Hop Tuples.

For [RFC7181], given that this protocol uses 2-hop information for
Multipoint Relay (MPR) Set and Routing Set calculation but does not
include that information in control traffic, this means that an
implementation must be behaving (i) as if a 2-Hop Tuple only exists
if N2_lost=false and (ii) as if a change of N2_lost (from false to
true, or true to false) corresponds to a 2-Hop Tuple appearing or
being removed. Specifically, this means behaving as if all of the
following changes were to be made to [RFC7181]:

o In Section 17.6 of [RFC7181], point 1, replace the final two
   bullet points with:

   * A 2-Hop Tuple with N2_out_metric != UNKNOWN_METRIC and N2_lost
      = false is added or removed; OR

   * A 2-Hop Tuple with N2_out_metric != UNKNOWN_METRIC has N2_lost
      changed; OR

   * The N2_out_metric of any 2-Hop Tuple with N2_lost = false
      changes, and either the flooding MPR selection process uses
      metric values (see Section 18.4), or the change is to or from
      UNKNOWN_METRIC.

o In Section 17.6 of [RFC7181], point 3, replace the final two
   bullet points with:

   * A 2-Hop Tuple with N2_in_metric != UNKNOWN_METRIC and N2_lost =
      false is added or removed; OR

   * A 2-Hop Tuple with N2_in_metric != UNKNOWN_METRIC has N2_lost
      changed; OR

   * The N2_in_metric of any 2-Hop Tuple with N2_lost = false
      changes.

o In Section 17.7 of [RFC7181], in the fifth bullet point, add "and
   N2_lost = false" after "N2_out_metric != UNKNOWN_METRIC".

o In Section 18.4 of [RFC7181], in the third bullet point, add ",
   N2_lost = false" after "N2_out_metric != UNKNOWN_METRIC".

o In Section 18.5 of [RFC7181], in the third bullet point, add ",
   N2_lost = false" after "N2_in_metric != UNKNOWN_METRIC".

o In Section 19.1 of [RFC7181], in the final main bullet point
   (marked as "(OPTIONAL)"), add "and N2_lost = false" after
   "N2_out_metric != UNKNOWN_METRIC".

o In Appendix C.7 of [RFC7181], in point 1, add "and N2_lost =
   false" after "N2_out_metric != UNKNOWN_METRIC".

6. Security Considerations

   The update to [RFC6130] enables the retention and reuse of some
   information collected by that protocol, for only the duration that it
   could have been used in any case. As such, this protocol introduces
   no new security considerations to an implementation of [RFC6130] or
   of any other protocol that uses it, such as [RFC7181].

7. References

7.1. Normative References

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
               Requirement Levels", BCP 14, RFC 2119, March 1997,
               <http://www.rfc-editor.org/info/rfc2119>.

   [RFC6130]   Clausen, T., Dean, J., and C. Dearlove, "Mobile Ad Hoc
               Network (MANET) Neighborhood Discovery Protocol (NHDP)",
               RFC 6130, April 2011,
               <http://www.rfc-editor.org/info/rfc6130>.

   [RFC7181]   Clausen, T., Dearlove, C., Jacquet, P., and U. Herberg,
               "The Optimized Link State Routing Protocol Version 2", RFC
               7181, April 2014,
               <http://www.rfc-editor.org/info/rfc7181>.

7.2. Informative References

   [Err4276]   RFC Errata, Errata ID 4276, RFC 6130.

   [NHDP-MIB]
               Herberg, U., Cole, R., Chakeres, I., and T. Clausen,
               "Definition of Managed Objects for the Neighborhood
               Discovery Protocol", Work in Progress, draft-ietf-manet-
               rfc6779bis, August 2014.

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