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Definition of Managed Objects for the Neighborhood Discovery Protocol
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Status of This Memo

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Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes objects for configuring aspects of the Neighborhood Discovery Protocol (NHDP) process on a router. The NHDP MIB also reports state information, performance information and notifications. This additional state and performance information is useful to management stations troubleshooting neighbor discovery problems.

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1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes objects for configuring aspects of the Neighborhood Discovery Protocol (NHDP) [NHDP] process on a router. The NHDP MIB also reports state information, performance information and notifications. This additional state and performance information is useful to management stations troubleshooting neighbor discovery problems.

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

3. Conventions

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].

4. Overview

The NHDP protocol allows routers in a Mobile Ad-Hoc Network (MANET) setting to discover and track one-hop and two-hop neighbor sets. This information is useful for routers running various routing and multicast flooding protocols developed within the IETF MANET Working Group.

4.1. Terms

The following definitions apply throughout this document:

- Configuration Objects - switches, tables, objects which are initialized to default settings or set through the management interface defined by this MIB.

- Tunable Configuration Objects - objects whose values affect timing or attempt bounds on the NHDP protocol.

- State Objects - automatically generated values which define the current operating state of the NHDP protocol process in the router.

- Performance Objects - automatically generated values which help an administrator or automated tool to assess the performance of the NHDP protocol process on the router and the overall discovery performance within the NHDP domain.

4.2. Organization

This document is organized as ...

5. Structure of the MIB Module

This section presents the structure of the NHDP MIB module. The MIB is arranged into the following structure:

- nhdpNotifications - objects defining NHDP MIB notifications.

- nhdpObjects - defining objects within this MIB. The objects are arranged into the following groups:

-

  * General Information Group - defining objects of a general nature, e.g., version numbers.

  * Configuration Group - defining objects related to the configuration of the NHDP instance on the device.

  * State Group - defining objects which reflect the current state of the NHDP running on the device.

  * Performance Group - defining objects which are useful to a management station when characterizing the performance of the NHDP on the device and in the MANET.

- nhdpConformance - defining the minimal and maximal conformance requirements for implementations of this MIB.

5.1. Textual Conventions

This section is TBD.

5.2. The General Information Group

This section provides general information about the capabilities of the device running the NHDP. This group is currently empty and will be removed in future drafts if no objects are identified.

5.3. The Configuration Group

The device is configured with a set of controls. These will serve as the object descriptions once they are discussed and refined. The list of configuration controls for the NHDP-MIB (found in [ietf-manet-nhdp]), are discussed in the following subsections.

5.3.1. Interface Parameters

The Interface Parameters include:

5.3.1.1. Message Intervals

- HELLO_INTERVAL - is the maximum time between the transmission of two successive HELLO messages on this MANET interface. If using periodic transmission of HELLO messages, these SHOULD be at a separation of HELLO_INTERVAL, possibly modified by jitter as specified in [XXX].

- HELLO_MIN_INTERVAL - is the minimum interval between transmission of two successive HELLO messages, on this MANET interface. (This minimum interval MAY be modified by jitter, as defined in [XXX].)

- REFRESH_INTERVAL - is the maximum interval between advertisements in a HELLO message of each 1-hop neighbor address and its status. In all intervals of length REFRESH_INTERVAL, a router MUST include all 1-hop neighbor information which it is specified as sending in at least one HELLO message on this MANET interface.

The following constraints apply to these interface parameters:

- HELLO_INTERVAL > 0

- HELLO_MIN_INTERVAL >= 0

- HELLO_INTERVAL >= HELLO_MIN_INTERVAL

- REFRESH_INTERVAL >= HELLO_INTERVAL

- If INTERVAL_TIME message TLVs as defined in [XXX] are included in HELLO messages, then HELLO_INTERVAL MUST be representable as described in [XXX].

- If REFRESH_INTERVAL > HELLO_INTERVAL, then a router may distribute its neighbor advertisements between HELLO messages in any manner, subject to the constraints above.

- For a router to employ this protocol in a purely responsive manner on a MANET interface, REFRESH_INTERVAL and HELLO_INTERVAL SHOULD both be set to a value such that a responsive HELLO message is always expected in a shorter period than this.

The following default values are recommended:

- HELLO_INTERVAL = 2 seconds

- HELLO_MIN_INTERVAL = HELLO_INTERVAL/4

- REFRESH_INTERVAL = HELLO_INTERVAL

5.3.1.2. Information Validity Times

Parameters related to the Information Validity Times include:

- L_HOLD_TIME - is the period of advertisement, on this MANET interface, of former 1-hop neighbor addresses as lost in HELLO messages, allowing recipients of these HELLO messages to accelerate removal of information from their Link Sets. L_HOLD_TIME can be set to zero if accelerated information removal is not required.

- H_HOLD_TIME - is used as the value in the VALIDITY_TIME message TLV included in all HELLO messages on this MANET interface.

The following constraints apply to these interface parameters:

- L_HOLD_TIME >= 0

- H_HOLD_TIME >= REFRESH_INTERVAL

- If HELLO messages can be lost then both SHOULD be significantly greater than REFRESH_INTERVAL.

- H_HOLD_TIME MUST be representable as described in [XXX].

- o H_HOLD_TIME = 3 x REFRESH_INTERVAL
- o L_HOLD_TIME = H_HOLD_TIME
- o N_HOLD_TIME = L_HOLD_TIME
- o I_HOLD_TIME = N_HOLD_TIME

5.3.1.3. Link Quality

Parameters related to the Link Quality include:

- o HYST_ACCEPT - is the link quality threshold at or above which a link becomes usable, if it was not already so.
- o HYST_REJECT - is the link quality threshold below which a link becomes unusable, if it was not already so.
- o INITIAL_QUALITY - is the initial quality of a newly identified link.
- o INITIAL_PENDING - if true, then a newly identified link is considered pending, and is not usable until the link quality has reached or exceeded the HYST_ACCEPT threshold.

The following constraints apply to these interface parameters:

- o 0 < = HYST_REJECT < = HYST_ACCEPT < = 1
- o 0 < = INITIAL_QUALITY < = 1.
- o If link quality is not updated, then INITIAL_QUALITY >= HYST_ACCEPT.
- o If INITIAL_QUALITY => HYST_ACCEPT, then INITIAL_PENDING == false.
- o If INITIAL_QUALITY < HYST_REJECT, then INITIAL_PENDING == true.

Link quality is a mechanism whereby a router MAY 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. Link quality is used only locally by a router, and routers may fully inter-operate whether they are using the same, different or no link quality methods.

NHDP can be operated when the local router does not implement Link Quality. In order for a router to not employ link quality, the router MUST define:

- o INITIAL_PENDING = false

- o INITIAL_QUALITY >= HYST_REJECT (there is no reason not to define INITIAL_QUALITY = 1).

If link quality is changed, then parameter values will depend on the link quality process. If link quality is not changed, then:

- o HYST_ACCEPT = 1

- o HYST_REJECT = 0

- o INITIAL_QUALITY = 1

- o INITIAL_PENDING = false

5.3.1.4. Jitter

If jitter, as defined in [XXX], is used then these parameters are as follows:

- o HP_MAXJITTER - represents the value of MAXJITTER used in [XXX] for periodically generated HELLO messages on this MANET interface.

- o HT_MAXJITTER - represents the value of MAXJITTER used in [XXX] for externally triggered HELLO messages on this MANET interface.

For constraints on these interface parameters see [XXX].

The following default values are recommended:

- o HP_MAXJITTER = HELLO_INTERVAL/4

- o HT_MAXJITTER = HP_MAXJITTER

- o C = 1/1024 second

5.3.2. Router Parameters

The following Router Parameters apply:

5.3.2.1. Information Validity Time

- o N_HOLD_TIME - is used as the period during which former 1-hop neighbor addresses are advertised as lost in HELLO messages, allowing recipients of these HELLO messages to accelerate removal of information from their 2-Hop Sets. N_HOLD_TIME can be set to zero if accelerated information removal is not required.

- o I_HOLD_TIME - is the period for which a recently used local interface address is recorded.

The following constraints applies to these router parameters:

- o N_HOLD_TIME >= 0
- o I_HOLD_TIME >= 0

5.3.3. Parameter Change Constraints

These parameters may be made dynamic:

- o HELLO_INTERVAL
- o REFRESH_INTERVAL
- o HYST_ACCEPT and HYST_REJECT
- o L_HOLD_TIME
- o N_HOLD_TIME
- o HP_MAXJITTER
- o HT_MAXJITTER

5.4. The State Group

The State Subtree reports current state information, including neighbor tables. These are separately discussed below.

(Note: these will serve as the object descriptions once they are discussed and refined.)

The Local Information Base (LIB), contains the addresses of the interfaces (MANET and non-MANET) of this router. The contents of this Information Base are not changed by signaling. The LIB contains two tables:

- o The "Local Interface Set", which consists of Local Interface Tuples, each of which records the addresses of an interface (MANET or non- MANET) of the router.
- o The "Removed Interface Address Set", which consists of Removed Interface Address Tuples, each of which records a recently used address of an interface (MANET or non-MANET) of the router. A router’s Removed Interface Address Set records addresses which

were recently local interface addresses. If a router's interface addresses are immutable then this set is always empty and MAY be omitted.

The Interface Information Based (IIB), recording information regarding links to this MANET interface and symmetric 2-hop neighbors which can be reached through such links. The IIB contains two tables:

- A "Link Set", which records information about current and recently lost links between this interface and MANET interfaces of 1-hop neighbors. The Link Set consists of Link Tuples, each of which contains information about a single link. Recently lost links are recorded so that they can be advertised in HELLO messages, accelerating their removal from relevant 1-hop neighbors' Link Sets. Link quality information, if used and available, is recorded in Link Tuples and may indicate that links are treated as lost.

- A "Two-Hop Set", which records the existence of bidirectional links between symmetric 1-hop neighbors of this MANET interface and other routers (symmetric 2-hop neighbors). The 2-Hop Set consists of 2-Hop Tuples, each of which records an interface address of a symmetric 2-hop neighbor, and all interface addresses of the corresponding symmetric 1-hop neighbor. The 2-Hop Set is updated by the signaling of this protocol, but is not itself reported in that signaling.

The Neighbor Information Base (NIB), records information regarding current and recently lost 1-hop neighbors of this router. The NIB contains two tables:

- The "Neighbor Set", and

- The "Lost Neighbor Set".

5.5. The Performance Group

The Performance Group reports values relevant to system performance. This section lists objects for NHDP performance monitoring, some of which explicitly appear in the NHDP-MIB and others which are obtainable through a combination of base objects from this MIB and reports available through the REPORT-MIB [REPORT]. Throughout this section those objects will be pointed out that are intended as base objects which will be explicitly defined within this MIB and those objects which are derived through a combination of the base objects and capabilities afforded by the REPORT-MIB.

The objects described in the following can be useful for determining certain properties of the NHDP instance. Notably unstable neighbors or 2-hop neighbors and frequent changes of sets can have a negative influence on the performance of NHDP. The following objects thus allow to acquire information related to the stability and performance of NHDP:

The following objects return some of the statistics related to HELLO messages:

- Total number of sent HELLO messages on an interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageXmits

  Object type: Counter32

- Total number of received HELLO messages on an interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageRecvd

  Object type: Counter32

- Total number of sent periodic HELLO messages on an interface

  This is a Base Object.

  Object name: nhdpIfHelloMessagePeriodicXmits

  Object type: Counter32

- Total number of sent triggered HELLO messages on an interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageTriggeredXmits

  Object type: Counter32

- Acquire history of HELLO message scheduling instance for the given time duration on an interface

This object returns the history of the exact timestamps of each HELLO message that has been sent as well as the type of the message (triggered or periodical). The list of events starts at the given point of time t0 and ends at the given time t1.

This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

Object name: nhdpMessageSchedulingHistory

Object type: SEQUENCE OF (TimeStamp, nhdpMessageType)

- Histogram of the intervals between HELLO messages on an interface

  Returns the values (in a 2-dimensional array) that represent a histogram of intervals between HELLO messages, separated by periodic and triggered HELLOs. The histogram displays the distribution of intervals between two consecutive HELLOs of the same type (triggered or periodical) using a given bin size. It includes all HELLOs that have been sent after the given time t0 and before the given time t1.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpMessageSchedulingHistogram

  Object type: SEQUENCE OF (nhdpMessageType, TimeTicks, Unsigned32)

- Changes of the frequency of the message scheduling on an interface

  This object will divide the given time interval from t0 to t1 into a given number of equal parts. It then creates a histogram for each part and calculate the distances (using the Bhattacharyya distance) between each two adjacent histograms in time. A higher value between two histograms means more difference between the histograms. For instance, that could happen if suddenly many triggered HELLO messages are sent, whereas before there have been only very few such triggered messages.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

Object name: nhdpMessageSchedulingFrequencyChanges

Object type: SEQUENCE OF (nhdpMessageType, TimeStamp, Float32)

- Average number of sent HELLO messages per second between the given time t0 and t1 on an interface

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpHelloSentPerSecondCount

  Object type: Float32

- Average number of received HELLO messages per second on an interface between the given time t0 and t1

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpHelloReceivedPerSecondCount

  Object type: Float32

- Total accumulated size in octets of sent HELLO messages on an interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageXmitAccumulatedSize

  Object type: Counter32

- Total accumulated size in octets of received HELLO messages on an interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageRecvdAccumulatedSize

  Object type: Counter32

- Average size in octets of sent HELLO messages per second between the given time t0 and t1 on an interface

This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

Object name: nhdpHelloSentPerSecondOctets

Object type: Float32

- Average size in octets of received HELLO messages per second between the given time t0 and t1 on an interface

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpHelloReceivedPerSecondOctets

  Object type: Float32

- Total accumulated number of advertized symmetric neighbors in HELLOs on that interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount

  Object type: Counter32

- Total accumulated number of advertized heard neighbors in HELLOs on that interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount

  Object type: Counter32

- Total accumulated number of advertized lost neighbors in HELLOs on that interface

  This is a Base Object.

  Object name: nhdpIfHelloMessageXmitAccumulatedLostNeighborCount

  Object type: Counter32

- Number of expected packets from a given neighbor based on the packet sequence number on an interface

  This is a Base Object.

  Object name: nhdpDiscIfExpectedPackets

  Object type: Counter32

- Success rate of received HELLOs (number of received_HELLOs divided by number of expected packets based on the packet sequence number)

  This is a Base Object.

  Object name: nhdpDiscIfRevdPackets

  Object type: Counter32

The following objects inspect the frequency of all Neighbor Set changes:

- Number of Neighbor Set changes

  This object counts each Neighbor Set change. A change occurs whenever a new Neighbor Tuple has been added, a Neighbor Tuple has been removed or any entry of a Neighbor Tuple has been modified.

  This is a Base Object.

  Object name: nhdpNibNeighborSetChanges

  Object type: Counter32

- Acquire history of Neighbor Set changes

  This object returns the history of the exact timestamps of each time the Neighbor Set has been changed.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborChangeHistory

  Object type: SEQUENCE OF TimeStamp

- Histogram of the intervals between Neighbor Set changes

  Returns the values (in a 2-dimensional array) that represent a histogram of intervals between Neighbor Set changes.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborChangeHistogram

  Object type: SEQUENCE OF (TimeTicks, Unsigned32)

- Changes of the frequency of the Neighbor Set changes

  This object will divide the given time interval from t0 to t1 into a given number of equal parts. It then creates a histogram for each part and calculate the distances (using the Bhattacharyya distance) between each two adjacent histograms in time. A higher value between two histograms means more difference between the histograms.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborChangeFrequencyChanges

  Object type: SEQUENCE OF (TimeStamp, Float32)

The next objects examine the uptime of a given neighbor:

- Number of changes of a Neighbor Tuple

  Returns the number of changes to the given Neighbor Tuple.

  This is a Base Object.

  Object name: nhdpDiscNeighborNibNeighborSetChanges

  Object type: Counter32

- Neighbor uptime

  Returns the number of milliseconds since the Neighbor Tuple corresponding to the given neighbor exists.

This is a Base Object.

Object name: nhdpDiscNeighborNibNeighborSetUpTime

Object type: Unsigned32

- Acquire history of change of onlink status of a given neighbor

  This object returns the history of the exact timestamps of each time the neighbor becomes onlink or offlink. A neighbor is said to become "onlink" if a new Neighbor Tuple is created that corresponds to the given neighbor. It becomes "offlink" if such a tuple has been deleted.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborStatusHistory

  Object type: SEQUENCE OF TimeStamp

- Histogram of the intervals between a change of the onlink status of a given neighbor

  Returns the values that represent a histogram of intervals between a change of the onlink status of a given neighbor. The histogram includes all changes that have been made after the given time t0 and before the given time t1.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborStatusHistogram

  Object type: SEQUENCE OF (TimeTicks, Unsigned32)

The following objects examine the stability of a neighbor. A neighbor is said to be unstable if it "flaps" frequently between several links. It is said to be stable if the set of Link Tuples that correspond to the given neighbor is stationary.

- Count the changes of the interface over which a given neighbor can be reached.

  This object counts each time the neighbor changes the interface over which it is reachable. That means that the corresponding Link Tuple of the given link moves from the Link Set of one interface to another interface.

This is a Base Object.

Object name: nhdpDiscNeighborNibNeighborSetReachableLinkChanges

Object type: Counter32

- Acquire history of changes of the interface over which a given neighbor can be reached.

  This object returns the history of the exact timestamps of each time the neighbor changes the interface over which it is reachable. That means that the corresponding Link Tuple of the given link moves from the Link Set of one interface to another interface.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborIfChangeHistory

  Object type: SEQUENCE OF (TimeStamp)

- Histogram of the intervals between a change of the interface over which a given neighbor is reachable

  Returns the values that represent a histogram of intervals between a change of the interface over which a given neighbor is reachable after the given time t0 and before the given time t1.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpNeighborIfChangeHistogram

  Object type: SEQUENCE OF (TimeTicks, Unsigned32))

The following objects inspect the stability of a given 2-hop neighbor:

- Count the changes of the N2_neighbor_iface_addr_list of a given 2-hop neighbor

  This object returns the count of the times the 2-hop neighbor changes its N2_neighbor_iface_addr_list, i.e. the neighbor over which it is reachable.

This is a Base Object.

Object name: nhdpIib2HopSetPerfChanges

Object type: Counter32

- Acquire history of changes of the N2_neighbor_iface_addr_list of a given 2-hop neighbor (Note: Not sure what the Base Object is for this set and not clear how to capture in the REPORT-MIB.)

  This object returns the history of the exact timestamps of each time the 2-hop neighbor changes its N2_neighbor_iface_addr_list, i.e. the neighbor over which it is reachable.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpN2ReachabilityChangeHistory

  Object type: SEQUENCE OF (TimeStamp)

- Histogram of the intervals between a change of a 2-hop neighbor’s N2_neighbor_iface_addr_list

  Returns the values that represent a histogram of intervals between a change of the 2-hop neighbor’s N2_neighbor_iface_addr_list after the given time t0 and before the given time t1.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpN2ReachabilityChangeHistogram

  Object type: SEQUENCE OF (TimeTicks, Unsigned32)

The next objects examine the uptime of a given 2-hop neighbor:

- 2-hop Neighbor uptime

  Returns the number of milliseconds since the 2-Hop Tuple corresponding to the given 2-hop neighbor IP address exists.

  This is a Base Object.

Object name: nhdpIib2HopSetPerfUpTime

Object type: Unsigned32

- Acquire history of change of onlink status of a given 2-hop neighbor

  This object returns the history of the exact timestamps of each time the 2-hop neighbor becomes onlink or offlink. A 2-hop neighbor is said to become "onlink" if a new 2-hop Tuple is created that corresponds to the given 2-hop neighbor. It becomes "offlink" if such a tuple has been deleted.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpN2StatusHistory

  Object type: SEQUENCE OF (TimeStamp)

- Histogram of the intervals between a change of the onlink status of a given 2-hop neighbor

  Returns the values that represent a histogram of intervals between a change of the onlink status of a given 2-hop neighbor. The histogram includes all changes that have been made after the given time t0 and before the given time t1.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpN2StatusHistogram

  Object type: SEQUENCE OF (TimeTicks, Unsigned32)

If Link Quality is used, the following object provides information about the link quality of a given link:

- Acquire history of the values of the link quality of a given link between a given time t0 and t1.

  This is a Derived Object to be pulled from the REPORT-MIB. It is derived from the XXX Base Object.

  Object name: nhdpLinkQualityHistory

Object type: SEQUENCE OF (nhdpNibNeighborSetRouterId, TimeStamp, Float32)

6. The Notifications

The Notifications Subtree contains the list of notifications supported within the NHDP MIB and their intended purpose or utility. This group is currently empty, pending further discussion.

7. Relationship to Other MIB Modules

[TODO]: The text of this section specifies the relationship of the MIB modules contained in this document to other standards, particularly to standards containing other MIB modules. Definitions imported from other MIB modules and other MIB modules that SHOULD be implemented in conjunction with the MIB module contained within this document are identified in this section.

7.1. Relationship to the SNMPv2-MIB

The 'system' group in the SNMPv2-MIB [RFC3418] is defined as being mandatory for all systems, and the objects apply to the entity as a whole. The 'system' group provides identification of the management entity and certain other system-wide data. The NHDP-MIB does not duplicate those objects.

7.2. Relationship to the IF-MIB

[TODO] This section is included as an example; If the MIB module is not an adjunct of the Interface MIB, then this section should be removed.

7.3. MIB modules required for IMPORTS

[TODO]: Citations are not permitted within a MIB module, but any module mentioned in an IMPORTS clause or document mentioned in a REFERENCE clause is a Normative reference, and must be cited someplace within the narrative sections. If there are imported items in the MIB module, such as Textual Conventions, that are not already cited, they can be cited in text here. Since relationships to other MIB modules should be described in the narrative text, this section is typically used to cite modules from which Textual Conventions are imported.

The following NHDP MIB module IMPORTS objects from SNMPv2-SMI [RFC2578], SNMPv2-TC [RFC2579], SNMPv2-CONF [RFC2580], and IF-MIB [RFC2863]

8. Definitions

```
NHDP-MIB DEFINITIONS ::= BEGIN

-- This MIB is currently in a very initial stage.
-- Not all proposed objects have been identified yet
-- in the current draft.  The MIB have not been
-- formally checked by any MIB checkers yet.

IMPORTS

    Float32
                FROM SMIng  --[RFC3781]

    MODULE-IDENTITY, OBJECT-TYPE, Counter32,
    Integer32, Unsigned32, mib-2
                FROM SNMPv2-SMI  --[RFC2578]

    TEXTUAL-CONVENTION, StorageType, TimeStamp,
    TruthValue, RowStatus
                FROM SNMPv2-TC  --[RFC2579]

    MODULE-COMPLIANCE, OBJECT-GROUP
                FROM SNMPv2-CONF  --[STD58]

    InetAddressType, InetAddress,
    InetAddressPrefixLength
                FROM INET-ADDRESS-MIB  --[RFC3291]

    InterfaceIndexOrZero
                FROM IF-MIB  --[RFC2863]
    ;

nhdpMIB MODULE-IDENTITY
       LAST-UPDATED "200910211000Z" -- October 21,2009
       ORGANIZATION "IETF MANET working group"
       CONTACT-INFO
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```
      DESCRIPTION
          "This NHDP MIB module is applicable to devices
           implementing the Neighborhood Discovery Protocol
           defined in [XXX].

           Copyright (C) The IETF Trust (2009). This version
           of this MIB module is part of RFC xxxx; see the RFC
           itself for full legal notices."

      -- revision
      REVISION    "200910211000Z"   -- October 21, 2009
      DESCRIPTION
        "The fourth version of this MIB module,
         published as draft-ietf-manet-nhdp-mib-01.txt.
         Added objects pertaining to the performance
         group."
      REVISION    "200905031500Z"   -- May 3, 2009
      DESCRIPTION
        "The third version of this MIB module,
         published as draft-ietf-manet-nhdp-mib-00.txt.
         No major revisions to this draft.  Mainly rev'd
         as a new working group document.  But also cleaned
         syntax errors, typos and other issues discovered
         with 'smilint'."
```

```
       REVISION    "200902151500Z"   -- February 15, 2009
       DESCRIPTION
         "The second version of this MIB module,
          published as draft-cole-manet-nhdp-mib-01.txt.  Major
          update adding objects for configuration and state."
       REVISION    "200804251500Z"   -- April 25, 2008
       DESCRIPTION
         "The original version of this MIB module,
          published as draft-cole-manet-nhdp-mib-00.txt."
       -- RFC-Editor assigns XXXX
       ::= { mib-2 998 }   -- to be assigned by IANA

--
-- Top-Level Components of this MIB
--
nhdpNotifications OBJECT IDENTIFIER ::= { nhdpMIB 0 }
nhdpObjects       OBJECT IDENTIFIER ::= { nhdpMIB 1 }
nhdpConformance   OBJECT IDENTIFIER ::= { nhdpMIB 2 }


--
-- Textual Conventions
--

NeighborIfIndex ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS       current
    DESCRIPTION
        "A locally arbitrary unique identifier associated with an
        NHDP neighbor interface.

        All objects of type NeighborIfIndex are assigned by the agent
        out of a common number space. In other words, NeighborIfIndex
        values assigned to entries in one table must not overlap with
        NeighborIfIndex values assigned to entries in another
        table.

        The NeighborIfIndex defines a discovered interface of a 1-hop
        or 2-hop neighbor of the local router.  The agent identifies a
        unique neighbor interface through the reciept of an address
        list advertised through an NHDP HELLO message.

        The value for each discovered neighbor interface must remain
        constant at least from one re-initialization of the entity's
        network management system to the next re-initialization, except
        that if an application is deleted and re-created.

        The specific value is meaningful only within a given SNMP
```

```
        entity. An NeighborIfIndex value must not be re-used until the
        next agent restart."
    SYNTAX       Unsigned32 (1..2147483647)


NeighborRouterId ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS       current
    DESCRIPTION
        "A locally arbitrary unique identifier associated with an
        NHDP discovered peer router.

        All objects of type NeighborRouterId are assigned by the agent
        out of a common number space.

        The NeighborRouterId defines a discovered NHDP peer of
        the local router.  The agent identifies a
        unique neighbor through the reciept of an address
        list advertised through an NHDP HELLO message and the
        associated  .....

        The value for each discovered neighbor ID must remain
        constant at least from one re-initialization of the entity's
        network management system to the next re-initialization, except
        that if an application is deleted and re-created.

        The specific value is meaningful only within a given SNMP
        entity. An NeighborRouterId value must not be re-used until the
        next agent restart."
    SYNTAX       Unsigned32 (1..2147483647)



--
-- nhdpObjects
--

--    General Objects Group - ...
--    Configuration Objects Group - ...
--    State Objects Group - ...
--    Performance Objects Group - ...


--
-- nhdpGeneralObjGrp
--

--    Note: These objects apply globally to the router's
```

```
--    NHDP process.

nhdpGeneralObjGrp  OBJECT IDENTIFIER ::= { nhdpObjects 1 }

  --(proposed object list here.)







--
-- nhdpConfigurationObjGrp
--

-- Contains the NHDP objects which configure specific options
-- which determine the overall performance and operation of the
-- discovery protocol.

nhdpConfigurationObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 2 }


   nhdpInterfaceTable  OBJECT-TYPE
      SYNTAX      SEQUENCE OF NhdpInterfaceEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The NHDP Interface Table describes the
          configuration of the interfaces of this NHDP device.
          The ifIndex is from the interfaces group
          defined in the Interfaces Group MIB.

          The object 'nhdpIfStatus' provides the functionality
          expected by the NHDP in the Local Interface Base (LIB)
          Local Interface Set Table.  Hence, the Local Interface
          Set Table will not be defined below."
      REFERENCE
         "RFC 2863 - The Interfaces Group MIB, McCloghrie,
          K., and F. Kastenholtz, June 2000."
   ::= { nhdpConfigurationObjGrp 1 }

   nhdpInterfaceEntry OBJECT-TYPE
      SYNTAX      NhdpInterfaceEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
```

```
         "The NHDP interface entry describes one NHDP
          local interface configuration as indexed by
          its ifIndex as defined in the Standard MIB II
          Interface Table (RFC2863)."
      INDEX { nhdpIfIndex }
   ::= { nhdpInterfaceTable 1 }

   NhdpInterfaceEntry ::=
      SEQUENCE {
         nhdpIfIndex
            InterfaceIndexOrZero,
         nhdpIfStatus
            TruthValue,
         nhdpHelloInterval
            Unsigned32,
         nhdpHelloMinInterval
            Unsigned32,
         nhdpRefreshInterval
            Unsigned32,
         nhdpLHoldTime
            Unsigned32,
         nhdpHHoldTime
            Unsigned32,
         nhdpHystAcceptQuality
            Unsigned32,
         nhdpHystRejectQuality
            Unsigned32,
         nhdpInitialQuality
            Unsigned32,
         nhdpInitialPending
            Unsigned32,
         nhdpHpMaxJitter
            Unsigned32,
         nhdpHtMaxJitter
            Unsigned32,
         nhdpNHoldTime
            Unsigned32,
         nhdpIHoldTime
            Unsigned32,
         nhdpIfRowStatus
            RowStatus
         }

   nhdpIfIndex  OBJECT-TYPE
      SYNTAX      InterfaceIndexOrZero
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
```

```
         "The ifIndex for this NHDP device interface."
      ::= { nhdpInterfaceEntry 1 }

   nhdpIfStatus  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhpdIfStatus indicates the current status of
          this NHDP device's interface with respect to
          supporting the NHDP protocol. A value of true(1) indicates
          that the interface is currently running the NHDP
          protocol.  A value of false(2) indicates that the interface
          is currently not running the NHDP protocol."
      REFERENCE
         "RFC XXXX - ."
      DEFVAL { 2 }
   ::= { nhdpInterfaceEntry 2 }

   -- Interface Parameters - Message Intervals

   nhdpHelloInterval  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhpdHelloInterval ..."
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 2 }
   ::= { nhdpInterfaceEntry 3 }

   -- Note: would like DEFVAL = nhdpHelloInterval
   nhdpHelloMinInterval  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhpdHelloMinInterval ...
          The default value for this object is
          equal to the nhdpHelloInterval"
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
```

```
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 4 }

   -- Note: would like DEFVAL = nhdpHelloInterval
   nhdpRefreshInterval  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhpdRefreshInterval ...
          The default bvalue for the nhdpRefreshInterval
          is equal fo the nhdpHelloInterval."
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 5 }

   -- Interface Parameters - Information Validity times

   nhdpLHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The L_HOLD_TIME is used to define the time
          for which a recently used and replaced
          originator address is used to recognize
          the router's own messages.

          The following constraint applies to this
          parameter: olsrv2OHoldTime >= 0"
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 6 }

   nhdpHHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
```

```
      DESCRIPTION
         "The H_HOLD_TIME is used to define the time
          for which a recently used and replaced
          originator address is used to recognize
          the router's own messages.

          The following constraint applies to this
          parameter: olsrv2OHoldTime >= 0"
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 7 }

   -- Interface Parameters - Link Quality
   -- (is optional and settings define operation)

   nhdpHystAcceptQuality  OBJECT-TYPE
      SYNTAX      Unsigned32 (0..255)
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpHystAcceptQuality is the
          link quality threshold at or above
          which a link becomes usable,
          if it was not already so.

          The following constraint   "
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 8 }

   nhdpHystRejectQuality  OBJECT-TYPE
      SYNTAX      Unsigned32 (0..255)
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpHystRejectQuality is the
          link quality threshold below which
          a link becomes unusable, if it
          was not already so.

          The following constraint   "
      REFERENCE
```

```
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 9 }

   nhdpInitialQuality  OBJECT-TYPE
      SYNTAX      Unsigned32 (0..255)
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpInitialQuality is the
          initial quality of a newly
          identified link.

          The following constraint   "
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 10 }

   -- Note: Probably wnat to move this following object
   -- 'nhdpInitialPending' to the State Objects Group.

   nhdpInitialPending  OBJECT-TYPE
      SYNTAX      Unsigned32 (0..255)
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpInitialPending is defined as
          follows:

          If true, then a newly identified link
          is considered pending, and is not
          usable until the link quality has
          reached or exceeded the
          nhdpHystAccept threshold.

          The following constraint   "
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 1 }
   ::= { nhdpInterfaceEntry 11 }
```

```
   -- Interface Parameters - Jitter

   -- Note: would like DEFVAL = nhdpHelloInterval/4
   nhdpHpMaxJitter  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpHpMaxJitter represents the
          value of MAXJITTER used in [4] for
          periodically generated HELLO messages
          on this MANET interface.

          The following constraint ...
         "
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 2 }
   ::= { nhdpInterfaceEntry 12 }


   -- Note: would like DEFVAL = nhdpHpMaxJitter
   nhdpHtMaxJitter  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpHtMaxJitter represents the
          value of MAXJITTER used in [4] for
          externally triggered HELLO messages
          on this MANET interface.

          The following constraint   "
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 13 }

   -- Router Parameters - Information Validity Time

   nhdpNHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
```

```
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpHHoldTime is used as the period
          during which former 1-hop neighbor
          addresses are advertised as lost in
          HELLO messages, allowing recipients of
          these HELLO messages to accelerate removal
          of information from their 2-Hop Sets.
          N_HOLD_TIME can be set to zero if
          accelerated information removal is not
          required.

          The following constraint
          nhdpHHoldTime >= 0"
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 2 }
   ::= { nhdpInterfaceEntry 14 }

   -- Note: would like DEFVAL = nhdpHelloInterval
   nhdpIHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The nhdpIHoldTime is the period
          for which a recently used local
          interface address is recorded.

          The following constraint
          nhdpIHoldTime >= 0  "
      REFERENCE
         "The NHDP version 9 draft.
          Section 5 on Protocol Parameters and
          Constraints."
      DEFVAL { 10 }
   ::= { nhdpInterfaceEntry 15 }

   nhdpIfRowStatus  OBJECT-TYPE
      SYNTAX      RowStatus
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
```

```
         "This
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpInterfaceEntry 16 }




--
-- nhdpStateObjGrp
--

-- Contains information describing the current state of the NHDP
-- process.

nhdpStateObjGrp    OBJECT IDENTIFIER ::= { nhdpObjects 3 }

   -- Before building the NHDP Information Bases, we define
   -- two new constructs for indexing into the following
   -- tables and indexing into other tables in other MIBs.
   -- The NeighborIfIndex defines a unique (to the local router)
   -- index referencing a discovered interface on another
   -- router within the NHDP MANET. The NeighborRouterId defines a
   -- unique (to the local router) index referencing a discovered
   -- router within the NHDP MANET.



   -- Note: This table is indexed by an IpAddr associated with
   -- NeighborIfIndex.  Multiple addresses can be associated
   -- with a given NeighborIfIndex.  Each NeighborIfIndex is
   -- associated with a NeighborRouterId.  Throughout this MIB,
   -- the NeighborIfIndex and the NeighborRouterId are used
   -- to define the set of IpAddrs related to the interface
   -- in discussion.


   nhdpDiscIfSetTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpDiscIfSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          " A router's set of discovered interfaces on
```

```
            neighboring routers.
          "
       REFERENCE
          "The NHDP draft."
    ::= { nhdpStateObjGrp 1 }

    nhdpDiscIfSetEntry  OBJECT-TYPE
       SYNTAX      NhdpDiscIfSetEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include the nhdpDiscRouterId of
           the discovered router, the nhdpDiscIfIndex
           of the discovered interface and the
           current set of addresses associated
           with this neighbor interface.  The
           nhdpDiscIfIndex has to uniquely identify
           the remote interface address sets.  It
           need not be unique across the MANET.
           It must be unique within this router.

           Note: need to describe how to age out
           the entries in this table?
          "
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpDiscIfSetIpAddr }
    ::= { nhdpDiscIfSetTable 1 }

    NhdpDiscIfSetEntry ::=
       SEQUENCE {
          nhdpDiscIfSetRouterId
            NeighborRouterId,
          nhdpDiscIfSetIndex
            NeighborIfIndex,
          nhdpDiscIfSetIpAddrType
            InetAddressType,
          nhdpDiscIfSetIpAddr
            InetAddress,
          nhdpDiscIfSetIpAddrPrefixLen
            InetAddressPrefixLength
        }

   nhdpDiscIfSetRouterId  OBJECT-TYPE
      SYNTAX      NeighborRouterId
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
```

```
         "The NHDP router ID (locally created)
          of a neigboring router.  Used for cross
          indexing into other NHDP tables and other
          MIBs.
         "
      REFERENCE
         "This NHDP-MIB draft."
   ::= { nhdpDiscIfSetEntry 1 }

   nhdpDiscIfSetIndex  OBJECT-TYPE
      SYNTAX      NeighborIfIndex
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The NHDP interface index (locally created)
          of a neigbor's interface.  Used for cross
          indexing into other NHDP tables and other
          MIBs.
         "
      REFERENCE
         "This NHDP-MIB draft."
   ::= { nhdpDiscIfSetEntry 2 }

   nhdpDiscIfSetIpAddrType  OBJECT-TYPE
      SYNTAX      InetAddressType
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The type of the ...
          in the InetAddress MIB [RFC 4001]."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscIfSetEntry 3 }

   nhdpDiscIfSetIpAddr  OBJECT-TYPE
      SYNTAX      InetAddress
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpDiscIfSetIpAddr is a
          recently used address of a neighbor
          of this router.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscIfSetEntry 4 }

   nhdpDiscIfSetIpAddrPrefixLen  OBJECT-TYPE
```

```
      SYNTAX      InetAddressPrefixLength
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "Indicates the number of leading one bits that form the
          mask to be logical-ANDed with the destination address
          before being compared to the value in the
          nhdpDiscIfSetAddr field.  If the resulting
          address block is contained in a block in this
          table, then a match should be returned.
          "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscIfSetEntry 5 }



   -- An NHDP router's Local Information Base (LIB)

      -- Local IF Set Table
      -- Entry (foreach IF): (IfAddrList,
      --                      PrefixMask,
      --                      Manet_indication)
      --
      -- Note:  This table is redundant with information in
      -- the nhdpIfTable above.  Hence it is not present here.




      -- Removed Addr Set Table
      -- Entry (foreach Addr): (IfAddrRemoved,
      --                        ExpirationTime)

    nhdpLibRemovedAddrSetTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpLibRemovedAddrSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          " A router's Removed Addr Set Table ...
          "
       REFERENCE
          "The NHDP draft."
    ::= { nhdpStateObjGrp 2 }

    nhdpLibRemovedAddrSetEntry  OBJECT-TYPE
       SYNTAX      NhdpLibRemovedAddrSetEntry
```

```
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include the
           removed addresses and their expiration
           time from this table.

           The association between these addrs and
           the router's Interface is found in the
           Standard MIB II's IP addr table
           (RFC1213).
          "
       REFERENCE
          "The NHDP draft."
       INDEX { nhdpLibRemovedAddrSetIpAddr }
    ::= { nhdpLibRemovedAddrSetTable 1 }

    NhdpLibRemovedAddrSetEntry ::=
       SEQUENCE {
          nhdpLibRemovedAddrSetIpAddrType
            InetAddressType,
          nhdpLibRemovedAddrSetIpAddr
            InetAddress,
          nhdpLibRemovedAddrSetIpAddrPrefixLen
            InetAddressPrefixLength,
          nhdpLibRemovedAddrSetIfIndex
            InterfaceIndexOrZero,
          nhdpLibRemovedAddrSetIrTime
            Unsigned32
        }

   nhdpLibRemovedAddrSetIpAddrType  OBJECT-TYPE
      SYNTAX      InetAddressType
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The type of the ...
          in the InetAddress MIB [RFC 4001]."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpLibRemovedAddrSetEntry 1 }

   nhdpLibRemovedAddrSetIpAddr  OBJECT-TYPE
      SYNTAX      InetAddress
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpLibRemovedAddrSetAddr is a
```

```
          recently used address of an interface of
          this router."
       REFERENCE
          "The NHDP draft."
    ::= { nhdpLibRemovedAddrSetEntry 2 }

    nhdpLibRemovedAddrSetIpAddrPrefixLen  OBJECT-TYPE
       SYNTAX      InetAddressPrefixLength
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
          "Indicates the number of leading one bits that form the
           mask to be logical-ANDed with the address
           to determine the network address to which
           this interface is attached.
           "
       REFERENCE
          "The NHDP draft."
    ::= { nhdpLibRemovedAddrSetEntry 3 }

    -- Note: need to identify a time type for the
    -- nhdpRemoveAddrSetIrTime.

      nhdpLibRemovedAddrSetIfIndex  OBJECT-TYPE
         SYNTAX      InterfaceIndexOrZero
         MAX-ACCESS  read-only
         STATUS      current
         DESCRIPTION
            "Specifies the local IfIndex from which this
             Ip addr was re4cently removed.
            "
         REFERENCE
            "The NHDP draft."
      ::= { nhdpLibRemovedAddrSetEntry 4 }

      nhdpLibRemovedAddrSetIrTime  OBJECT-TYPE
         SYNTAX      Unsigned32
         MAX-ACCESS  read-only
         STATUS      current
         DESCRIPTION
            "Specifies when this Tuple expires and MUST be removed
             from this table.
            "
         REFERENCE
            "The NHDP draft."
      ::= { nhdpLibRemovedAddrSetEntry 5 }
```

```
   -- Interface Information Base (IIB)

   --
   -- NHDP Interface Information Base (IIB)
   --

   --     IIB Link Set
   --         Entry (foreach 1-H neighbor): (NeighborAddrList,
   --                                        HeardTime,
   --                                        SymTime,
   --                                        Quality,
   --                                        Pending,
   --                                        Lost,
   --                                        ExpireTime)

   nhdpIibLinkSetTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpIibLinkSetEntry
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
         " A router's Link Set records links from
           other routers which are, or recently
           were, 1-hop neighbors.  It consists
           of Link Tuples, each representing a
           single link:

           (L_neighbor_iface_addr_list, L_HEARD_time,
            L_SYM_time, L_quality, L_pending,
            L_lost, L_time).
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpStateObjGrp 3 }

    nhdpIibLinkSetEntry  OBJECT-TYPE
       SYNTAX      NhdpIibLinkSetEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include ...
          "
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpIibLinkSet1HopIfIndex }
    ::= { nhdpIibLinkSetTable 1 }

    NhdpIibLinkSetEntry ::=
       SEQUENCE {
```

```
          nhdpIibLinkSet1HopIfIndex
            NeighborIfIndex,
          nhdpIibLinkSetIfIndex
            InterfaceIndexOrZero,
          nhdpIibLinkSetLHeardTime
            Unsigned32,
          nhdpIibLinkSetLSymTime
            Unsigned32,
          nhdpIibLinkSetLQuality
            Unsigned32,
          nhdpIibLinkSetLPending
            TruthValue,
          nhdpIibLinkSetLLost
            TruthValue,
          nhdpIibLinkSetLTime
            Unsigned32
        }

   nhdpIibLinkSet1HopIfIndex  OBJECT-TYPE
      SYNTAX      NeighborIfIndex
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpIibLinkSet1HopIfIndex is
          the value of the NeighborIfIndex (from
          table 'xxx' above).  This object
          is repeated here to support table
          walks to view the set of neighbors
          of this router.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 1 }

   nhdpIibLinkSetIfIndex  OBJECT-TYPE
      SYNTAX      InterfaceIndexOrZero
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpIibLinkSetIfIndex is
          is the local router's interface
          index associated with the symmetric
          link to this entries neighbor
          interface.

          The IP addr set associated with this
          neighbor's interface is found in the
          'nhdpDiscIfSetTable' above.
```

```
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 2 }

   nhdpIibLinkSetLHeardTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpIibLinkSetLHeardTime is
          the time until which the MANET
          interface of the 1-hop neighbor
          would be considered heard if not
          considering link quality.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 3 }

   nhdpIibLinkSetLSymTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpIibLinkSetLSymTime is the
          time until which the link to the
          1-hop neighbor would be considered
          symmetric if not considering link
          quality.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 4 }

   -- (Note: Is this wise to include in a MIB?  What is the
   --  frequency of updates or what are the requirements on
   --  the frequency of updates to this parameter?)
   nhdpIibLinkSetLQuality  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpIibLinkSetLQuality is a
          dimensionless number between 0
          (inclusive) and 1 (inclusive)
          describing the quality of a link;
          a greater value of L_quality
```

```
          indicating a higher quality link.
        "
      REFERENCE
        "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 5 }

   nhdpIibLinkSetLPending  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "The nhdpIibLinkSetLPending is a
         boolean flag, describing if a
         link is considered pending (i.e.,
         a candidate, but not yet
         established, link).
        "
      REFERENCE
        "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 6 }

   nhdpIibLinkSetLLost  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "The nhdpIibLinkSetLLost is a
         boolean flag, describing if a
         link is considered lost due
         to link quality.
        "
      REFERENCE
        "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 7 }

   -- Note: need to locate a time type for this object
   nhdpIibLinkSetLTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
        "The nhdpIibLinkSetLTime specifies
         when this Tuple expires and MUST
         be removed.
        "
      REFERENCE
        "The NHDP draft."
   ::= { nhdpIibLinkSetEntry 8 }
```

```
  --
  --     IIB 2-Hop Set
  --         Entry (foreach IF on a 2-H neighbor):
  --                                  (1NeighIfAddrList,
  --                                   2NeighIfAddr,
  --                                   ExpireTime)

    nhdpIib2HopSetTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpIib2HopSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          " A router's 2-Hop Set records symmetric
            2-hop neighbors, and the symmetric links
            to symmetric 1-hop neighbors through
            which the symmetric 2-hop neighbors
            can be reached.  It consists of 2-Hop
            Tuples, each representing a single
            interface address of a symmetric
            2-hop neighbor, and a single MANET
            interface of a symmetric 1-hop
            neighbor, i.e.,

           (N2_neighbor_iface_addr_list,
            N2_2hop_addr, N2_time).
          "
       REFERENCE
          "The NHDP draft."
    ::= { nhdpStateObjGrp 4 }

    nhdpIib2HopSetEntry  OBJECT-TYPE
       SYNTAX      NhdpIib2HopSetEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include the 2 hop neighbor addrs,
           which act as the table index, and associated
           1 hop symmetric link addr set, designated through
           the nhdpDiscIfIndex, and ...
          "
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpIib2HopSetIpAddress }
    ::= { nhdpIib2HopSetTable 1 }

    NhdpIib2HopSetEntry ::=
       SEQUENCE {
          nhdpIib2HopSetIpAddressType
```

```
          InetAddressType,
        nhdpIib2HopSetIpAddress
          InetAddress,
        nhdpIib2HopSet1HopIfIndex
          NeighborIfIndex,
        nhdpIib2HopSetN2Time
          Unsigned32
       }


   nhdpIib2HopSetIpAddressType  OBJECT-TYPE
      SYNTAX      InetAddressType
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The type of the ...
          in the InetAddress MIB [RFC 4001]."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIib2HopSetEntry 1 }

   nhdpIib2HopSetIpAddress  OBJECT-TYPE
      SYNTAX      InetAddress
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpIib2HopSetIpAddr is an
          address of an interface of a symmetric
          2-hop neighbor which has a symmetric
          link (using any MANET interface) to
          the indicated symmetric 1-hop neighbor.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIib2HopSetEntry 2 }

   nhdpIib2HopSet1HopIfIndex  OBJECT-TYPE
      SYNTAX      NeighborIfIndex
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpIib2HopSet1HopIfIndex is
          NeighborIfIndex of the one hop
          neighbor which communicated the ipAddress
          of the 2 hop neighbor in this row entry.
         "
      REFERENCE
         "The NHDP draft."
```

```
   ::= { nhdpIib2HopSetEntry 3 }

   -- Note: need to get a time type for this object.
   nhdpIib2HopSetN2Time  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpIib2HopSetN2Time specifies
          when this column entry expires and
          MUST be removed.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIib2HopSetEntry 4 }




   --
   -- Neighbor Information Base (NIB)
   --
   -- Each router maintains a Neighbor Information Base
   -- that records information about addresses of
   -- current and recently symmetric 1-hop neighbors.
   --
   -- All addresses MUST have an associated prefix
   -- length.  Prefix lengths are indicated in HELLO
   -- messages as specified in [1]; if an address
   -- has no specified prefix length, then its prefix
   -- length is equal to the address length.  Two
   -- addresses are considered equal if and only
   -- if their associated prefix lengths are also equal.



   --     NIB Neighbor Set
   --         Entry (foreach 1-H Neighbor):
   --              (AllIfAddrListOfIhNeighbor,
   --               SymmetricIndicator)
   --     The NIB Neighbor Set Table is small because
   --     most of the corresponding information is found
   --     in the nhdpDiscoveredIfTable above.

   nhdpNibNeighborSetTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpNibNeighborSetEntry
      MAX-ACCESS   not-accessible
      STATUS       current
```

```
      DESCRIPTION
         " A router's Neighbor Set records all
           interface addresses of each 1-hop
           neighbor.  It consists of Neighbor
           Tuples, each representing a single
           1-hop neighbor:

           (N_neighbor_addr_list,
            N_symmetric)
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpStateObjGrp 5 }

   nhdpNibNeighborSetEntry  OBJECT-TYPE
      SYNTAX      NhdpNibNeighborSetEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The entries include ...
         "
      REFERENCE
         "This NHDP-MIB draft."
      INDEX { nhdpNibNeighborSetRouterId }
   ::= { nhdpNibNeighborSetTable 1 }

    NhdpNibNeighborSetEntry ::=
       SEQUENCE {
          nhdpNibNeighborSetRouterId
            NeighborRouterId,
          nhdpNibNeighborSetNSymmetric
            TruthValue
         }

   nhdpNibNeighborSetRouterId  OBJECT-TYPE
      SYNTAX      NeighborRouterId
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpNibNeighborSetRouterId is
          the NeighborRouterId of a one hop
          neighbor to this router.  It must also
          exist in the 'nhdpDiscSetTable'
          allowing the manager to determine
          the set of Ip addr's associated
          with the NeighborRouterId in this row.
         "
      REFERENCE
```

```
         "The NHDP draft."
   ::= { nhdpNibNeighborSetEntry 1 }

   nhdpNibNeighborSetNSymmetric  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpNibNeighborNSymmetric is
          a boolean flag, describing if this
          is a symmetric 1-hop neighbor.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpNibNeighborSetEntry 2 }



  --     Lost Neighbor Set
  --         Entry ( foreach IF foreach 1-H Neighbor): (IfAddr,
  --                                                    ExpireTime)

    nhdpNibLostNeighborSetTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpNibLostNeighborSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          " A router's Lost Neighbor Set records all
            interface addresses of each 1-hop
            neighbor recently advertised as lost.
            It consists of Neighbor
            Tuples, each representing a single
            1-hop neighbor:

            (NL_neighbor_addr_list,
             NL_time)
          "
       REFERENCE
          "The NHDP draft."
    ::= { nhdpStateObjGrp 6 }

    nhdpNibLostNeighborSetEntry  OBJECT-TYPE
       SYNTAX      NhdpNibLostNeighborSetEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include ...
          "
```

```
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpNibLostNeighborSetRouterId }
    ::= { nhdpNibLostNeighborSetTable 1 }

    NhdpNibLostNeighborSetEntry ::=
       SEQUENCE {
          nhdpNibLostNeighborSetRouterId
            NeighborRouterId,
          nhdpNibLostNeighborSetNLTime
            Unsigned32
         }

   nhdpNibLostNeighborSetRouterId  OBJECT-TYPE
      SYNTAX      NeighborRouterId
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpNibLostNeighborSetRouterId is
          the NeighborRouterId of a one hop
          neighbor to this router which was
          recently lost.  It must also
          exist in the 'nhdpDiscSetTable'
          allowing the manager to determine
          the set of Ip addr's associated
          with the NeighborRouterId in this row.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpNibLostNeighborSetEntry 1 }


   -- Note: need to fime time type for this object
   nhdpNibLostNeighborSetNLTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpNibLostNeighborSetNLTime
          specifies when this Tuple expires
          and MUST be removed.
         "
      REFERENCE
         "The NHDP draft."
   ::= { nhdpNibLostNeighborSetEntry 2 }
```

```
--
-- nhdpPerformanceObjGrp
--

-- Contains objects which help to characterize the performance of
-- the NHDP process, typically counters.

nhdpPerformanceObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 4 }

  --
  -- Objects per local interface
  --

  nhdpInterfacePerfTable  OBJECT-TYPE
      SYNTAX      SEQUENCE OF NhdpInterfacePerfEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "This table summarizes performance objects that are
          measured per local NHDP interface."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpPerformanceObjGrp 1 }

   nhdpInterfacePerfEntry OBJECT-TYPE
      SYNTAX      NhdpInterfacePerfEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "A single entry contains performance counters for
          a local NHDP interface."
      INDEX { nhdpIfIndex }
   ::= { nhdpInterfacePerfTable 1 }

   NhdpInterfacePerfEntry ::=
      SEQUENCE {
         nhdpIfPerfIndex
            InterfaceIndexOrZero,
         nhdpIfHelloMessageXmits
            Counter32,
         nhdpIfHelloMessageRecvd
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedSize
            Counter32,
         nhdpIfHelloMessageRecvdAccumulatedSize
            Counter32,
         nhdpIfHelloMessageTriggeredXmits
            Counter32,
```

```
         nhdpIfHelloMessagePeriodicXmits
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedLostNeighborCount
            Counter32
         }

   nhdpIfPerfIndex  OBJECT-TYPE
      SYNTAX      InterfaceIndexOrZero
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The ID of an interface.  Used for cross
          indexing into other NHDP tables and other
          MIBs."
   ::= { nhdpInterfacePerfEntry 1 }

   nhdpIfHelloMessageXmits  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented each time a HELLO
         message has been transmitted on that interface."
   ::= { nhdpInterfacePerfEntry 2 }

   nhdpIfHelloMessageRecvd  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented each time a
         HELLO message has been received on that interface."
   ::= { nhdpInterfacePerfEntry 3 }

   nhdpIfHelloMessageXmitAccumulatedSize  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented by the number of octets in
         a HELLO message each time a
         HELLO message has been sent."
   ::= { nhdpInterfacePerfEntry 4 }
```

```
   nhdpIfHelloMessageRecvdAccumulatedSize  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented by the number of octets in
         a HELLO message each time a
         HELLO message has been received."
   ::= { nhdpInterfacePerfEntry 5 }

   nhdpIfHelloMessageTriggeredXmits  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented each time a triggered
         HELLO message has been sent."
   ::= { nhdpInterfacePerfEntry 6 }

   nhdpIfHelloMessagePeriodicXmits  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented each time a periodic
         HELLO message has been sent."
   ::= { nhdpInterfacePerfEntry 7 }

   nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented by the number of advertized
         symmetric neighbors in a HELLO each time a HELLO
         message has been sent."
   ::= { nhdpInterfacePerfEntry 8 }

   nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented by the number of advertized
         heard neighbors in a HELLO each time a HELLO
         message has been sent."
   ::= { nhdpInterfacePerfEntry 9 }
```

```
   nhdpIfHelloMessageXmitAccumulatedLostNeighborCount  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter is incremented by the number of advertized
         lost neighbors in a HELLO each time a HELLO
         message has been sent."
   ::= { nhdpInterfacePerfEntry 10 }



  --
  -- Objects per discovered neighbor interface
  --

  nhdpDiscIfSetPerfTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpDiscIfSetPerfEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          "A router's set of performance properties for
          each discovered interface of a neighbor."
       REFERENCE
          "The NHDP draft."
   ::= { nhdpPerformanceObjGrp 2 }


   nhdpDiscIfSetPerfEntry  OBJECT-TYPE
       SYNTAX      NhdpDiscIfSetPerfEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "There is an entry for each discovered
          interface of a neighbor."
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpDiscIfSetPerfIndex }
   ::= { nhdpDiscIfSetPerfTable 1 }

    NhdpDiscIfSetPerfEntry ::=
       SEQUENCE {
          nhdpDiscIfSetPerfIndex
            NeighborIfIndex,
          nhdpDiscIfRecvdPackets
            Counter32,
          nhdpDiscIfExpectedPackets
            Counter32
```

```
        }

   nhdpDiscIfSetPerfIndex  OBJECT-TYPE
      SYNTAX      NeighborIfIndex
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The NHDP interface ID (locally created)
          of a neigboring router.  Used for cross
          indexing into other NHDP tables and other
          MIBs."
      REFERENCE
         "This NHDP-MIB draft."
   ::= { nhdpDiscIfSetPerfEntry 1 }

   nhdpDiscIfRecvdPackets  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments each
         time this device receives a packet from that interface
         of the neighbor."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscIfSetPerfEntry 2 }

   nhdpDiscIfExpectedPackets  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments by the number
          of missed packets from this neighbor based
          on the packet sequence number each time this
          device receives a packet from that interface
          of the neighbor."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscIfSetPerfEntry 3 }



   --
   -- Objects concerning the neighbor set
   --

   nhdpNibNeighborSetChanges  OBJECT-TYPE
```

```
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments each time the Neighbor Set changes.
         A change occurs whenever a new Neighbor Tuple has been
         added, a Neighbor Tuple has been removed or any entry of
         a Neighbor Tuple has been modified."
   ::= { nhdpPerformanceObjGrp 3 }



   --
   -- Objects per discovered neighbor
   --

   nhdpDiscNeighborSetPerfTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpDiscNeighborSetPerfEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          "A router's set of discovered neighbors and
           their properties."
       REFERENCE
          "The NHDP draft."
   ::= { nhdpPerformanceObjGrp 4 }

   nhdpDiscNeighborSetPerfEntry  OBJECT-TYPE
       SYNTAX      NhdpDiscNeighborSetPerfEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include the nhdpDiscRouterId of
           the discovered router, ..."
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpDiscNeighborSetRouterId }
   ::= { nhdpDiscNeighborSetPerfTable 1 }

    NhdpDiscNeighborSetPerfEntry ::=
       SEQUENCE {
          nhdpDiscNeighborSetRouterId
            NeighborRouterId,
          nhdpDiscNeighborNibNeighborSetChanges
            Counter32,
          nhdpDiscNeighborNibNeighborSetUpTime
            Unsigned32,
          nhdpDiscNeighborNibNeighborSetReachableLinkChanges
```

```
            Counter32
          }

   nhdpDiscNeighborSetRouterId  OBJECT-TYPE
      SYNTAX      NeighborRouterId
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The NHDP router ID (locally created)
          of a neigboring router.  Used for cross
          indexing into other NHDP tables and other
          MIBs."
      REFERENCE
         "This NHDP-MIB draft."
   ::= { nhdpDiscNeighborSetPerfEntry 1 }

   -- (Note: Can we point this to changes in a state grp
   --  table below?)
   nhdpDiscNeighborNibNeighborSetChanges  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments each time the neighbor becomes
         onlink or offlink.  A neighbor is said to become
         'onlink' if a new Neighbor Tuple is created that
         corresponds to the given neighbor.  It becomes 'offlink'
         if such a tuple has been deleted."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscNeighborSetPerfEntry 2 }

   -- (Note: Can we point this to the time since an entry in a
   --  table below has changed?)
   nhdpDiscNeighborNibNeighborSetUpTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This object returns the time in milliseconds since
         the neighbor becomes onlink or offlink.  A neighbor is
         said to become 'onlink' if a new Neighbor Tuple is created that
         corresponds to the given neighbor.  It becomes 'offlink' if
         such a tuple has been deleted.

         Positive values indicate that the neighbor is currently
         'onlink' and indicates the duration of the current 'onlink'
         period.  Negative values indicate that the neighbor is
```

```
         currently 'offlink' and the magnitude indicates the
         duration of the current 'offlink' period."
      REFERENCE
         "This NHDP-MIB draft."
   ::= { nhdpDiscNeighborSetPerfEntry 3 }

   nhdpDiscNeighborNibNeighborSetReachableLinkChanges  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments each
         time the neighbor changes the interface over which it is
         reachable.  That means that the corresponding Link Tuple of the
         given link moves from the Link Set of one interface to another
         interface."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpDiscNeighborSetPerfEntry 4 }




   --
   -- Objects per discovered 2-hop neighbor
   --

   nhdpIib2HopSetPerfTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpIib2HopSetPerfEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
           "This table..."
       REFERENCE
          "The NHDP draft."
    ::= { nhdpPerformanceObjGrp 5 }

    nhdpIib2HopSetPerfEntry  OBJECT-TYPE
       SYNTAX      NhdpIib2HopSetPerfEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries ..."
       REFERENCE
          "This NHDP-MIB draft."
       INDEX { nhdpIib2HopSetIpAddress }
    ::= { nhdpIib2HopSetPerfTable 1 }
```

```
    NhdpIib2HopSetPerfEntry ::=
       SEQUENCE {
          nhdpIib2HopSetPerfIpAddress
            InetAddress,
          nhdpIib2HopSetPerfChanges
            Counter32,
          nhdpIib2HopSetPerfUpTime
            Unsigned32
         }

   nhdpIib2HopSetPerfIpAddress  OBJECT-TYPE
      SYNTAX      InetAddress
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The nhdpIib2HopSetIpAddr is an
          address of an interface of a symmetric
          2-hop neighbor which has a symmetric
          link (using any MANET interface) to
          the indicated symmetric 1-hop neighbor."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIib2HopSetPerfEntry 1 }

   nhdpIib2HopSetPerfChanges  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments each
         time this 2-hop neighbor changes its
         N2_neighbor_iface_addr_list in the
         nhdpIib2HopSetTable."
      REFERENCE
         "The NHDP draft."
   ::= { nhdpIib2HopSetPerfEntry 2 }

   nhdpIib2HopSetPerfUpTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This object returns the time in milliseconds since
         the 2-Hop Tuple
         corresponding to the given 2-hop neighbor IP address exists
         in the nhdpIib2HopSetTable."
      REFERENCE
         "This NHDP-MIB draft."
```

```
   ::= { nhdpIib2HopSetPerfEntry 3 }




--
-- nhdpNotifications
--

  -- Note: What are the valuable notification information for the
  -- NHDP-MIB?




--
-- nhdpConformance information
--

-- Note: To be determined.

nhdpCompliances       OBJECT IDENTIFIER ::= { nhdpConformance 1 }
nhdpMIBGroups         OBJECT IDENTIFIER ::= { nhdpConformance 2 }


-- Compliance Statements
nhdpBasicCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
    "A basic compliance which allows ...."
  MODULE -- this module
--  MANDATORY-GROUPS { nhdpGeneralGroup,
--                     nhdpConfigurationGroup }
  MANDATORY-GROUPS { nhdpConfigurationGroup }


  ::= { nhdpCompliances 1 }

nhdpFullCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
    "A full compliance which allows ...."
  MODULE -- this module
--  MANDATORY-GROUPS { nhdpGeneralGroup,
--                     nhdpConfigurationGroup,
--                     nhdpStateGroup,
```

```
--                      nhdpPerformanceGroup,
--                      nhdpNotificationGroup }
  MANDATORY-GROUPS { nhdpConfigurationGroup,
                     nhdpStateGroup,
                     nhdpPerformanceGroup }

  ::= { nhdpCompliances 2 }


--
-- Units of Conformance
--

--  nhdpGeneralGroup OBJECT-GROUP
--     OBJECTS {
--
--             }
--      STATUS  current
--      DESCRIPTION
--         "Set of NHDP general objects implemented
--          in this module."
--   ::= { nhdpMIBGroups 1 }

  nhdpConfigurationGroup OBJECT-GROUP
     OBJECTS {
              nhdpIfStatus,
              nhdpHelloInterval,
              nhdpHelloMinInterval,
              nhdpRefreshInterval,
              nhdpLHoldTime,
              nhdpHHoldTime,
              nhdpHystAcceptQuality,
              nhdpHystRejectQuality,
              nhdpInitialQuality,
              nhdpInitialPending,
              nhdpHpMaxJitter,
              nhdpHtMaxJitter,
              nhdpNHoldTime,
              nhdpIHoldTime,
              nhdpIfRowStatus
             }
      STATUS  current
      DESCRIPTION
         "Set of NHDP configuration objects implemented
          in this module."
   ::= { nhdpMIBGroups 2 }

  nhdpStateGroup OBJECT-GROUP
```

```
     OBJECTS {
              nhdpDiscIfSetRouterId,
              nhdpDiscIfSetIndex,
              nhdpDiscIfSetIpAddrType,
              nhdpDiscIfSetIpAddrPrefixLen,
              nhdpLibRemovedAddrSetIpAddrType,
              nhdpLibRemovedAddrSetIpAddrPrefixLen,
              nhdpLibRemovedAddrSetIfIndex,
              nhdpLibRemovedAddrSetIrTime,
              nhdpIibLinkSetIfIndex,
              nhdpIibLinkSetLHeardTime,
              nhdpIibLinkSetLSymTime,
              nhdpIibLinkSetLQuality,
              nhdpIibLinkSetLPending,
              nhdpIibLinkSetLLost,
              nhdpIibLinkSetLTime,
              nhdpIib2HopSetIpAddressType,
              nhdpIib2HopSet1HopIfIndex,
              nhdpIib2HopSetN2Time,
              nhdpNibNeighborSetNSymmetric,
              nhdpNibLostNeighborSetNLTime
             }
      STATUS  current
      DESCRIPTION
         "Set of NHDP state objects implemented
          in this module."
   ::= { nhdpMIBGroups 3 }

  nhdpPerformanceGroup OBJECT-GROUP
     OBJECTS {
              nhdpIfHelloMessageXmits,
              nhdpIfHelloMessageRecvd,
              nhdpIfHelloMessageXmitAccumulatedSize,
              nhdpIfHelloMessageRecvdAccumulatedSize,
              nhdpIfHelloMessageTriggeredXmits,
              nhdpIfHelloMessagePeriodicXmits,
              nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount,
              nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount,
              nhdpIfHelloMessageXmitAccumulatedLostNeighborCount,
              nhdpDiscIfRecvdPackets,
              nhdpDiscIfExpectedPackets,
              nhdpNibNeighborSetChanges,
              nhdpDiscNeighborNibNeighborSetChanges,
              nhdpDiscNeighborNibNeighborSetUpTime,
              nhdpDiscNeighborNibNeighborSetReachableLinkChanges,
              nhdpIib2HopSetPerfChanges,
              nhdpIib2HopSetPerfUpTime
            }
```

```
      STATUS  current
      DESCRIPTION
         "Set of NHDP performance objects implemented
          in this module."
   ::= { nhdpMIBGroups 4 }

--  nhdpNotificationGroup OBJECT-GROUP
--     OBJECTS {
--
--             }
--      STATUS  current
--      DESCRIPTION
--         "Set of NHDP notification objects implemented
--          in this module."
--   ::= { nhdpMIBGroups 5 }



END
```

9. Security Considerations

[TODO] Each specification that defines one or more MIB modules MUST contain a section that discusses security considerations relevant to those modules. This section MUST be patterned after the latest approved template (available at http://www.ops.ietf.org/mib-security.html). Remember that the objective is not to blindly copy text from the template, but rather to think and evaluate the risks/vulnerabilities and then state/ document the result of this evaluation.

[TODO] if you have any read-write and/or read-create objects, please include the following boilerplate paragraph.

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- [TODO] writable MIB objects that could be especially disruptive if abused MUST be explicitly listed by name and the associated security risks MUST be spelled out; RFC 2669 has a very good example.

- o [TODO] list the writable tables and objects and state why they are sensitive.

[TODO] else if there are no read-write objects in your MIB module, use the following boilerplate paragraph.

There are no management objects defined in this MIB module that have a MAX-ACCESS clause of read-write and/or read-create. So, if this MIB module is implemented correctly, then there is no risk that an intruder can alter or create any management objects of this MIB module via direct SNMP SET operations.

[TODO] if you have any sensitive readable objects, please include the following boilerplate paragraph.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- o [TODO] you must explicitly list by name any readable objects that are sensitive or vulnerable and the associated security risks MUST be spelled out (for instance, if they might reveal customer information or violate personal privacy laws such as those of the European Union if exposed to unauthorized parties)

- o [TODO] list the tables and objects and state why they are sensitive.

[TODO] discuss what security the protocol used to carry the information should have. The following three boilerplate paragraphs should not be changed without very good reason. Changes will almost certainly require justification during IESG review.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

10. IANA Considerations

[TODO] In order to comply with IESG policy as set forth in http://www.ietf.org/ID-Checklist.html, every Internet-Draft that is submitted to the IESG for publication MUST contain an IANA Considerations section. The requirements for this section vary depending what actions are required of the IANA. see RFC4181 section 3.5 for more information on writing an IANA clause for a MIB module document.

[TODO] select an option and provide the necessary details.

Option #1:

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

Descriptor	OBJECT IDENTIFIER value
sampleMIB	{ mib-2 XXX }

Option #2:

Editor's Note (to be removed prior to publication): the IANA is requested to assign a value for "XXX" under the 'mib-2' subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "XXX" (here and in the MIB module) with the assigned value and to remove this note.

Note well: prior to official assignment by the IANA, a draft document MUST use placeholders (such as "XXX" above) rather than actual numbers. See RFC4181 Section 4.5 for an example of how this is done in a draft MIB module.

Option #3:

This memo includes no request to IANA.

11. Contributors

This MIB document uses the template authored by D. Harrington which is based on contributions from the MIB Doctors, especially Juergen Schoenwaelder, Dave Perkins, C.M.Heard and Randy Presuhn.

12. Acknowledgements

[TODO]This acknowledgement can be removed from your MIB module document.

13. References

13.1. Normative References

[RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.

[RFC3418] Presuhn, R., "Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)", STD 62, RFC 3418, December 2002.

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

[RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

[RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.

13.2. Informative References

[RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.

[NHDP] Clausen, T., Dearlove, C., and J. Dean, "The MANET Neighborhood Discovery Protocol (NHDP)", July 2009.

[REPORT] Cole, R., Macker, J., and A. Morton, "The MANET Report MIB", June 2009.

Appendix A. Change Log

Here we list the changes made to the various drafts of this MIB.

We list here the changes made on the draft-ietf-manet-nhdp-mib-00 draft to generate the draft-ietf-manet-nhdp-mib-01 draft.

1. Made and extensive addition in the area of performance monitoring. Added text in the front material, added a PerformanceGroup to the MIB and added the PerformanceGroup to the Conformance Sections.

We list here the changes made on the draft-cole-manet-nhdp-mib-01 draft to generate the draft-ietf-manet-nhdp-mib-00 draft.

1. Cleanup up numerous typos and add material to the Conformance section in order to pass the MIB checker, i.e., smilint.

We list here the changes made on the draft-cole-manet-nhdp-mib-00 draft to generate the draft-cole-manet-nhdp-mib-01 draft.

1. Defined the NeighborIfIndex and the NeighborRouterId textual conventions. These identify a remote neighbor IfIndex and a remote neighbor router and are used as indexes into NHDP state tables. These constructs were necessary in order to associate address lists with specific remote interfaces as required by the NHDP protocol specification.

2. Developed the nhdpInterfaceTable as part of the configuration group.

3. Developed the nhdpDiscIfSetTable as a means to associate address lists with remotely discovered neighbor interfaces.

4. Added tables defining the router’s NHDP Local Information Base (LIB) as specified in the NHPD protocol specification.

5. Added tables defining the router’s NHDP Interface information Base (IIB) as specified in the NHPD protocol specification.

6. Added tables defining the router’s NHDP Neighbor Information Base (NIB) as specified in the NHPD protocol specification.

7. Aligned the NHDP-MIB and the OLSRv2-MIB configuration tables and indexing.

Appendix B. Open Issues

This section contains the set of open issues related to the development and design of the NHDP-MIB. This section will not be present in the final version of the MIB and will be removed once all the open issues have been resolved.

1. How to handle dynamic parameters within NHDP? Should we expose setting, min and max values?

2. Need to address how to handle Link Quality settings and parameters for a) optional operation and b) changing nature of link quality.

3. What notifications are of interest and utility?

4. Identify all objects requiring non-volatile storage in their DESCRIPTION clauses.

5. Incorporate parameter relationship conditions into their DESCRIPTION clauses.

6. Also, specify specific SNMP response to the snmp set request, i.e., 'generic error', 'bad value', etc.

7. Fill in all of the DEFVAL within the configuration group objects.

8. Run through the MIB checker.

9. Clean up all of the 'Note:' statements within the body of the MIB.

10. Work on the Security Section. This MIB does have settable objects, but not sensitive objects (true?).

11. Work on the relationship to other MIBs, IF-MIB, NHDP-MIB.

12. Cleanup all the [TODOs] from the MIB template.

Appendix C.

```
   ************************************************************
   * Note to the RFC Editor (to be removed prior to publication) *
   *                                                          *
   * 1) The reference to RFCXXXX within the DESCRIPTION clauses  *
   * of the MIB module point to this draft and are to be      *
   * assigned by the RFC Editor.                              *
   *                                                          *
   * 2) The reference to RFCXXX2 throughout this document point  *
   * to the current draft-ietf-manet-nhdp-mib-xx.txt.  This   *
   * need to be replaced with the XXX RFC number.             *
   *                                                          *
   ************************************************************
```

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