Definition of Managed Objects for the Neighborhood Discovery Protocol

Abstract

This document 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 parameters of the Neighborhood Discovery Protocol (NHDP) process on a router. The MIB module defined in this document, denoted NHDP-MIB, also reports state, performance information, and notifications about NHDP. This additional state and performance information is useful to troubleshoot problems and performance issues during neighbor discovery.

Status of This Memo

This is an Internet Standards Track document.

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Table of Contents

1. Introduction .................................................. 3
2. The Internet-Standard Management Framework .................. 3
3. Conventions .................................................... 3
4. Overview ...................................................... 3
   4.1. Terms ................................................... 4
   4.2. Notation ................................................ 4
5. Structure of the MIB Module .................................. 4
   5.1. Notifications .......................................... 5
      5.1.1. Introduction ..................................... 5
      5.1.2. Notification Generation ........................... 5
      5.1.3. Limiting Frequency of Notifications .............. 5
   5.2. The Configuration Group ................................ 6
   5.3. The State Group ......................................... 7
   5.4. The Performance Group .................................. 7
   5.5. Tables and Indexing .................................... 7
6. Relationship to Other MIB Modules ........................... 9
   6.1. Relationship to the SNMPv2-MIB .......................... 9
   6.2. Relationship to Routing Protocol MIB Modules Relying on the NHDP-MIB Module ......................... 10
   6.3. MIB Modules Required for IMPORTS ....................... 10
7. Definitions .................................................... 10
8. Security Considerations ...................................... 62
9. Applicability Statement ...................................... 64
10. IANA Considerations .......................................... 65
11. Acknowledgements ........................................... 65
12. References ................................................... 65
   12.1. Normative References .................................. 65
   12.2. Informative References ................................. 66
1. Introduction

This document 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 parameters of the Neighborhood Discovery Protocol (NHDP) [RFC6130] process on a router. The MIB module defined in this document, denoted NHDP-MIB, also reports state, performance information, and notifications about NHDP. This additional state and performance information is useful to troubleshoot problems and performance issues during neighbor discovery.

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", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

4. Overview

[RFC6130] allows a router to discover and track topological information of routers up to two hops away by virtue of exchanging HELLO messages. 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:

- Notification Objects - triggers and associated notification messages allowing for asynchronous tracking of pre-defined events on the managed router.
- Configuration Objects - switches, tables, and objects that are initialized to default settings or set through the management interface defined by this MIB module.
- State Objects - automatically generated values that define the current operating state of the NHDP instance in the router.
- Performance Objects - automatically generated values that help an administrator or automated tool to assess the performance of the NHDP instance on the router and the overall discovery performance within the Mobile Ad Hoc Network (MANET).

4.2. Notation

The same notations as defined in [RFC6130] are used throughout this document.

5. Structure of the MIB Module

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

- nhdpNotifications - objects defining NHDP-MIB notifications.
- nhdpObjects - defining objects within this MIB module. The objects are arranged into the following groups:
  * Configuration Group - defining objects related to the configuration of the NHDP instance on the router.
  * State Group - defining objects that reflect the current state of the NHDP instance running on the router.
  * Performance Group - defining objects that are useful to a management station when characterizing the performance of NHDP on the router and in the MANET.
- nhdpConformance - defining the minimal and maximal conformance requirements for implementations of this MIB module.
5.1. Notifications

This section describes the use of notifications and mechanisms to enhance the ability to manage NHDP routing domains.

5.1.1. Introduction

Notifications can be emitted by a router running an instance of this specification as a reaction to a specific event. This allows a network manager to efficiently determine the source of problems or significant changes of configuration or topology, instead of polling a possibly large number of routers.

5.1.2. Notification Generation

When an exception event occurs, the application notifies the local agent, which sends a notification to the appropriate SNMP management stations. The message includes the notification type and may include a list of notification-specific variables. Section 7 contains the notification definitions, which includes the variable lists. At least one IP address of the router that originates the notification is included in the variable list so that the network manager may determine the source of the notification.

5.1.3. Limiting Frequency of Notifications

To limit the frequency of notifications, the following additional mechanisms are suggested, similar to those in [RFC4750].

5.1.3.1. Ignoring Initial Activity

The majority of critical events occur when NHDP is first enabled on a router, at which time the symmetric neighbors and two-hop neighbors of the router are discovered. During this initial period, a potential flood of notifications is unnecessary since the events are expected. To avoid unnecessary notifications, a router SHOULD NOT originate expected notifications until a certain time interval has elapsed, which is to be predefined by the network manager. It is RECOMMENDED that this time interval is at least 3 x nhdpHelloInterval, so that symmetric neighbors are discovered. The suppression window for notifications is started when the nhdpIfStatus transitions from its default value of ‘false(2)’ to ‘true(1)’.

5.1.3.2. Throttling Notifications

The mechanism for throttling the notifications is the same as in [RFC4750] (i.e., the number of transmitted notifications per time is bounded).
Appropriate values for the window time and upper bound are to be selected by the network manager and depend on the deployment of the MANET. If NHDP is deployed on a lossy, wireless medium, sending too many notifications in a short time interval may lead to collisions and dropped packets. In particular, in dense deployments of routers running NHDP (i.e., where each router has many neighbors), a change of the local topology may trigger many notifications at the same time. [RFC4750] recommends "7 traps with a window time of 10 seconds" as the upper bound. As NHDP is expected to be deployed in more lossy channels than OSPF, it is RECOMMENDED to choose a lower threshold for the number of notifications per time than that. Specifically, it is RECOMMENDED that the threshold value for the objects reflecting the change be set to a value of ‘10’ and the DEFAULT values for these objects within the Notifications Group be set to this value. Further, a time window for the change objects is defined within this MIB module. It is RECOMMENDED that if the number of occurrences exceeds the change threshold within the previous change window, then the notification is to be sent. Furthermore, it is RECOMMENDED that the value for this window be set to at least 5 times the nhdpHelloInterval.

The following objects are used to define the thresholds and time windows for specific notifications defined in the NHDP-MIB module: nhdpNbrStateChangeThreshold, nhdpNbrStateChangeWindow, nhdp2HopNbrStateChangeThreshold, and nhdp2HopNbrStateChangeWindow.

5.1.3.3. One Notification per Event

Similar to the mechanism in [RFC4750], only one notification is sent per event.

5.2. The Configuration Group

The router running NHDP is configured with a set of controls. The authoritative list of configuration controls within the NHDP-MIB module are found within the MIB module itself. Generally, an attempt was made in developing the NHDP-MIB module to support all configuration objects defined in [RFC6130]. For all of the configuration parameters, the same constraints and default values of these parameters as defined in [RFC6130] are followed. Refer to [RFC5148] for guidance on setting jitter-related parameters, e.g., nhdpMaxJitter.
5.3. The State Group

The State Group reports current state information of a router running NHDP. The NHDP-MIB State Group tables were designed to contain the complete set of state information defined within the information bases specified in Sections 6, 7, and 8 of [RFC6130].

Two constructs, i.e., TEXTUAL-CONVENTIONs, are defined to support the tables in the State Group. NHDP stores and indexes information through sets of (dynamically defined) addresses, i.e., address sets. Within SMIv2, it is not possible to index tables with variably defined address sets. Hence, these TEXTUAL-CONVENTIONs are defined to provide a local mapping between NHDP-managed address sets and SMIv2 table indexing. These constructs are the NeighborIfIndex and NeighborRouterIndex. These are locally (to the router) defined, unique identifiers of virtual neighbors and neighbor interfaces. Due to the nature of NHDP, the local router may have identified distinct address sets but is not able to associate these as a single interface. Hence, two or more NeighborIfIndexes pointing to multiple distinct address sets may, in fact, be related to a common neighbor interface. This ambiguity may also hold with respect to the assignment of the NeighborRouterIndex. The local MIB agent is responsible for managing, aggregating, and retiring the defined indexes and for updating MIB tables using these indexes as the local router learns more about its neighbors’ topologies. These constructs are used to define indexes to the appropriate State Group tables and to correlate table entries to address sets, virtual neighbor interfaces, and virtual neighbors within the MANET.

5.4. The Performance Group

The Performance Group reports values relevant to system performance. Unstable neighbors or 2-hop neighbors and frequent changes of sets can have a negative influence on the performance of NHDP. This MIB module defines several objects that can be polled in order to, e.g., calculate histories or monitor frequencies of changes. This may help the network administrator to determine unusual topology changes or other changes that affect stability and reliability of the MANET. One such framework is specified in [REPORT-MIB].

5.5. Tables and Indexing

The NHDP-MIB module contains a number of tables that record data related to:

- the local router,
- a local MANET interface on the router,
other routers that are 1 hop removed from the local router,

- interfaces on other routers that are 1 hop removed from the local router, and

- other routers that are 2 hops removed from the local router.

The NHDP-MIB module’s tables are indexed via the following constructs:

- `nhdpIfIndex` - the IfIndex of the local router on which NHDP is configured.

- `nhdpDiscIfIndex` - a locally managed index representing a known interface on a neighboring router.

- `nhdpDiscRouterIndex` - a locally managed index representing an ID of a known neighboring router.

These tables and their indexing are:

- `nhdpInterfaceTable` - describes the configuration of the interfaces of this router. This table has INDEX `{ nhdpIfIndex }.

- `nhdpLibLocalIfSetTable` - records all network addresses that are defined as local interface network addresses on this router. This table has INDEX `{ nhdpLibLocalIfSetIndex }.

- `nhdpLibRemovedIfAddrSetTable` - records network addresses that were recently used as local interface network addresses on this router but have been removed. This table has INDEX `{ nhdpLibRemovedIfAddrSetIndex }.

- `nhdpInterfaceStateTable` - records state information related to specific interfaces of this router. This table has INDEX `{ nhdpIfIndex }.

- `nhdpDiscIfSetTable` - includes the nhdpDiscRouterIndex of the discovered router, the nhdpDiscIfIndex of the discovered interface, and the current set of addresses associated with this neighbor interface. This table has INDEX `{ nhdpDiscIfSetIndex }.

- `nhdpLibLinkSetTable` - for each local interface, records all links belonging to other routers that are, or recently were, 1-hop neighbors to this router. This table has INDEX `{ nhdpIfIndex, nhdpDiscIfIndex }.
o nhdpIib2HopSetTable - for each local interface, records network addresses (one at a time) of symmetric 2-hop neighbors and the symmetric links to symmetric 1-hop neighbors of this router through which these symmetric 2-hop neighbors can be reached. This table has INDEX { nhdpIfIndex, nhdpDiscIfIndex, nhdpIib2HopSetIpAddressType, nhdpIib2HopSetIpAddress }.

o nhdpNibNeighborSetTable - records all network addresses of each 1-hop neighbor to this router. This table has INDEX { nhdpDiscRouterIndex }.

o nhdpNibLostNeighborSetTable - records network addresses of other routers that were recently symmetric 1-hop neighbors to this router but are now advertised as lost. This table has INDEX { nhdpDiscRouterIndex }.

o nhdpInterfacePerfTable - records performance objects that are measured for each local NHDP interface on this router. This table has INDEX { nhdpIfIndex }.

o nhdpDiscIfSetPerfTable - records performance objects that are measured for each discovered interface of a neighbor of this router. This table has INDEX { nhdpDiscIfIndex }.

o nhdpDiscNeighborSetPerfTable - records performance objects that are measured for discovered neighbors of this router. This table has INDEX { nhdpDiscRouterIndex }.

o nhdpIib2HopSetPerfTable - records performance objects that are measured for discovered 2-hop neighbors of this router. This table has INDEX { nhdpDiscRouterIndex }.

6. Relationship to Other MIB Modules

This section specifies the relationship of the MIB module contained in this document to other standards, particularly to standards containing other MIB modules. MIB modules and specific definitions imported from MIB modules that SHOULD be implemented in conjunction with the MIB module contained within this document are identified in this section.

6.1. Relationship to the SNMPv2-MIB

The System group in the SNMPv2-MIB module [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 module does not duplicate those objects.
6.2. Relationship to Routing Protocol MIB Modules Relying on the NHDP-MIB Module

[RFC6130] allows routing protocols to rely on the neighborhood information that is discovered by means of HELLO message exchange. In order to allow for troubleshooting, fault isolation, and management of such routing protocols through a routing protocol MIB module, it may be desired to align the State Group tables of the NHDP-MIB module and the routing protocol MIB module. This is accomplished through the definition of two TEXTUAL-CONVENTIONS in the NHDP-MIB module: the NeighborIfIndex and the NeighborRouterIndex. These object types are used to develop indexes into common NHDP-MIB module and routing protocol State Group tables. These objects are locally significant but should be locally common to the NHDP-MIB module and the routing protocol MIB module implemented on a common networked router. This will allow for improved cross-referencing of information across the two MIB modules.

6.3. MIB Modules Required for IMPORTS

The following NHDP-MIB module IMPORTS objects from SNMPv2-SMI [RFC2578], SNMPv2-TC [RFC2579], SNMPv2-CONF [RFC2580], IF-MIB [RFC2863], INET-ADDRESS-MIB [RFC4001], and FLOAT-TC-MIB [RFC6340].

7. Definitions

This section contains the MIB module defined by the specification.

NHDP-MIB DEFINITIONS ::= BEGIN

-- This MIB module defines objects for the management of
-- NHDP (RFC 6130) - The Neighborhood Discovery Protocol,
-- Clausen, T., Dearlove, C., and J. Dean, January 2011.

IMPORTS

MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
Counter32, Counter64, Integer32, Unsigned32, mib-2,
TimeTicks
FROM SNMPv2-SMI -- RFC 2578

TEXTUAL-CONVENTION, TruthValue, TimeStamp,
RowStatus
FROM SNMPv2-TC -- RFC 2579

MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
FROM SNMPv2-CONF -- STD 58
SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB -- RFC 3411

InetAddressType, InetAddress,
InetAddressPrefixLength
    FROM INET-ADDRESS-MIB -- RFC 4001
InterfaceIndex
    FROM IF-MIB -- RFC 2863

Float32TC
    FROM FLOAT-TC-MIB -- RFC 6340
;

nhdpMIB MODULE-IDENTITY
    LAST-UPDATED "2012102221000Z" -- 22 October 2012
    ORGANIZATION "IETF MANET Working Group"
    CONTACT-INFO
        "WG E-Mail: manet@ietf.org"
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              http://www.cs.jhu.edu/~rgcole/
DESCRIPTION
"This NHDP-MIB module is applicable to routers implementing the Neighborhood Discovery Protocol defined in RFC 6130.

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This version of this MIB module is part of RFC 6779; see the RFC itself for full legal notices."

-- revision
REVISION "201210221000Z" -- 22 October 2012
DESCRIPTION
"Initial version of this MIB module, published as RFC 6779."
 ::= { mib-2 213 }

-- Top-Level Components of this MIB Module

-- nhdpNotifications OBJECT IDENTIFIER ::= { nhdpMIB 0 }
nhdpObjects       OBJECT IDENTIFIER ::= { nhdpMIB 1 }
nhdpConformance   OBJECT IDENTIFIER ::= { nhdpMIB 2 }

-- TEXTUAL-CONVENTIONS

-- Two new TEXTUAL-CONVENTIONS have been defined in this MIB module for indexing into the following tables and indexing into other tables in other MIB modules.
-- This was necessary because NHDP manages and
indexes based upon dynamic address tuples, i.e.,
address sets, while SMI requires statically
defined indexes for accessing its table rows.
The NeighborIfIndex defines a unique (to the local router)
index referencing a discovered virtual interface on another
neighbor within the MANET. The NeighborRouterIndex defines a
unique (to the local router) index referencing a discovered
virtual neighbor within the MANET.

Due to the nature of NHDP,
different indexes may be related to common neighbor
interfaces or common neighbor routers, but the information
obtained through NHDP has not allowed the local router
to relate these virtual objects (i.e., interfaces or routers)
at this point in time. As more topology information
is gathered by the local router, it may associate
virtual interfaces or routers and collapse these
indexes appropriately.

Multiple addresses can be associated with a
given NeighborIfIndex. Each NeighborIfIndex is
associated with a NeighborRouterIndex. Throughout
the nhdpStateObjGroup, the
NeighborIfIndex and the NeighborRouterIndex are used
to define the set of IpAddr related to a virtual
neighbor interface or virtual neighbor under discussion.

NeighborIfIndex ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS current
DESCRIPTION
"An arbitrary, locally unique identifier associated with a
virtual interface of a discovered NHDP neighbor.
Due to the nature of NHDP, the local router
may not know if two distinct addresses belong to the
same interface of a neighbor or to two different
interfaces. As the local router gains more
knowledge of its neighbors, its local view may change, and
this table will be updated to reflect the local router’s
current understanding, associating address sets to neighbor
interfaces. The local router identifies a virtual neighbor
interface through the receipt of address lists advertised
through an NHDP HELLO message.

All objects of type NeighborIfIndex are assigned by the agent
out of a common number space.
The value for each discovered virtual neighbor interface may not remain constant from one re-initialization of the entity’s network management agent to the next re-initialization. If the local router gains information associating two virtual interfaces on a neighbor as a common interface, then the agent MUST aggregate the two address sets to a single index chosen from the set of aggregated indexes, and it MUST update all tables in this MIB module that are indexed by indexes of type NeighborIfIndex. It MAY then reuse freed index values following the next agent restart.

The specific value is meaningful only within a given SNMP entity.

**SYNTAX**

`Unsigned32 (1..2147483647)`

**NeighborRouterIndex ::= TEXTUAL-CONVENTION**

**DISPLAY-HINT** "d"

**STATUS** current

**DESCRIPTION**

"An arbitrary, locally unique identifier associated with a virtual discovered neighbor (one or two hop). Due to the nature of NHDP, the local router may identify multiple virtual neighbors that, in fact, are one and the same. Neighbors that are two hops away with more than one advertised address will exhibit this behavior. As the local router’s knowledge of its neighbors’ topology increases, the local router will be able to associate multiple virtual neighbor indexes into a single virtual neighbor index chosen from the set of aggregated indexes; it MUST update all tables in this MIB module indexed by these indexes, and it MAY reuse the freed indexes following the next agent re-initialization.

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

The NeighborRouterIndex defines a discovered NHDP peer virtual neighbor of the local router. The value for each discovered virtual neighbor index MUST remain constant at least from one re-initialization of the entity’s network management agent to the next re-initialization, except if an application is deleted and re-created.

The specific value is meaningful only within a given SNMP entity. A NeighborRouterIndex value MUST not be reused.
until the next agent restart.

SYNTAX       Unsigned32 (1..2147483647)

--
-- nhdpObjects
--

--  1) Configuration Objects Group
--  2) State Objects Group
--  3) Performance Objects Group
--

-- nhdpConfigurationObjGrp
--

-- Contains the NHDP objects that configure specific options
-- that determine the overall performance and operation of
-- NHDP.

nhdpConfigurationObjGrp  OBJECT IDENTIFIER ::= { nhdpObjects 1 }


nhdpInterfaceTable  OBJECT-TYPE
SYNTAX      SEQUENCE OF NhdpInterfaceEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The nhdpInterfaceTable describes the
configuration of the interfaces of this router
that are intended to use MANET control protocols.
As such, this table ‘sparse augments’ the ifTable
specifically when NHDP is to be configured to
operate over this interface. The interface is
identified by the ifIndex from the interfaces
group defined in the Interfaces Group MIB module.

A conceptual row in this table exists if and only
if either a manager has explicitly created the row
or there is an interface on the managed device
that supports and runs NHDP.

The manager can create a row by setting
rowStatus to ‘createAndGo’ or ‘createAndWait’.
Row objects having associated DEFVAL clauses are
automatically defined by the agent with these
values during row creation, unless the manager
explicitly defines these object values during the
row creation."
If the corresponding entry with ifIndex value
is deleted from the Interface Table, then the entry
in this table is automatically deleted,
NHDP is disabled on this interface,
and all configuration and state information
related to this interface is to be removed
from memory."

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 nhdpInterfaceEntry describes one NHDP
local interface configuration as indexed by
its ifIndex as defined in the Standard MIB II
Interface Table (RFC 2863).

The objects in this table are persistent, and when
written, the device SHOULD save the change to
non-volatile storage. For further information
on the storage behavior for these objects, refer
to the description for the nhdpIfRowStatus
object."

INDEX { nhdpIfIndex }
::= { nhdpInterfaceTable 1 }

NhdpInterfaceEntry ::= SEQUENCE {
    nhdpIfIndex InterfaceIndex,
    nhdpIfName SnmpAdminString,
    nhdpIfStatus TruthValue,
    nhdpHelloInterval Unsigned32,
    nhdpHelloMinInterval Unsigned32,
    nhdpRefreshInterval Unsigned32,
    nhdpLHoldTime Unsigned32,
    nhdpHHoldTime
}
Unsigned32,
nhdpHystAcceptQuality
  Float32TC,
nhdpHystRejectQuality
  Float32TC,
nhdpInitialQuality
  Float32TC,
nhdpInitialPending
  TruthValue,
nhdpHpMaxJitter
  Unsigned32,
nhdpHtMaxJitter
  Unsigned32,
nhdpIfRowStatus
  RowStatus
}

nhdpIfIndex OBJECT-TYPE
  SYNTAX     InterfaceIndex
  MAX-ACCESS not-accessible
  STATUS     current
  DESCRIPTION
    "This value MUST correspond to an ifIndex referring
to a valid entry in the Interfaces Table."
  REFERENCE
    "RFC 2863 - The Interfaces Group MIB, McCloghrie, K.,
and F. Kastenholtz, June 2000"
  ::= { nhdpInterfaceEntry 1 }

nhdpIfName OBJECT-TYPE
  SYNTAX     SnmpAdminString
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The textual name of the interface. The value of this
object SHOULD be the name of the interface as assigned by
the local device. This can be a text-name, such as 'le0'
or a simple port number, such as '1',
depending on the interface-naming syntax of the device.

If there is no local name or this object is otherwise not
applicable, then this object contains a zero-length string."

  ::= { nhdpInterfaceEntry 2 }

nhdpIfStatus OBJECT-TYPE
  SYNTAX     TruthValue
  MAX-ACCESS read-create
  STATUS     current
DESCRIPTION

"nhdpIfStatus indicates whether this interface is currently running NHDP. A value of ‘true(1)’ indicates that NHDP is running on this interface. A value of ‘false(2)’ indicates that NHDP is not currently running on this interface. This corresponds to the _I_manet parameter in the Local Interface Set of NHDP."

DEFVAL { false }
::= { nhdpInterfaceEntry 3 }

-- Interface Parameters - Message Intervals --

nhdpHelloInterval OBJECT-TYPE
SYNTAX Unsigned32
UNITS "milliseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"nhdpHelloInterval corresponds to HELLO_INTERVAL of NHDP and represents the maximum time between the transmission of two successive HELLO messages on this MANET interface.

Guidance for setting this object may be found in Section 5 of the NHDP specification (RFC 6130), which indicates that:
  o nhdpHelloInterval > 0
  o nhdpHelloInterval >= nhdpHelloMinInterval"

REFERENCE

"Section 5 on Protocol Parameters and Constraints of RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

DEFVAL { 2000 }
::= { nhdpInterfaceEntry 4 }

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

"nhdpHelloMinInterval corresponds to HELLO_MIN_INTERVAL of NHDP and represents
the minimum interval between transmission
of two successive HELLO messages on this
MANET interface.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that:
o nhdpHelloMinInterval <= nhdpHelloInterval

REFERENCE
"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"
DEFVAL { 500 } ::= { nhdpInterfaceEntry 5 }

nhdpRefreshInterval OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "milliseconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
"nhdpRefreshInterval corresponds to
REFRESH_INTERVAL of NHDP and represents the
maximum interval between advertisements of
each 1-hop neighbor network address and its
status. Each advertisement is in a HELLO
message on this MANET interface.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that:
o nhdpRefreshInterval >= nhdpHelloInterval"

REFERENCE
"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"
DEFVAL { 2000 } ::= { nhdpInterfaceEntry 6 }

--
-- Interface Parameters - Information Validity times
--

nhdpLHoldTime OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "milliseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"nhdpLHoldTime corresponds to
L_HOLD_TIME of NHDP and represents 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.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that it should be assigned a
value significantly greater than the refresh
interval held by nhdpRefreshInterval."

REFERENCE

"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"
DEFVAL { 6000 }

::= { nhdpInterfaceEntry 7 }
nhwndHHoldTime OBJECT-TYPE
SYNTAX Unsigned32
UNITS "milliseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"nhwdHHoldTime corresponds to
H_HOLD_TIME of NHDP and 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.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that it should be assigned a
value significantly greater than the refresh interval
held by nhdpRefreshInterval and must be representable
as described in RFC 5497."

REFERENCE

"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
nhdpHystAcceptQuality OBJECT-TYPE
SYNTAX Float32TC
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"nhdpHystAcceptQuality corresponds to
HYST_ACCEPT of NHDP and represents the link
quality threshold at or above which a link becomes
usable, if it was not already so.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that:
\[ 0 \leq \text{nhdpHystRejectQuality} \]
\[ \leq \text{nhdpHystAcceptQuality} \leq 1.0 \]

The default value for this object is 1.0. According to
RFC 6340:
Since these textual conventions are defined in terms
of the OCTET STRING type, the SMI’s mechanisms for
formally setting range constraints are not available.
MIB designers using these textual conventions will need
to use DESCRIPTION clauses to spell out any applicable
range constraints beyond those implied by the underlying
IEEE types.
Therefore, this object does not have a DEFVAL clause."
REFERENCE
"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"

DEFVAL { 1.0 } see DESCRIPTION

::= { nhdpInterfaceEntry 9 }
"nhdpHystRejectQuality corresponds to
HYST_REJECT of NHDP and represents the
link quality threshold below which a
link becomes unusable, if it was not
already so.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that:
  o 0 <= nhdpHystRejectQuality
     <= nhdpHystAcceptQuality <= 1.0

The default value for this object is 0.0. According to
RFC 6340:
  Since these textual conventions are defined in terms
  of the OCTET STRING type, the SMI’s mechanisms for
  formally setting range constraints are not available.
  MIB designers using these textual conventions will need
  to use DESCRIPTION clauses to spell out any applicable
  range constraints beyond those implied by the underlying
  IEEE types.
  Therefore, this object does not have a DEFVAL clause."

REFERENCE
"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"

DEFVAL { 0.0 } see DESCRIPTION
::= { nhdpInterfaceEntry 10 }

nhdpInitialQuality OBJECT-TYPE
  SYNTAX      Float32TC
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
"nhdpInitialQuality corresponds to
INITIAL_QUALITY of NHDP and represents the
initial quality of a newly identified link.

Guidance for setting this object may be found
in Section 5 of the NHDP specification (RFC 6130),
which indicates that:
  o 0 <= nhdpInitialQuality <= 1.0

The default value for this object is 1.0. According to
RFC 6340:
  Since these textual conventions are defined in terms
  of the OCTET STRING type, the SMI’s mechanisms for
formally setting range constraints are not available. MIB designers using these textual conventions will need to use DESCRIPTION clauses to spell out any applicable range constraints beyond those implied by the underlying IEEE types.

Therefore, this object does not have a DEFVAL clause.

REFERENCE

"Section 5 on Protocol Parameters and Constraints of RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

DEFVAL { false } ::= { nhdpInterfaceEntry 12 }

-- Interface Parameters - Jitter

nhdpHpMaxJitter OBJECT-TYPE
SYNTAX Unsigned32
UNITS "milliseconds"
MAX-ACCESS read-create

DEFVAL { 1.0 } see DESCRIPTION

::= { nhdpInterfaceEntry 11 }

nhdpInitialPending OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-create
STATUS current

DESCRIPTION

"nhdpInitialPending corresponds to INITIAL_PENDING of NHDP. If the value of this object is 'true(1)', then a newly identified link is considered pending and is not usable until the link quality has reached or exceeded the nhdpHystAcceptQuality threshold.

Guidance for setting this object may be found in Section 5 of the NHDP specification (RFC 6130), which indicates that:

o If nhdpInitialQuality >= nhdpHystAcceptQuality, then nhdpInitialPending := false(2).

o If nhdpInitialQuality < nhdpHystRejectQuality, then nhdpInitialPending := true(1)."

REFERENCE

"Section 5 on Protocol Parameters and Constraints of RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
nhdpHpMaxJitter  OBJECT-TYPE
SYNTAX        Unsigned32
UNITS         "milliseconds"
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION   "nhdpHpMaxJitter corresponds to
HP_MAXJITTER of NHDP and represents the
value of MAXJITTER used in RFC 5148 for
periodically generated HELLO messages on
this MANET interface.

Guidance for setting this object may be found
in Section 5 of RFC 5148, which indicates that:
  o nhdpHpMaxJitter <= nhdpHelloInterval / 2
  o nhdpHpMaxJitter should not be greater
    than nhdpHelloInterval / 4
  o If nhdpMinHelloInterval > 0, then
    nhdpHpMaxJitter <= nhdpHelloMinInterval; and
    nhdpHpMaxJitter should not be greater than
    nhdpHelloMinInterval / 2"
REFERENCE
  "Section 5 of RFC 5148 - Jitter Considerations in
Mobile Ad Hoc Networks (MANETs),
Clausen, T., Dearlove, C., and B. Adamson, February 2008"
DEFVAL { 500 } ::= { nhdpInterfaceEntry 13 }

nhdpHtMaxJitter  OBJECT-TYPE
SYNTAX        Unsigned32
UNITS         "milliseconds"
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION   "nhdpHtMaxJitter corresponds to
HT_MAXJITTER of NHDP and represents the
value of MAXJITTER used in RFC 5148 for
externally triggered HELLO messages on this
MANET interface.

Guidance for setting this object may be found
in Section 5 of RFC 5148, which indicates that:
  o nhdpHtMaxJitter <= nhdpHelloInterval / 2
  o nhdpHtMaxJitter should not be greater
    than nhdpHelloInterval / 4
  o If nhdpMinHelloInterval > 0, then
    nhdpHtMaxJitter <= nhdpHelloMinInterval; and
    nhdpHtMaxJitter should not be greater than
    nhdpHelloMinInterval / 2"
REFERENCE
  "Section 5 of RFC 5148 - Jitter Considerations in
Mobile Ad Hoc Networks (MANETs),
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.

An entry may not exist in the 'active(1)' state unless all
objects in the entry have a defined appropriate value. For
objects with DEFVAL clauses, the management station
does not need to specify the value of this object in order
for the row to transit to the 'active(1)' state; the default
value for this object is used. For objects that do not
have DEFVAL clauses, then the network manager MUST
specify the value of this object prior to this row
transitioning to the 'active(1)' state.

When this object transitions to 'active(1)', all objects
in this row SHOULD be written to non-volatile (stable)
storage. Read-create objects in this row MAY be modified.
When an object in a row with nhdpIfRowStatus of 'active(1)'
is changed, then the updated value MUST be reflected in NHDP,
and this new object value MUST be written to non-volatile
storage.

If the value of this object is not equal to 'active(1)',
all associated entries in the nhdpLibLocalIfSetTable,
nhdpInterfaceStateTable, nhdpLibLinkSetTable, and
nhdpInterfacePerfTable MUST be deleted."
REFERENCE
  "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
  Discovery Protocol (NHDP), Clausen, T., Dearlove,
  C., and J. Dean, April 2011"
DEFVAL { active }
::= { nhdpInterfaceEntry 15 }
nhdpNHoldTime OBJECT-TYPE
SYNTAX Unsigned32
UNITS "milliseconds"
MAX-ACCESS read-write
STATUS current
DESCRIPTION

"nhdpNHoldTime corresponds to
N_HOLD_TIME of NHDP and 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.

This object is persistent, and when written,
the entity SHOULD save the change to
non-volatile storage."
REFERENCE

"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"
DEFVAL { 6000 }
::= { nhdpConfigurationObjGrp 2 }

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

"nhdpIHoldTime corresponds to
I_HOLD_TIME of NHDP and represents the period
for which a recently used local interface network
address is recorded.

This object is persistent, and when written,
the entity SHOULD save the change to
non-volatile storage."
REFERENCE

"Section 5 on Protocol Parameters and
Constraints of RFC 6130 - Mobile Ad Hoc Network
(MANET) Neighborhood Discovery Protocol (NHDP),
Clausen, T., Dearlove, C., and J. Dean, April 2011"
DEFVAL { 6000 }
::= { nhdpConfigurationObjGrp 3 }
-- A router’s Local Information Base (LIB)

--

-- Local Interface Set Table

--

nhdpLibLocalIfSetTable OBJECT-TYPE
SYNTAX      SEQUENCE OF NhdpLibLocalIfSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"A router’s Local Interface Set records all network addresses that are defined as local MANET interface network addresses. As such, this table ‘sparse augments’ the nhdpInterfaceTable when network addresses are being defined for the interfaces existing within the nhdpInterfaceTable. The local interface is defined by the nhdpIfIndex.

The Local Interface Set consists of Local Interface Address Tuples per MANET interface and their prefix lengths (in order to determine the network addresses related to the interface).

A conceptual row in this table exists if and only if a manager has explicitly created the row. The manager can create a row by setting rowStatus to ‘createAndGo’ or ‘createAndWait’.

Further guidance on the addition or removal of local addresses and network addresses is found in Section 9 of RFC 6130."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

::= { nhdpConfigurationObjGrp 4 }

NhdpLibLocalIfSetEntry OBJECT-TYPE
SYNTAX      NhdpLibLocalIfSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"A router’s Local Interface Set consists of Configured Interface Address Tuples for each network interface."
The objects in this table are persistent, and when written, the device SHOULD save the change to non-volatile storage. For further information on the storage behavior for these objects, refer to the description for the nhdpLibLocalIfSetRowStatus object.

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

INDEX { nhdpLibLocalIfSetIndex }
::= { nhdpLibLocalIfSetTable 1 }

NhdpLibLocalIfSetEntry ::= SEQUENCE {
  nhdpLibLocalIfSetIndex  OBJECT-TYPE
    SYNTAX      Integer32 (0..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
      "The index for this table. Necessary because multiple addresses may be associated with a given nhdpIfIndex."

    REFERENCE
      "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

  ::= { nhdpLibLocalIfSetEntry 1 }

  nhdpLibLocalIfSetIfIndex  OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
"Specifies the local nhdpIfIndex for which this IP address was added."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

::= { nhdpLibLocalIfSetEntry 2 }

nhdpLibLocalIfSetIpAddrType OBJECT-TYPE
SYNTAX          InetAddressType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
"The type of the nhdpLibLocalIfSetIpAddr in the InetAddress MIB (RFC 4001).

Only the values ‘ipv4(1)’ and ‘ipv6(2)’ are supported."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

::= { nhdpLibLocalIfSetEntry 3 }

nhdpLibLocalIfSetIpAddr OBJECT-TYPE
SYNTAX          InetAddress (SIZE(4|16))
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
"nhdpLibLocalIfSetIpAddr is an address of an interface of this router.

This object is interpreted according to the setting of nhdpLibLocalIfSetIpAddrType."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

::= { nhdpLibLocalIfSetEntry 4 }

nhdpLibLocalIfSetIpAddrPrefixLen OBJECT-TYPE
SYNTAX          InetAddressPrefixLength
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
"Indicates the number of leading one bits that form the mask. The mask is logically ANDed
to the nhdpLibLocalIfSetIpAddr to determine
the address prefix. A row match is true
if the address used as an index falls within
the network address range defined by the
address prefix."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"

::= { nhdpLibLocalIfSetEntry 5 }

nhdpLibLocalIfSetRowStatus  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.

An entry may not exist in the ‘active(1)’ state unless all
read-create objects in the entry have a defined
appropriate value. As no objects in this table have
DEFVAL clauses, the management station MUST specify
the values of all read-create objects prior to this row
transitioning to the ‘active(1)’ state.

When this object transitions to ‘active(1)’, all objects
in this row SHOULD be written to non-volatile (stable)
storage. Read-create objects in this row MAY be modified.
When an object in a row with nhdpIfRowStatus of ‘active(1)’
is changed, then the updated value MUST be reflected in NHDP,
and this new object value MUST be written to non-volatile
storage."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"

DEFVAL { notReady }

::= { nhdpLibLocalIfSetEntry 6 }

--

-- Removed Interface Addr Set Table
--
nhdpLibRemovedIfAddrSetTable OBJECT-TYPE
SYNTAX      SEQUENCE OF NhdpLibRemovedIfAddrSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "A router’s Removed Interface Address Set records network addresses that 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
  
  "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
::= { nhdpConfigurationObjGrp 5 }

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 addresses and the router’s Interface is found in the Standard MIB II’s IP address table (RFC 1213)."
REFERENCE
  
  "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
INDEX { nhdpLibRemovedIfAddrSetIndex }
::= { nhdpLibRemovedIfAddrSetTable 1 }

NhdpLibRemovedIfAddrSetEntry ::= SEQUENCE {
  nhdpLibRemovedIfAddrSetIndex
    Integer32,
  nhdpLibRemovedIfAddrSetIpAddrType
    InetAddressType,
  nhdpLibRemovedIfAddrSetIpAddr
    InetAddress,
  nhdpLibRemovedIfAddrSetIpAddrPrefixLen
    Herberg, et al. Standards Track [Page 31]
InetAddressPrefixLength,

nhdpLibRemovedIfAddrSetIfIndex

InterfaceIndex,

nhdpLibRemovedIfAddrSetIRTime

TimeStamp

}\n
nhdpLibRemovedIfAddrSetIndex OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The index for this table. Necessary
because multiple addresses may be associated
with a given nhdpIfIndex."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"::= { nhdpLibRemovedIfAddrSetEntry 1 }

nhdpLibRemovedIfAddrSetIpAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The type of the nhdpLibRemovedIfAddrSetIpAddr
in the InetAddress MIB (RFC 4001).

Only the values 'ipv4(1)' and 'ipv6(2)' are supported."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"::= { nhdpLibRemovedIfAddrSetEntry 2 }

nhdpLibRemovedIfAddrSetIpAddr OBJECT-TYPE
SYNTAX InetAddress (SIZE(4|16))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"nhdpLibRemovedIfAddrSetIpAddr is a
recently used address of an interface of
this router."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
nhdpLibRemovedIfAddrSetIpAddrPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Indicates the number of leading one bits that form the mask. The mask is logically ANDed to the nhdpLibRemovedIfAddrSetIpAddr to determine the address prefix. A row match is true if the address used as an index falls within the network address range defined by the address prefix."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

nhdpLibRemovedIfAddrSetIfIndex  OBJECT-TYPE
SYNTAX      InterfaceIndex
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Specifies the local IfIndex from which this IP address was recently removed."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

nhdpLibRemovedIfAddrSetIRTime  OBJECT-TYPE
SYNTAX      TimeStamp
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"nhdpLibRemovedIfAddrSetIRTime specifies the value of sysUpTime when this entry should expire and be removed from the nhdpLibRemovedIfAddrSetTable."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
-- nhdpStateObjGrp

-- Contains information describing the current state of the NHDP
-- process on this router.

nhdpStateObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 2 }

  nhdpUpTime OBJECT-TYPE
  SYNTAX      TimeStamp
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
  "The value of sysUpTime at the time the current NHDP
   process was initialized."
  ::= { nhdpStateObjGrp 1 }

  nhdpInterfaceStateTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF NhdpInterfaceStateEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
  "nhdpInterfaceStateTable lists state information
   related to specific interfaces of this router.
   The value of nhdpIfIndex is an ifIndex from the
   interfaces group defined in the Interfaces Group
   MIB.

   The objects in this table are persistent, and when
   written, the entity SHOULD save the change to
   non-volatile storage."
  REFERENCE
   "RFC 2863 - The Interfaces Group MIB, McCloghrie,
   K., and F. Kastenholtz, June 2000."
  ::= { nhdpStateObjGrp 2 }

  nhdpInterfaceStateEntry OBJECT-TYPE
  SYNTAX      NhdpInterfaceStateEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
  "nhdpInterfaceStateEntry describes one NHDP
   local interface state as indexed by
   its nhdpIfIndex."
  INDEX { nhdpIfIndex }
  ::= { nhdpInterfaceStateTable 1 }
NhdpInterfaceStateEntry ::=  
SEQUENCE {  
nhdpIfStateUpTime  
   TimeStamp  
}  

nhdpIfStateUpTime  OBJECT-TYPE  
SYNTAX      TimeStamp  
MAX-ACCESS  read-only  
STATUS      current  
DESCRIPTION  
"The value of the sysUpTime when  
NHDP was last initialized on this  
MANET interface."  
::= { nhdpInterfaceStateEntry 1 }  

--  
-- This table allows for the mapping between discovered  
-- remote interfaces and routers and their addresses.  
--  
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  
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood  
Discovery Protocol (NHDP), Clausen, T., Dearlove,  
C., and J. Dean, April 2011"  
::= { nhdpStateObjGrp 3 }  

NhdpDiscIfSetEntry OBJECT-TYPE  
SYNTAX      NhdpDiscIfSetEntry  
MAX-ACCESS  not-accessible  
STATUS      current  
DESCRIPTION  
"The entries include the nhdpDiscRouterIndex of  
the discovered router, the nhdpDiscIfIndex  
of the discovered interface, and the  
current set of addresses associated  
with this neighbor interface. The  
hdpDiscIfIndex uniquely identifies  
the remote interface address sets  
through this table. It does not need  
to be unique across the MANET but MUST
be locally unique within this router."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
INDEX ( nhdpDiscIfSetIndex )
 ::= { nhdpDiscIfSetTable 1 }

NhdpDiscIfSetEntry ::= SEQUENCE {
    nhdpDiscIfSetIndex
        OBJECT-TYPE
        SYNTAX      Integer32 (0..65535)
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "The index for this table. Necessary
            because multiple addresses may be associated
            with a given nhdpDiscIfIndex."
        REFERENCE
            "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
            Discovery Protocol (NHDP), Clausen, T., Dearlove,
            C., and J. Dean, April 2011"
 ::= { nhdpDiscIfSetEntry 1 }

nhdpDiscIfIndex  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
    MIB modules."
REFERENCE
nhdpDiscRouterIndex OBJECT-TYPE
SYNTAX NeighborRouterIndex
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The NHDP neighbor index (locally created)
of a neighboring router. Used for cross-
indexing into other NHDP tables and other
MIB modules."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"

::= { nhdpDiscIfSetEntry 2 }

nhdpDiscIfSetIpAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The type of the nhdpDiscIfSetIpAddr
in the InetAddress MIB (RFC 4001).

Only the values 'ipv4(1)' and
'ipv6(2)' are supported."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"

::= { nhdpDiscIfSetEntry 3 }

nhdpDiscIfSetIpAddr OBJECT-TYPE
SYNTAX InetAddress (SIZE(4|16))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The nhdpDiscIfSetIpAddr is a
recently used address of a neighbor
of this router."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpDiscIfSetEntry 5 }

nhdpDiscIfSetIpAddrPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "Indicates the number of leading one bits that
  form the mask. The mask is logically ANDed
to the nhdpDiscIfSetIpAddr to determine
the address prefix. A row match is true
if the address used as an index falls within
the network address range defined by the
address prefix."
REFERENCE
  "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpDiscIfSetEntry 6 }

-- Interface Information Base (IIB)

--
-- Link Set
--

nhdpIibLinkSetTable OBJECT-TYPE
SYNTAX      SEQUENCE OF NhdpIibLinkSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "A Link Set of an interface records all links
from other routers that are, or recently
were, 1-hop neighbors."
REFERENCE
  "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpStateObjGrp 4 }

NhdpIibLinkSetEntry OBJECT-TYPE
SYNTAX      NhdpIibLinkSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "A Link Set consists of Link Tuples, each
representing a single link indexed by the
local and remote interface pair:
(L_neighbor_iface_addr_list, L_HEARD_time, L_SYM_time, L_quality, L_pending, L_lost, L_time).

The local interface is indexed via the nhdpIfIndex. The 1-hop interface is indexed via the nhdpDiscIfIndex. There SHOULD be an entry in this table for each local interface and associated 1-hop neighbor reachable on this local interface.

Note that L_quality is not included in the entries below, because updates may be required too frequently.

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

INDEX { nhdpIfIndex, nhdpDiscIfIndex }
 ::= { nhdpIibLinkSetTable 1 }

NhdpIibLinkSetEntry ::= SEQUENCE {
  nhdpIibLinkSetLHeardTime TimeStamp,
  nhdpIibLinkSetLSymTime TimeStamp,
  nhdpIibLinkSetLPending TruthValue,
  nhdpIibLinkSetLLost TruthValue,
  nhdpIibLinkSetLTime TimeStamp
}

nhdpIibLinkSetLHeardTime OBJECT-TYPE
SYNTAX      TimeStamp
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "nhdpIibLinkSetLHeardTime corresponds to L_HEARD_time of NHDP and represents the time up to which the MANET interface of the 1-hop neighbor would be considered heard if not considering link quality."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011

::= { nhdpIibLinkSetEntry 1 }

nhdpIibLinkSetLSymTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"nhdpIibLinkSetLSymTime corresponds to L_SYM_time of NHDP and represents the time up to which the link to the 1-hop neighbor would be considered symmetric if not considering link quality."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011

::= { nhdpIibLinkSetEntry 2 }

nhdpIibLinkSetLPending OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"nhdpIibLinkSetLPending corresponds to L_pending of NHDP and is a boolean flag, describing if a link is considered pending (i.e., a candidate, but not yet established, link)."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011

::= { nhdpIibLinkSetEntry 3 }

nhdpIibLinkSetLLost OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"nhdpIibLinkSetLLost corresponds to L_lost of NHDP and is a boolean flag, describing if a link is considered lost due to low link quality."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove,
::= { nhdpIibLinkSetEntry 4 }

nhdpIibLinkSetLTime  OBJECT-TYPE
SYNTAX      TimeStamp
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"nhdpIibLinkSetLTime specifies the value of sysUptime when this entry should expire and be removed from the nhdpIibLinkSetTable."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
::= { nhdpIibLinkSetEntry 5 }

--
-- 2-Hop Set
--

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."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
::= { nhdpStateObjGrp 5 }

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

(N2_neighbor_iface_addr_list, N2_2hop_addr, N2_time)."
The entries include the 2-hop neighbor addresses, which act as the table index, and associated 1-hop symmetric link address set, designated through nhdpDiscIfIndex, and an expiration time.

The nhdpIfIndex in the INDEX is the interface index of the local interface through which these 2-hop addresses are accessible. The nhdpDiscIfIndex in the INDEX represents the 1-hop neighbor interface through which these 2-hop addresses are reachable.

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

INDEX { nhdpIfIndex,
           nhdpDiscIfIndex,
           nhdpIib2HopSetIpAddressType,
           nhdpIib2HopSetIpAddress
}

 ::= { nhdpIib2HopSetTable 1 }

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

NhdpIib2HopSetIpAddressType OBJECT-TYPE
   SYNTAX      InetAddressType
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
      "The type of the nhdpIib2HopSetIpAddress in the InetAddress MIB module (RFC 4001).

      Only the values 'ipv4(1)' and 'ipv6(2)' are supported."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
nhdpIib2HopSetIpAddress  OBJECT-TYPE
SYNTAX    InetAddress (SIZE(4|16))
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"nhdpIib2HopSetIpAddress corresponds
to N2_2hop_addr of NHDP and is a network
address of a symmetric 2-hop neighbor that
has a symmetric link (using any MANET
interface) to the indicated symmetric
1-hop neighbor."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpIib2HopSetEntry 2 }

nhdpIib2HopSetIpAddrPrefixLen  OBJECT-TYPE
SYNTAX    InetAddressPrefixLength
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Indicates the number of leading one bits that
form the mask. The mask is logically ANDed
to the nhdpIib2HopSetIpAddress to determine
the address prefix. A row match is true
if the address used as an index falls within
the network address range defined by the
address prefix."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpIib2HopSetEntry 3 }

nhdpIib2HopSet1HopIfIndex  OBJECT-TYPE
SYNTAX    NeighborIfIndex
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"nhdpIib2HopSet1HopIfIndex is
nhdpDiscIfIndex of the 1-hop
neighbor that communicated the ipAddress
of the 2-hop neighbor in this row entry."
nhdpNibNeighborSetTable OBJECT-TYPE
SYNTAX SEQUENCE OF NhdpNibNeighborSetEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A router’s Neighbor Set records all
network addresses of each 1-hop
neighbor."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
 ::= { nhdpStateObjGrp 6 }

-- Neighbor Information Base (NIB)
-- Each router maintains a Neighbor Information Base
-- that records information about addresses of
-- current and recently symmetric 1-hop neighbors.
--

nhdpNibNeighborSetTable OBJECT-TYPE
SYNTAX SEQUENCE OF NhdpNibNeighborSetEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A router’s Neighbor Set records all
network addresses of each 1-hop
neighbor."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
 ::= { nhdpStateObjGrp 6 }

-- Neighbor Set
-- The Neighbor Set Table is small because
-- most of the corresponding information is found
-- in the nhdpDiscoveredIfTable above.
--
A router’s Neighbor Set consists of Neighbor Tuples, each representing a single 1-hop neighbor:

\[(N_{neighbor\_addr\_list}, N_{symmetric})\]

**NhdpNibNeighborSetEntry**

**NhdpNibNeighborSetEntry**

SYNTAX NhdpNibNeighborSetEntry

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

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

INDEX { nhdpDiscRouterIndex }

::= { nhdpNibNeighborSetTable 1 }

NhdpNibNeighborSetEntry ::= 

SEQUENCE {

  nhdpNibNeighborSetNSymmetric

    TruthValue

}

NhdpNibNeighborSetNSymmetric

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"nhdpNibNeighborNSymmetric corresponds to \(N_{symmetric}\) of NHDP and is a boolean flag, describing if this is a symmetric 1-hop neighbor."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

::= { nhdpNibNeighborSetEntry 1 }

--

-- Lost Neighbor Set
--

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 that were recently symmetric 1-hop neighbors but are now..."
advertised as lost.

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
 ::= { nhdpStateObjGrp 7 }

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
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
INDEX { nhdpDiscRouterIndex }
 ::= { nhdpNibLostNeighborSetTable 1 }

NhdpNibLostNeighborSetEntry ::= SEQUENCE {
   nhdpNibLostNeighborSetNLTime
      TimeStamp
}

NhdpNibLostNeighborSetNLTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"NhdpNibLostNeighborSetNLTime specifies the value of sysUptime when this entry should expire and be removed from the nhdpNibLostNeighborSetTable."

REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
 ::= { nhdpNibLostNeighborSetEntry 1 }

--
-- nhdpPerformanceObjGrp
--

Herberg, et al. Standards Track [Page 46]
nhdpPerformanceObjGrp  OBJECT IDENTIFIER ::= { nhdpObjects 3 }

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     "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
::= { 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 {
  nhdpIfHelloMessageXmits  Counter32,
  nhdpIfHelloMessageRecvd  Counter32,
  nhdpIfHelloMessageXmitAccumulatedSize  Counter64,
  nhdpIfHelloMessageRecvdAccumulatedSize  Counter64,
  nhdpIfHelloMessageTriggeredXmits  Counter32,
  nhdpIfHelloMessagePeriodicXmits  Counter32,
  nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount  
}
Counter32,
nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount
Counter32,

nhdpIfHelloMessageXmitAccumulatedLostNeighborCount
Counter32

}

nhdpIfHelloMessageXmits OBJECT-TYPE
SYNTAX Counter32
UNITS "messages"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"A counter is incremented each time a HELLO
message has been transmitted on that interface."
::= { nhdpInterfacePerfEntry 1 }

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

nhdpIfHelloMessageXmitAccumulatedSize OBJECT-TYPE
SYNTAX Counter64
UNITS "octets"
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 3 }

nhdpIfHelloMessageRecvdAccumulatedSize OBJECT-TYPE
SYNTAX Counter64
UNITS "octets"
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 4 }
nhdpIfHelloMessageTriggeredXmits OBJECT-TYPE
SYNTAX    Counter32
UNITS      "messages"
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
   "A counter is incremented each time a triggered
HELLO message has been sent."
::= { nhdpInterfacePerfEntry 5 }

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

nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount OBJECT-TYPE
SYNTAX    Counter32
UNITS      "neighbors"
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
   "A counter is incremented by the number of advertised
symmetric neighbors in a HELLO each time a HELLO
message has been sent."
::= { nhdpInterfacePerfEntry 7 }

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

nhdpIfHelloMessageXmitAccumulatedLostNeighborCount OBJECT-TYPE
SYNTAX    Counter32
UNITS      "neighbors"
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"A counter is incremented by the number of advertised lost neighbors in a HELLO each time a HELLO message has been sent."

::= { nhdpInterfacePerfEntry 9 }

--
-- 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    "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
::= { 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    "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
INDEX       { nhdpDiscIfIndex }
::= { nhdpDiscIfSetPerfTable 1 }

NhdpDiscIfSetPerfEntry ::= SEQUENCE {
   nhdpDiscIfRecvdPackets  Counter32,
   nhdpDiscIfExpectedPackets  Counter32
}

NhdpDiscIfRecvdPackets OBJECT-TYPE
SYNTAX      Counter32
UNITS       "packets"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION

"This counter increments each time this router receives a packet from that interface of the neighbor."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

 ::= { nhdpDiscIfSetPerfEntry 1 }

nhdpDiscIfExpectedPackets OBJECT-TYPE
SYNTAX Counter32
UNITS "packets"
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 router receives a packet from that interface of the neighbor."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

 ::= { nhdpDiscIfSetPerfEntry 2 }

--
-- Objects concerning the Neighbor Set
--

nhdpNibNeighborSetChanges OBJECT-TYPE
SYNTAX Counter32
UNITS "changes"
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
A router’s set of discovered neighbors and their properties.

Reference:
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
::= { nhdpDiscNeighborSetPerfEntry 1 }

nhdpDiscNeighborNibNeighborSetUpTime  OBJECT-TYPE
SYNTAX      TimeStamp
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"This object returns the sysUpTime when
the neighbor becomes 'nbrup'. A neighbor is
said to become 'nbrup' if a new nhdpNibNeighborSetEntry
is created for a particular nhdpNibNeighborSetRouterIndex.
It becomes 'nbrdown' if the entry for that neighbor
has been deleted."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpDiscNeighborSetPerfEntry 2 }

nhdpDiscNeighborNibNeighborSetReachableLinkChanges  OBJECT-TYPE
SYNTAX      Counter32
UNITS       "changes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"This object counts each time the neighbor changes
the interface(s) over which it is reachable.
A change in the set of Link Tuples corresponding
to the appropriate Neighbor Tuple is registered,
i.e., a corresponding Link Tuple is added or removed
from the set of all corresponding Link Tuples."
REFERENCE
"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
Discovery Protocol (NHDP), Clausen, T., Dearlove,
C., and J. Dean, April 2011"
::= { nhdpDiscNeighborSetPerfEntry 3 }

--
-- 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

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

::= { 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

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"
INDEX { nhdpDiscRouterIndex }

 ::= { nhdpIib2HopSetPerfTable 1 }

NhdpIib2HopSetPerfEntry ::= 
SEQUENCE {
    nhdpIib2HopSetPerfChanges
        Counter32,
    nhdpIib2HopSetPerfUpTime
        TimeStamp
}

NhdpIib2HopSetPerfChanges OBJECT-TYPE
SYNTAX Counter32
UNITS "changes"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object counts the changes of the union of all N2_neighbor iface_addr_list of 2-Hop Tuples with an N2_2hop_addr equal to one of the given 2-hop neighbor’s addresses."
REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011"

 ::= { nhdpIib2HopSetPerfEntry 1 }

NhdpIib2HopSetPerfUpTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
This object returns the sysUpTime when the 2-Hop Tuple corresponding to the given 2-hop neighbor IP address was registered in the nhdpIib2HopSetTable.

REFERENCE
RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011

::= { nhdpIib2HopSetPerfEntry 2 }

--
-- nhdpNotifications
--

nhdpNotificationsObjects OBJECT IDENTIFIER ::= { nhdpNotifications 0 }
nhdpNotificationsControl OBJECT IDENTIFIER ::= { nhdpNotifications 1 }
nhdpNotificationsStates OBJECT IDENTIFIER ::= { nhdpNotifications 2 }

-- nhdpNotificationsObjects

nhdpNbrStateChange NOTIFICATION-TYPE
OBJECTS { nhdpIfName, -- The originator of
    nhdpNbrState -- The new state
}
STATUS current
DESCRIPTION

"nhdpNbrStateChange is a notification sent when more than nhdpNbrStateChangeThreshold neighbors change their status (i.e., 'down(0)', 'asymmetric(1)', or 'symmetric(2)') within a time window of nhdpNbrStateChangeWindow."

::= { nhdpNotificationsObjects 1 }

nhdp2HopNbrStateChange NOTIFICATION-TYPE
OBJECTS { nhdpIfName, -- The originator of the notification
    nhdp2HopNbrState -- The new state
}
STATUS current
DESCRIPTION

"nhdp2HopNbrStateChange is a notification sent when more than nhdp2HopNbrStateChangeThreshold 2-hop neighbors change their status (i.e., 'down(0)' or 'up(1)') within a time window of nhdp2HopNbrStateChangeWindow."

::= { nhdpNotificationsObjects 2 }
nhdpIfStateChange  NOTIFICATION-TYPE
   OBJECTS { nhdpIfName, -- The local interface
            nhdpIfStatus  -- The new status
   }
   STATUS       current
   DESCRIPTION
      "nhdpIfStateChange is a notification sent when
      nhdpIfStatus has changed on this interface."
   ::= { nhdpNotificationsObjects 3 }

-- nhdpNotificationsControl

nhdpNbrStateChangeThreshold  OBJECT-TYPE
   SYNTAX      Integer32 (0..255)
   UNITS       "changes"
   MAX-ACCESS  read-write
   STATUS      current
   DESCRIPTION
      "A threshold value for the
      nhdpNbrStateChange object. If the
      number of occurrences exceeds this threshold
      within the previous nhdpNbrStateChangeWindow,
      then the nhdpNbrStateChange notification
      is to be sent.

      It is recommended that the value of this
      threshold be set to at least 10 and higher
      in dense topologies with frequent expected
      topology changes."
   DEFVAL { 10 }
   ::= { nhdpNotificationsControl 1 }

nhdpNbrStateChangeWindow  OBJECT-TYPE
   SYNTAX      TimeTicks
   MAX-ACCESS  read-write
   STATUS      current
   DESCRIPTION
      "A time window for the
      nhdpNbrStateChange object. If the
      number of occurrences exceeds the
      nhdpNbrStateChangeThreshold
      within the previous nhdpNbrStateChangeWindow,
      then the nhdpNbrStateChange notification
      is to be sent.

      It is recommended that the value for this
      window be set to at least 5 times the
      nhdpHelloInterval."
This object represents the time in hundredths of a second.
DEFVAL { 1000 }
::= { nhdpNotificationsControl 2 }

nhdp2HopNbrStateChangeThreshold  OBJECT-TYPE
SYNTAX     Integer32 (0..255)
UNITS       "changes"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"A threshold value for the
nhdp2HopNbrStateChange object. If the
number of occurrences exceeds this threshold
within the previous nhdp2HopNbrStateChangeWindow,
then the nhdp2HopNbrStateChange notification
is to be sent.

It is recommended that the value of this
threshold be set to at least 10 and higher
when topologies are expected to be highly dynamic."
DEFVAL { 10 }
::= { nhdpNotificationsControl 3 }

nhdp2HopNbrStateChangeWindow  OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"A time window for the
nhdp2HopNbrStateChange object. If the
number of occurrences exceeds the
nhdp2HopNbrStateChangeThreshold
within the previous nhdp2HopNbrStateChangeWindow,
then the nhdp2HopNbrStateChange notification
is to be sent.

It is recommended that the value for this
window be set to at least 5 times
nhdpHelloInterval.

This object represents the time in hundredths of a second."
DEFVAL { 1000 }
::= { nhdpNotificationsControl 4 }

-- nhdpNotificationStates
nhdpNbrState OBJECT-TYPE
SYNTAX INTEGER {
    down(0),
    asymmetric(1),
    symmetric(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"NHDP neighbor states. In NHDP, it is not necessary to remove Protocol Tuples from Protocol Sets at the exact time indicated, only to behave as if the Protocol Tuples were removed at that time. This case is indicated here as ‘down(0)’, all other cases being indicated as ‘asymmetric(1)’ or ‘symmetric(2)’. If ‘down(0)’, the direct neighbor is also added to the nhdpNibLostNeighborSetTable."
::= { nhdpNotificationsStates 1 }

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

--
-- nhdpConformance information
--

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."
nhdpFullCompliance  MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
  "The full implementation requirements for
  managed network entities that implement
  NHDP."

nhdpConfigurationGroup  OBJECT-GROUP
  OBJECTS {
    nhdpIfName,
    nhdpIfStatus,
    nhdpHelloInterval,
    nhdpHelloMinInterval,
    nhdpRefreshInterval,
    nhdpLHoldTime,
    nhdpHHoldTime,
    nhdpHystAcceptQuality,
    nhdpHystRejectQuality,
    nhdpInitialQuality,
    nhdpInitialPending,
    nhdpHpMaxJitter,
    nhdpHtMaxJitter,
    nhdpNHoldTime,
    nhdpIHoldTime,
    nhdpIFRowStatus,
    nhdpLibLocalIfSetIfIndex,
    nhdpLibLocalIfSetIpAddrType,
    nhdpLibLocalIfSetIpAddr,
    nhdpLibLocalIfSetIpAddrPrefixLen,
    nhdpLibLocalIfSetRowStatus,
    nhdpLibRemovedIfAddrSetIpAddrType,
    nhdpLibRemovedIfAddrSetIpAddr,
nhdpLibRemovedIfAddrSetIpAddrPrefixLen,  
nhdpLibRemovedIfAddrSetIfIndex,  
nhdpLibRemovedIfAddrSetIRTime
}

STATUS current

DESCRIPTION
"Set of NHDP configuration objects implemented in this module."

::= { nhdpMIBGroups 2 }

nhdpStateGroup OBJECT-GROUP

OBJECTS {
    nhdpUpTime,  
nhdpIfStateUpTime,  
nhdpDiscRouterIndex,  
nhdpDiscIfIndex,  
nhdpDiscIfSetIpAddrType,  
nhdpDiscIfSetIpAddr,  
nhdpDiscIfSetIpAddrPrefixLen,  
nhdpIibLinkSetLHeardTime,  
nhdpIibLinkSetLSymTime,  
nhdpIibLinkSetLPending,  
nhdpIibLinkSetLLost,  
nhdpIibLinkSetLTime,  
nhdpIib2HopSetIpAddrPrefixLen,  
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

{ nhdpMIBGroups 4 }

nhdpNotificationObjectGroup OBJECT-GROUP
OBJECTS {
  nhdpNbrStateChangeThreshold,
  nhdpNbrStateChangeWindow,
  nhdp2HopNbrStateChangeThreshold,
  nhdp2HopNbrStateChangeWindow,
  nhdpNbrState,
  nhdp2HopNbrState
}
STATUS current
DESCRIPTION "Set of NHDP notification objects implemented in this module."
::= { nhdpMIBGroups 5 }

nhdpNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
  nhdpNbrStateChange,
  nhdp2HopNbrStateChange,
  nhdpIfStateChange
}
STATUS current
DESCRIPTION "Set of NHDP notifications implemented in this module."
::= { nhdpMIBGroups 6 }

END
8. Security Considerations

This MIB module defines objects for the configuration, monitoring, and notification of the Neighborhood Discovery Protocol [RFC6130]. NHDP allows routers to acquire topological information up to two hops away by virtue of exchanging HELLO messages. The information acquired by NHDP may be used by routing protocols. The neighborhood information, exchanged between routers using NHDP, serves these routing protocols as a baseline for calculating paths to all destinations in the MANET, relay set selection for network-wide transmissions, etc.

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:

- nhdpIfStatus - This writable object turns on or off the NHDP process for the specified interface. If disabled, higher-level protocol functions, e.g., routing, would fail, causing network-wide disruptions.

- nhdpHelloInterval, nhdpHelloMinInterval, and nhdpRefreshInterval - These writable objects control the rate at which HELLO messages are sent on an interface. If set at too high a rate, this could represent a form of denial-of-service (DoS) attack by overloading interface resources.

- nhdpHystAcceptQuality, nhdpHystRejectQuality, nhdpInitialQuality, and nhdpInitialPending - These writable objects affect the perceived quality of the NHDP links and hence the overall stability of the network. If improperly set, these settings could result in network-wide disruptions.

- nhdpInterfaceTable - This table contains writable objects that affect the overall performance and stability of the NHDP process. Failure of the NHDP process would result in network-wide failure. Particularly sensitive objects from this table are discussed in the previous list items. This is the only table in the NHDP-MIB module with writable objects.

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:

- nhdpDiscIfSetTable - The object contains information on discovered neighbors, specifically their IP address in the nhdpDiscIfSetIpAddr object. This information provides an adversary broad information on the members of the MANET, located within this single table. This information can be used to expedite attacks on the other members of the MANET without having to go through a laborious discovery process on their own. This object is the index into the table and has a MAX-ACCESS of 'not-accessible'. However, this information can be exposed using SNMP operations.

MANET technology is often deployed to support communications of emergency services or military tactical applications. In these applications, it is imperative to maintain the proper operation of the communications network and to protect sensitive information related to its operation. Therefore, it is RECOMMENDED to provide support for the Transport Security Model (TSM) [RFC5591] in combination with TLS/DTLS [RFC6353].

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), 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.

Implementations MUST provide the security features described by the SNMPv3 framework (see [RFC3410]), including full support for authentication and privacy via the User-based Security Model (USM) [RFC3414] with the AES cipher algorithm [RFC3826]. Implementations MAY also provide support for the Transport Security Model (TSM) [RFC5591] in combination with a secure transport such as SSH [RFC5592] or TLS/DTLS [RFC6353].

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.
9. Applicability Statement

This document describes objects for configuring parameters of the Neighborhood Discovery Protocol [RFC6130] process on a router. This MIB module, denoted NHDP-MIB, also reports state, performance information, and notifications. This section provides some examples of how this MIB module can be used in MANET network deployments. A fuller discussion of MANET network management use cases and challenges will be provided elsewhere.

NHDP is designed to allow routers to automatically discover and track routers one hop remote (denoted “neighbors”) and routers two hops remote (denoted “two-hop neighbors”). This information is used by other MANET protocols in operation on the router to perform routing, multicast forwarding, and other functions with ad hoc and mobile networks. In the following, three example scenarios are listed where this MIB module is useful:

- For a Parking Lot Initial Configuration Situation - It is common for the vehicles comprising the MANET being forward deployed at a remote location, e.g., the site of a natural disaster, to be off-loaded in a parking lot where an initial configuration of the networking devices is performed. The configuration is loaded into the devices from a fixed location Network Operation Center (NOC) at the parking lot, and the vehicles are stationary at the parking lot while the configuration changes are made. Standards-based methods for configuration management from the co-located NOC are necessary for this deployment option.

- For Mobile Vehicles with Low-Bandwidth Satellite Link to a Fixed NOC - Here, the vehicles carrying the MANET routers carry multiple wireless interfaces, one of which is a relatively low-bandwidth, on-the-move satellite connection that interconnects a fix NOC to the nodes of the MANET. Standards-based methods for monitoring and fault management from the fixed NOC are necessary for this deployment option.

- For Fixed NOC and Mobile Local Manager in Larger Vehicles - for larger vehicles, a hierarchical network management arrangement is useful. Centralized network management is performed from a fixed NOC while local management is performed locally from within the vehicles. Standards-based methods for configuration, monitoring, and fault management are necessary for this deployment option.
10. IANA Considerations

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

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHDP-MIB</td>
<td>{ mib-2 213 }</td>
</tr>
</tbody>
</table>

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12. References

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