    An Optimization for the MANET Neighborhood Discovery Protocol (NHDP)
                draft-dearlove-manet-nhdp-optimization-01

Abstract

   The link quality mechanism of the 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 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 NHDP, and the Optimized Link State Routing
   Protocol version 2 (OLSRv2) to permit 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

   The MANET Neighborhood Discovery Protocol (NHDP) [RFC6130], Section
   14, 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 just 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 reestablished, 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, in particular owing to
   the existence of implementations of that protocol that are not
   modularly separated from [RFC6130].

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

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 which 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 yield 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 be avoided by
   simply noting that this specification describes how the updates to
   [RFC6130] may be handled so as to be 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 = false (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 When creating a 2-Hop Tuple, set N2_lost := L_lost.

4.3. Information Base Changes

In Section 13, replace the second bullet point by:

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.

and replace the paragraph after the bullet points by:

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 2, renumbering point
   2 as point 1.

4.4. Constraints

   In Appendix B, 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
   MPR Set and Routing Set calculation, but not includes that
   information in control traffic, this means that an implementation
   must be (i) behaving 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. MIB Considerations

   This update to [RFC6130] does not change the definition of a
   symmetric 2-hop neighbor. It adds new information and states for
   each symmetric 2-hop neighbor, recorded in the Neighbor Information
   Base of a router and to be reflected in the appropriate tables of the
   corresponding NHDP-MIB module [RFC6779].

6.1. Updates to the State Group

   This update introduces, to the state of each 2-Hop Tuple, the boolean
   flag N2_lost. In order to reflect this, the updates in this section
   are to be made to the State Group (nhdpStateObjGrp) of the NHDP-MIB
   module [RFC6779].

   The DESCRIPTION of nhdpIib2HopSetEntry Object Type is to be updated,
   so as to read as follows:

       nhdpIib2HopSetEntry OBJECT-TYPE
           SYNTAX   NhdpIib2HopSetEntry
           MAX-ACCESS   not-accessible
           STATUS   current
           DESCRIPTION
               "nhdpIib2HopSetTable consists of 2-Hop Tuples, each
                representing a single network address of a symmetric
                2-hop neighbor and a single MANET interface of a
                symmetric 1-hop neighbor.

                (N2_neighbor_iface_addr_list,
                 N2_2hop_addr, N2_lost, N2_time).

                The entries include the 2-hop neighbor addresses, which
                act as the table index, and associated symmetric 1-hop
                neighbor address set, designated through nhdpDiscIfIndex,
                an expiration time, and a flag indicating if the 1-hop
                neighbor, through which this 2-hop neighbor is reachable,
                is considered lost due to link quality, or not.

                The nhdpIfIndex in the INDEX is the interface index of
                the local interface through which these 2-hop addresses
                are accessible. The nhdpDiscIfIndex in the INDEX
                represents the 1-hop neighbor interface through which
                these 2-hop neighbor addresses are reachable."
           REFERENCE
               "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
                Discovery Protocol (NHDP), Clausen, T., Dearlove,
                C., and J. Dean, April 2011"
           INDEX { nhdpIfIndex,
                   nhdpDiscIfIndex,
                   nhdpIib2HopSetIpAddressType,
                   nhdpIib2HopSetIpAddress
           }
           ::= { nhdpIib2HopSetTable 1 }

   The SEQUENCE of NhdpIib2HopSetEntry is to be updated, so as to read
   as follows:

```
        NhdpIib2HopSetEntry ::=
            SEQUENCE {
              nhdpIib2HopSetIpAddressType
                  InetAddressType,
              nhdpIib2HopSetIpAddress
                  InetAddress,
              nhdpIib2HopSetIpAddrPrefixLen
                  InetAddressPrefixLength,
              nhdpIib2HopSet1HopIfIndex
                  NeighborIfIndex,
              nhdpIib2HopSetN2Time
                  TimeStamp,
              nhdpIib2HopSetN2Lost
                  TruthValue
            }
```

   The nhdpIib2HopSetN2Lost OBJECT-TYPE is to be defined as follows:

```
        nhdpIib2HopSetN2Lost OBJECT-TYPE
            SYNTAX        TruthValue
            MAX-ACCESS    read-only
            STATUS        current
            DESCRIPTION
              "nhdpIib2HopSetN2Lost corresponds to N2_lost of NHDP and
               is a boolean flag, describing if for a 2-Hop Tuple, the
               corresponding Link Tuple currently is considered lost
               due to link quality."
            REFERENCE
              "draft-dearlove-manet-nhdp-optimization-01"
            ::= {nhdpIib2HopSetEntry 5}
```

6.2. Updates to the Notification Group

   This update introduces an additional state for each 2-Hop Tuple.
   Whereas [RFC6130] has two states for 2-Hop Tuples, 'up' (a 2-Hop
   Tuple exists) and 'down' (a 2-Hop Tuple expires), this update
   introduces a third state for a 2-Hop Tuple: it exists, but (due to
   the link quality of the link to the corresponding 1-Hop neighbor) is
   not currently considered.

   To reflect this, the SYNTAX and DESCRIPTION of nhdp2HopNbrState
   OBJECT-TYPE are to be updated, so as to read as follows:

```
         nhdp2HopNbrState  OBJECT-TYPE
            SYNTAX   INTEGER {
                        down(0),
                        up(1),
                        notconsidered(2)
                     }
            MAX-ACCESS   read-only
            STATUS       current
            DESCRIPTION
               "NHDP 2-hop neighbor states. In NHDP, it is not necessary
                to remove Protocol Tuples from Protocol Sets at the
                exact time indicated, only to behave as if the Protocol
                Tuples were removed at that time. This case is indicated
                here as 'down(0)'; otherwise, it is either 'up(1)', if
                N2_lost for the 2-Hop Tuple is equal to false, or
                'notconsidered(2)' otherwise."
            ::= { nhdpNotificationsStates 2 }
```

7. IANA Considerations

   This document has no actions for IANA.

   [This section may be removed by the RFC Editor.]

8. 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].

9. Acknowledgments

   The authors would like to thank Liz Cullen (BAE Systems) for first
   illustrating the issue addressed in this specification.

10. Normative References

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
               Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC6130]   Clausen, T., Dean, J., and C. Dearlove, "Mobile Ad Hoc
               Network (MANET) Neighborhood Discovery Protocol (NHDP)",

          RFC 6130, April 2011.

   [RFC6779] Herberg, U., Cole, R., and I. Chakeres, "Definition of
              Managed Objects for the Neighborhood Discovery Protocol",
              RFC 6779, October 2012.

   [RFC7181] Clausen, T., Dearlove, C., Jacquet, P., and U. Herberg,
              "The Optimized Link State Routing Protocol version 2",
              RFC 7181, April 2014.

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