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Definition of Managed Objects for the Neighborhood Discovery Protocol  
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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) 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:

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

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

## 5. Structure of the MIB Module

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

- o nhdpNotifications - objects defining NHDP MIB notifications.
- o nhdpObjects - defining objects within this MIB. The objects are arranged into the following groups:
  - \* 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 instance 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.
- o nhdpConformance - defining the minimal and maximal conformance requirements for implementations of this MIB.

### 5.1. Textual Conventions

This section is TBD.

### 5.2. The Configuration Group

The device is configured with a set of controls. The list of configuration controls for the NHDP-MIB (found in [NHDP]), are discussed in the following subsections.

#### 5.2.1. Interface Parameters

The Interface Parameters include:

#### 5.2.1.1. Message Intervals

- o 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 [RFC5148].
- o 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 [RFC5148].)
- o REFRESH\_INTERVAL - is the maximum interval between advertisements, in a HELLO message on this MANET interface, of each 1-hop neighbor network address and its status. In all intervals of length REFRESH\_INTERVAL, a router MUST include each 1-hop neighbor network address and its status in at least one HELLO message on this MANET interface. (This may be in the same or in different HELLO messages.)

The following constraints apply to these interface parameters:

- o HELLO\_INTERVAL > 0
- o HELLO\_MIN\_INTERVAL >= 0
- o HELLO\_INTERVAL >= HELLO\_MIN\_INTERVAL
- o REFRESH\_INTERVAL >= HELLO\_INTERVAL
- o If an INTERVAL\_TIME message TLV as defined in [RFC5497] is included in a HELLO message, then HELLO\_INTERVAL MUST be representable as described in [RFC5497].

The following default values are recommended:

- o HELLO\_INTERVAL := 2 seconds
- o HELLO\_MIN\_INTERVAL := HELLO\_INTERVAL/4
- o REFRESH\_INTERVAL := HELLO\_INTERVAL

#### 5.2.1.2. Information Validity Times

Parameters related to the Information Validity Times include:

- o L\_HOLD\_TIME - is the period of advertisement, on this MANET interface, of former 1-hop neighbor network addresses as lost in HELLO messages, allowing recipients of these HELLO messages to accelerate removal of this information from their Link Sets. L\_HOLD\_TIME MAY be set to zero, if accelerated information removal is not required.
- o H\_HOLD\_TIME - is used as the Value in the VALIDITY\_TIME Message TLV included in all HELLO messages on this MANET interface. It is then used by each router receiving such a HELLO message to indicate the validity of the information taken from that HELLO message and recorded in the receiving router's Information Bases.

The following constraints apply to these interface parameters:

- o L\_HOLD\_TIME >= 0
- o H\_HOLD\_TIME >= REFRESH\_INTERVAL
- o If HELLO messages can be lost then both SHOULD be significantly greater than REFRESH\_INTERVAL.
- o H\_HOLD\_TIME MUST be representable as described in [RFC5497].

The following default values are recommended:

- o H\_HOLD\_TIME := 3 x REFRESH\_INTERVAL
- o L\_HOLD\_TIME := H\_HOLD\_TIME

#### 5.2.1.3. 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  $0 \leq \text{HYST\_REJECT} \leq \text{HYST\_ACCEPT} \leq 1$
- o  $0 \leq \text{INITIAL\_QUALITY} \leq 1$ .
- o If link quality is not updated, then  $\text{INITIAL\_QUALITY} \geq \text{HYST\_ACCEPT}$ .
- o If  $\text{INITIAL\_QUALITY} \geq \text{HYST\_ACCEPT}$ , then  $\text{INITIAL\_PENDING} := \text{false}$ .
- o If  $\text{INITIAL\_QUALITY} < \text{HYST\_REJECT}$ , then  $\text{INITIAL\_PENDING} := \text{true}$ .

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. As such, it is a "link admission" mechanism.

Link quality information for a link is generated (e.g., through access to signal to noise ratio, packet loss rate, or other information from the link layer) and used only locally, i.e. is not included in signaling, and routers may interoperate whether they are using the same, different, or no, link quality information.

In order for a router to not employ link quality, the router MUST define:

- o  $\text{INITIAL\_PENDING} := \text{false}$
- o  $\text{INITIAL\_QUALITY} \geq \text{HYST\_REJECT}$  (there is no reason not to define  $\text{INITIAL\_QUALITY} := 1$ ).

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

- o  $\text{HYST\_ACCEPT} := 1$
- o  $\text{HYST\_REJECT} := 0$
- o  $\text{INITIAL\_QUALITY} := 1$
- o  $\text{INITIAL\_PENDING} := \text{false}$

#### 5.2.1.4. Jitter

If jitter, as defined in [RFC5148], is used then these parameters are as follows:

- o HP\_MAXJITTER - represents the value of MAXJITTER used in [RFC5148] for periodically generated HELLO messages on this MANET interface.
- o HT\_MAXJITTER - represents the value of MAXJITTER used in [RFC5148] for externally triggered HELLO messages on this MANET interface.

For constraints on these interface parameters see [RFC5148].

The following default values are recommended:

- o HP\_MAXJITTER := HELLO\_INTERVAL/4
- o HT\_MAXJITTER := HP\_MAXJITTER
- o C := 1/1024 second

#### 5.2.2. Router Parameters

The following Router Parameters apply:

##### 5.2.2.1. Information Validity Time

- o N\_HOLD\_TIME - is used as the period during which former 1-hop neighbor network addresses are advertised as lost in HELLO messages, allowing recipients of these HELLO messages to accelerate removal of this information from their 2-Hop Sets. N\_HOLD\_TIME MAY be set to zero, if accelerated information is not required.
- o I\_HOLD\_TIME - is the period for which a recently used local interface network address is recorded.

The following constraints applies to these router parameters:

- o N\_HOLD\_TIME >= 0
- o I\_HOLD\_TIME >= 0

#### 5.3. The State Group

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

The Local Information Base (LIB), contains the network 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 records its local interfaces. It consists of Local Interface Tuples, one per interface. Note that the information from this set is contained in the `nhdpInterfaceTable`, which is defined by this MIB document. Therefore, the Local Interface Set is not defined as an object in this MIB.
- o The "Removed Interface Address Set", which records network addresses which were recently used as local interface network addresses. If a router's interface network addresses are immutable then the Removed Interface Address Set is always empty and MAY be omitted. It consists of Removed Interface Address Tuples, one per network address.

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:

- o 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.
- o 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:

- o A "Neighbor Set", which records all network addresses of each 1-hop neighbor. It consists of Neighbor Tuples, each representing a single 1-hop neighbor
- o A "Lost Neighbor Set", which records network addresses of routers which recently were symmetric 1-hop neighbors, but which are now

advertised as lost. It consists of Lost Neighbor Tuples, each representing a single such network address

#### 5.4. 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:

- o Total number of sent HELLO messages on an interface

This is a Base Object.

Object name: nhdpIfHelloMessageXmits

Object type: Counter32

- o Total number of received HELLO messages on an interface

This is a Base Object.

Object name: nhdpIfHelloMessageRecvd

Object type: Counter32

- o Total number of sent periodic HELLO messages on an interface

This is a Base Object.

Object name: nhdpIfHelloMessagePeriodicXmits

Object type: Counter32

- o Total number of sent triggered HELLO messages on an interface

This is a Base Object.

Object name: nhdpIfHelloMessageTriggeredXmits

Object type: Counter32

- o 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)

- o 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)

- o 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)

- o 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

- o 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

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

This is a Base Object.

Object name: nhdpIfHelloMessageXmitAccumulatedSize

Object type: Counter32

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

This is a Base Object.

Object name: nhdpIfHelloMessageRecvdAccumulatedSize

Object type: Counter32

- o 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

- o 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

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

This is a Base Object.

Object name:  
nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount

Object type: Counter32

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

This is a Base Object.

Object name:  
nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount

Object type: Counter32

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

This is a Base Object.

Object name: nhdpIfHelloMessageXmitAccumulatedLostNeighborCount

Object type: Counter32

- o 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

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

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

Object name: nhdpDiscIfRevdPacketsSuccessRate

Object type: Float32

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

- o 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

- o 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

- o 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)

- o 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:

- o 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

o 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

o 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

o 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.

- o 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

- o 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)

- o 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:

- o 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

- o 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)

- o 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:

- o 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

- o 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)

- o 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:

- o 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. 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 an initial stage.
-- Not all proposed objects have been identified yet
-- in the current draft.
```

```
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 "200911091000Z" -- November 09, 2009

ORGANIZATION "IETF MANET working group"

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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      "200911091000Z"   -- November 09, 2009
DESCRIPTION
  "The fifth version of this MIB module,
   published as draft-ietf-manet-nhdp-mib-02.txt.
   Cleaned up a few things and updated to newest
   revision of NHDP draft."
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 receipt 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 receipt 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
--

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

--
-- nhdpConfigurationObjGrp
--

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

nhdpConfigurationObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 1 }

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. Kastenholz, 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,
    nhdpPHoldTime
        Unsigned32,
    nhdpHystAcceptQuality
        Unsigned32,
    nhdpHystRejectQuality
        Unsigned32,
    nhdpInitialQuality
        Unsigned32,
    nhdpInitialPending
        TruthValue,
    nhdpHpMaxJitter
        Unsigned32,
    nhdpHtMaxJitter
        Unsigned32,
    nhdpIfRowStatus
        RowStatus
}
```

```
nhdpIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndexOrZero
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The ifIndex for this interface."
 ::= { nhdpInterfaceEntry 1 }
```

```
nhdpIfStatus OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The nhdpIfStatus indicates whether this interface is
        a MANET interface. A value of true(1) indicates
        that the interface is a MANET interface. A value of
        false(2) indicates that the interface is not a MANET
        interface. This corresponds to the I_manet parameter
        in the Local Interface Set, which is omitted in this MIB
        due to the redundancy with the nhdpInterfaceTable."
    DEFVAL { 2 }
 ::= { nhdpInterfaceEntry 2 }
```

```
--
-- Interface Parameters - Message Intervals
--
```

```
nhdpHelloInterval OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "milliseconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The nhdpHelloInterval is the maximum time
        between the transmission of two successive
        HELLO messages on this MANET interface.

        The following constraints apply to this
        parameter:
            nhdpHelloInterval >= 0
            nhdpHelloInterval >= nhdpHelloMinInterval"
    REFERENCE
        "The NHDP draft.
        Section 5 on Protocol Parameters and
        Constraints."
    DEFVAL { 2000 }
 ::= { nhdpInterfaceEntry 3 }
```

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

"The nhpdHelloMinInterval is the minimum interval between transmission of two successive HELLO messages, on this MANET interface.

The following constraints apply to this parameter:

nhdpHelloMinInterval >= 0"

REFERENCE

"The NHDP draft.  
Section 5 on Protocol Parameters and  
Constraints."

DEFVAL { 500 }

::= { nhdpInterfaceEntry 4 }

nhdpRefreshInterval OBJECT-TYPE

SYNTAX Unsigned32

UNITS "milliseconds"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The nhdpRefreshInterval is the maximum interval between advertisements, in a HELLO message on this MANET interface, of each 1-hop neighbor network address and its status.

The following constraint applies to this parameter:

nhdpRefreshInterval >= nhdpHelloInterval"

REFERENCE

"The NHDP draft.  
Section 5 on Protocol Parameters and  
Constraints."

DEFVAL { 2000 }

::= { nhdpInterfaceEntry 5 }

--

-- Interface Parameters - Information Validity times

--

nhdpLHoldTime OBJECT-TYPE

SYNTAX Unsigned32

UNITS "milliseconds"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The nhdpLHoldTime 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:

nhdpLHoldTime >= 0"

REFERENCE

"The NHDP draft.  
Section 5 on Protocol Parameters and Constraints."

DEFVAL { 6000 }

::= { nhdpInterfaceEntry 6 }

nhdpPHoldTime OBJECT-TYPE

SYNTAX Unsigned32

UNITS "milliseconds"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The nhdpPHoldTime 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:

nhdpPHoldTime >= 0"

REFERENCE

"The NHDP draft.  
Section 5 on Protocol Parameters and Constraints."

DEFVAL { 6000 }

::= { nhdpInterfaceEntry 7 }

--

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

-- Note: Can we set a Float32 value here ranging  
-- from 0.0 to 1.0?

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 applies to this  
parameter:

0 <= nhdpHystRejectQuality  
<= nhdpHystAcceptQuality <= 255"

## REFERENCE

"The NHDP draft.  
Section 5 on Protocol Parameters and  
Constraints."

DEFVAL { 255 }

::= { 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 applies to this  
parameter:

0 <= nhdpHystRejectQuality  
<= nhdpHystAcceptQuality <= 255"

## REFERENCE

"The NHDP draft.  
Section 5 on Protocol Parameters and  
Constraints."

DEFVAL { 0 }

::= { 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 applies to this  
parameter:

0 <= nhdpInitialQuality <= 255"

## REFERENCE

```
        "The NHDP draft.
        Section 5 on Protocol Parameters and
        Constraints."
    DEFVAL { 255 }
 ::= { nhdpInterfaceEntry 10 }

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

nhdpInitialPending OBJECT-TYPE
    SYNTAX      TruthValue
    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."
    REFERENCE
        "The NHDP draft.
        Section 5 on Protocol Parameters and
        Constraints."
    DEFVAL { 2 }
 ::= { nhdpInterfaceEntry 11 }

--
-- Interface Parameters - Jitter
--

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."
    REFERENCE
        "The NHDP draft.
        Section 5 on Protocol Parameters and
        Constraints."
```

```
    DEFVAL { 500 }
 ::= { nhdpInterfaceEntry 12 }

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."
    REFERENCE
        "The NHDP draft.
         Section 5 on Protocol Parameters and
         Constraints."
    DEFVAL { 500 }
 ::= { nhdpInterfaceEntry 13 }

nhdpIfRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object permits management of the table
         by facilitating actions such as row creation,
         construction, and destruction. The value of
         this object has no effect on whether other
         objects in this conceptual row can be
         modified."
    REFERENCE
        "The NHDP draft."
 ::= { nhdpInterfaceEntry 14 }

--
-- Router Parameters - Information Validity Time
--

nhdpNHoldTime OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "milliseconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The nhdpNHoldTime 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 applies to this parameter:

```
nhdpHHoldTime >= 0"
```

REFERENCE

"The NHDP draft.

Section 5 on Protocol Parameters and Constraints."

```
DEFVAL { 6000 }
```

```
::= { nhdpConfigurationObjGrp 2 }
```

```
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 applies to this parameter:

```
nhdpIHoldTime >= 0 "
```

REFERENCE

"The NHDP draft.

Section 5 on Protocol Parameters and Constraints."

```
DEFVAL { 6000 }
```

```
::= { nhdpConfigurationObjGrp 3 }
```

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

nhdpStateObjGrp    OBJECT IDENTIFIER ::= { nhdpObjects 2 }

-- 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 NhdDiscIfSetEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A router's set of discovered interfaces on
        neighboring routers."
    REFERENCE
        "The NHDP draft."
    ::= { nhdpStateObjGrp 1 }

-- Note: need to describe how to age out
-- the entries in this table?
nhdpDiscIfSetEntry OBJECT-TYPE
    SYNTAX          NhdDiscIfSetEntry
    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."

## 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 neighboring 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 neighbor's interface. Used for cross indexing into other NHDP tables and other

```
        MIBs."
REFERENCE
    "This NHDP-MIB draft."
 ::= { nhdpDiscIfSetEntry 2 }

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

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

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

nhdpLibRemovedIfAddrSetTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF NhdplibRemovedIfAddrSetEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A router's Removed Interface Address Set records
        network addresses which were recently used as local
        interface network addresses. If a router's interface
        network addresses are immutable then the Removed
        Interface Address Set is always empty and MAY be omitted.
        It consists of Removed Interface Address Tuples, one
        per network address."
    REFERENCE
        "The NHDP draft."
 ::= { nhdpStateObjGrp 2 }

nhdpLibRemovedIfAddrSetEntry OBJECT-TYPE
    SYNTAX          NhdplibRemovedIfAddrSetEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A router's Removed Interface Address Set consists
        of Removed Interface Address Tuples, one per network
        address:

        (IR_local_iface_addr, IR_time)

        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 { nhdpLibRemovedIfAddrSetIpAddr }
 ::= { nhdpLibRemovedIfAddrSetTable 1 }

```

```

NhdpLibRemovedIfAddrSetEntry ::=
SEQUENCE {
    nhdpLibRemovedIfAddrSetIpAddrType
        InetAddressType,
    nhdpLibRemovedIfAddrSetIpAddr
        InetAddress,
    nhdpLibRemovedIfAddrSetIpAddrPrefixLen
        InetAddressPrefixLength,
    nhdpLibRemovedIfAddrSetIfIndex
        InterfaceIndexOrZero,
    nhdpLibRemovedIfAddrSetIrTime
        Unsigned32
}

```

```

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

```

```

nhdpLibRemovedIfAddrSetIpAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The nhdpLibRemovedIfAddrSetAddr is a
    recently used address of an interface of
    this router."
REFERENCE
    "The NHDP draft."
 ::= { nhdpLibRemovedIfAddrSetEntry 2 }

```

```

nhdpLibRemovedIfAddrSetIpAddrPrefixLen 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."
 ::= { nhdpLibRemovedIfAddrSetEntry 3 }

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

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

nhdpLibRemovedIfAddrSetIrTime 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."
 ::= { nhdpLibRemovedIfAddrSetEntry 5 }

-- Interface Information Base (IIB)
--
-- NHDP Interface Information Base (IIB)
--
--      IIB Link Set
--      Entry (foreach 1-H neighbor): (NeighborIfAddrList,
--                                     HeardTime,
--                                     SymTime,
--                                     Quality,
--                                     Pending,
--                                     Lost,
```

```
--                               ExpireTime)

nhdpIibLinkSetTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF NhdpiibLinkSetEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A Link Set of an interface records links from
        other routers which are, or recently
        were, 1-hop neighbors."
    REFERENCE
        "The NHDP draft."
 ::= { nhdpStateObjGrp 3 }

nhdpIibLinkSetEntry OBJECT-TYPE
    SYNTAX          NhdpiibLinkSetEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A Link Set 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)."
```

```
    }

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
        'nhdpiibDiscIfSetTable' 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 2-Hop Set of an interface records network
    addresses of symmetric 2-hop neighbors, and
    the symmetric links to symmetric 1-hop neighbors
    through which these symmetric 2-hop neighbors
    can be reached. It consists of 2-Hop Tuples,
    each representing a single network address of
    a symmetric 2-hop neighbor, and a single MANET
```

```
interface of a symmetric 1-hop neighbor.

    (N2_neighbor_iface_addr_list,
     N2_2hop_addr, N2_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 an expiration time."
```

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 nhdpIib2HopSetIpAddress
     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 NhdpNextNeighborSetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A router's Neighbor Set records all network
        addresses of each 1-hop neighbor."
    REFERENCE
        "The NHDP draft."
 ::= { nhdpStateObjGrp 5 }
```

```
nhdpNibNeighborSetEntry OBJECT-TYPE
    SYNTAX      NhdpNextNeighborSetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A router's Neighbor Set consists
        of Neighbor Tuples, each representing
        a single 1-hop neighbor:

        (N_neighbor_addr_list,
         N_symmetric)"
    REFERENCE
        "This NHDP-MIB draft."
    INDEX { nhdpNibNeighborSetRouterId }
 ::= { nhdpNibNeighborSetTable 1 }
```

```
NhdpNextNeighborSetEntry ::=
    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 network
        addresses of routers which recently were
        symmetric 1-hop neighbors, but which are now
        advertised as lost."

```

```
REFERENCE
    "The NHDP draft."
 ::= { nhdpStateObjGrp 6 }

nhdpNibLostNeighborSetEntry OBJECT-TYPE
    SYNTAX      NhdpNibLostNeighborSetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A router's Lost Neighbor Set consists of
        Lost Neighbor Tuples, each representing a
        single such network address:

        (NL_neighbor_addr, NL_time)"
    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 3 }

--
-- 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 NhdDiscIfSetPerfEntry
    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      NhdDiscIfSetPerfEntry
    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 neighboring 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 NhdDiscNeighborSetPerfEntry
    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      NhdDiscNeighborSetPerfEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The entries include the nhdpDiscRouterId of
        the discovered router, as well as performance
        objects related to changes of the Neighbor
        Set."
```

```

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 neighboring 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."
 ::= { nhdpDiscNeighborSetUpPerfEntry 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 contains performance objects per
        discovered 2-hop neighbor."

```

```
REFERENCE
    "The NHDP draft."
 ::= { nhdpPerformanceObjGrp 5 }

nhdpIib2HopSetPerfEntry OBJECT-TYPE
    SYNTAX      Nhdpiib2HopSetPerfEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The entries contain performance objects per
         discovered 2-hop neighbor."
    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
    "The basic implementation requirements for
```

```
        managed network entities that implement
        NHDP."
MODULE -- this module
-- MANDATORY-GROUPS { nhdpGeneralGroup,
--                    nhdpConfigurationGroup }
MANDATORY-GROUPS { nhdpConfigurationGroup }

 ::= { nhdpCompliances 1 }

nhdpFullCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
    "The full implementation requirements for
    managed network entities that implement
    NHDP."
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,
    nhdpDiscIfSetIpAddressType,
    nhdpDiscIfSetIpAddressPrefixLen,
    nhdpLibRemovedIfAddrSetIpAddressType,
    nhdpLibRemovedIfAddrSetIpAddressPrefixLen,
    nhdpLibRemovedIfAddrSetIfIndex,
    nhdpLibRemovedIfAddrSetIrTime,
    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:

- o [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.
- [NHDP] Clausen, T., Dearlove, C., and J. Dean, "The MANET Neighborhood Discovery Protocol (NHDP)", draft-ietf-manet-nhdp-11 (work in progress), October 2009.
- [REPORT] Cole, R., Macker, J., and A. Morton, "The MANET Report MIB", June 2009.
- [RFC5148] Clausen, T., Dearlove, C., and B. Adamson, "Jitter Considerations in Mobile Ad Hoc Networks (MANETs)", RFC 5148, February 2008.
- [RFC5497] Clausen, T. and C. Dearlove, "Representing Multi-Value Time in Mobile Ad Hoc Networks (MANETs)", RFC 5497, March 2009.

### 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.

### 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-01 draft to generate the draft-ietf-manet-nhdp-mib-02 draft.

1. Cleaned up several things (e.g. moved N\_HOLD\_TIME from interface parameter to router paramter)
2. Updated to NHDP draft version 11

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 an 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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