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Definition of Managed Objects for the Neighborhood Discovery Protocol

Abstract

This document replaces RFC 6779; it contains revisions and extensions to the original document. It 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 extensions described in this document add objects and values to support the NHDP optimization specified in RFC 7466. 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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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 Mobile Ad Hoc Network (MANET) 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.

1.1. Differences from RFC 6779

This document obsoletes [RFC6779], replacing that document as the specification of the MIB module for [RFC6130]. This revision to [RFC6779] is necessitated by the update to [RFC6130] specified in [RFC7466].

The MIB module for [RFC6130], specified in this document, captures the new information and states for each symmetric 2-hop neighbor, recorded in the Neighbor Information Base of a router and to be reflected in the appropriate tables, introduced by [RFC7466], specifically:

- o Addition of objects `nhdpIib2HopSetN2Lost` and `nhdpIfPerfCounterDiscontinuityTime`.
- o Addition of extra value (`notconsidered`) to `nhdp2HopNbrState`.
- o Revised full compliance state.

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:

- o Notification Objects - triggers and associated notification messages allowing for asynchronous tracking of predefined events on the managed router.
- o Configuration Objects - switches, tables, and objects that are initialized to default settings or set through the management interface defined by this MIB module.
- o State Objects - automatically generated values that define the current operating state of the NHDP instance in the router.
- o Performance Objects - automatically generated values that help to assess the performance of the NHDP instance on the router and the overall discovery performance within the 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:

- o nhdpNotifications - objects defining NHDP-MIB notifications.

- o 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.
- o 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 an observer of these events 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 source of the notification may be determined.

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 2-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 predefined and administratively configured time interval has elapsed. It is RECOMMENDED that this time interval be at least 3 times `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 administratively configured 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. If the number of occurrences exceeds the change threshold within the previous change window, then it is RECOMMENDED that the notification 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., `nhdpmMaxJitter`.

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 SMIPv2, 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 SMIPv2 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 an observer determining unusual topology changes or other changes that affect stability and reliability of the MANET.

5.5. Tables and Indexing

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

- o the local router,
- o a local MANET interface on the router,
- o other routers that are one hop removed from the local router,
- o interfaces on other routers that are one hop removed from the local router, and
- o other routers that are two hops removed from the local router.

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

- o `nhdpIfIndex` - the `IfIndex` of the local router on which NHDP is configured.
- o `nhdpDiscIfIndex` - a locally managed index representing a known interface on a neighboring router.
- o `nhdpDiscRouterIndex` - a locally managed index representing an ID of a known neighboring router.

These tables and their indexing are:

- o `nhdpInterfaceTable` - describes the configuration of the interfaces of this router. This table has INDEX { `nhdpIfIndex` }.
- o `nhdpLibLocalIfSetTable` - records all network addresses that are defined as local interface network addresses on this router. This table has INDEX { `nhdpLibLocalIfSetIndex` }.

- o 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 }.
- o nhdpInterfaceStateTable - records state information related to specific interfaces of this router. This table has INDEX { nhdpIfIndex }.
- o 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 }.
- o nhdpIibLinkSetTable - 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. Relationship to the If-MIB

The nhdpInterfaceTable in this MIB module 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 [RFC2863] 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 [RFC2863].

A conceptual row in the `nhdpInterfaceTable` exists if and only if either the row has been administratively created or there is an interface on the managed device that supports and runs NHDP. This implies that for each entry in the `nhdpInterfaceTable`, there is a corresponding entry in the Interface Table where `nhdpIfIndex` and `ifIndex` are equal. If that corresponding entry in the Interface Table is deleted, then the entry in `nhdpInterfaceTable` 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.

6.4. 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], SNMP-FRAMEWORK-MIB [RFC3411], 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) - Mobile Ad Hoc Network (MANET)
-- Neighborhood Discovery Protocol (NHDP),
-- 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 "201607120000Z" -- 12 July 2016  
ORGANIZATION "IETF MANET Working Group"  
CONTACT-INFO  
    "WG Email: manet@ietf.org  
    WG web page: https://datatracker.ietf.org/wg/manet
```

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DESCRIPTION

"This NHDP-MIB module is applicable to routers implementing the Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP) defined in RFC 6130.

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-- revision

REVISION "201607120000Z" -- 12 July 2016

DESCRIPTION

"Updated version of this MIB module, including updates made to NHDP by RFC 7466, published as RFC 7939."

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 IP Addresses 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 NhdInterfaceEntry
    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 the row has been administratively created
        or there is an interface on the managed device
        that supports and runs NHDP.

        A row can be administratively created by setting
        rowStatus to 'createAndGo' or 'createAndWait'.
        During the row creation, objects having associated
        DEFVAL clauses are automatically defined by
        the agent if not explicitly administratively defined.

        For each entry in the nhdpInterfaceTable, there is a
        corresponding entry in the Interface Table where
        nhdpIfIndex and ifIndex are equal.  If that corresponding
        entry in the Interface Table is deleted, then the entry in
        the nhdpInterfaceTable 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. Kastenholz, June 2000"

```
::= { nhdpConfigurationObjGrp 1 }
```

nhdpInterfaceEntry OBJECT-TYPE

SYNTAX NhdInterfaceEntry

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 nonvolatile storage. For further information on the storage behavior for these objects, refer to the description for the nhdpIfRowStatus object."

INDEX { nhdpIfIndex }

```
::= { nhdpInterfaceTable 1 }
```

NhdInterfaceEntry ::=

SEQUENCE {

nhdpIfIndex

InterfaceIndex,

nhdpIfName

SnmpAdminString,

nhdpIfStatus

TruthValue,

nhdpHelloInterval

Unsigned32,

nhdpHelloMinInterval

Unsigned32,

nhdpRefreshInterval

Unsigned32,

nhdpLHoldTime

Unsigned32,

nhdpPHoldTime

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. Kastenholz, 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 }

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

"RFC 5497 - Representing Multi-Value Time in Mobile Ad Hoc Networks (MANETs), Clausen, T., and C. Dearlove, March 2009.

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 8 }
```

```
--
-- Interface Parameters - Link Quality
--
```

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:

- o 0 <= nhdpHystRejectQuality
 <= nhdpHystAcceptQuality <= 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 OBJECT-TYPE
```

```
SYNTAX      Float32TC
```

```
MAX-ACCESS  read-create
```

```
STATUS      current
```

```
DESCRIPTION
```

```
"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 { 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"

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



```
--
-- Interface Parameters - Jitter
--
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), Clausen, T., Dearlove, C., and B. Adamson, February 2008"

DEFVAL { 500 }

::= { nhdpInterfaceEntry 14 }

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, the value of this object prior to this row transitioning to the 'active(1)' state MUST be administratively specified.

When this object transitions to 'active(1)', all objects in this row SHOULD be written to nonvolatile (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 nonvolatile storage.

If the value of this object is not equal to 'active(1)', all associated entries in the nhdpLibLocalIfSetTable, nhdpInterfaceStateTable, nhdpIibLinkSetTable, 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 }
```

```
--
```

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

```
--
```

```
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 nonvolatile 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 nonvolatile 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 one has been administratively created. This can be done 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 Local Interface Tuples for each network
        interface.

        The objects in this table are persistent, and when
        written, the device SHOULD save the change to
        nonvolatile 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
            Integer32,
        nhdpLibLocalIfSetIfIndex
            InterfaceIndex,
        nhdpLibLocalIfSetIpAddrType
            InetAddressType,
        nhdpLibLocalIfSetIpAddr
            InetAddress,
        nhdpLibLocalIfSetIpAddrPrefixLen
            InetAddressPrefixLength,
        nhdpLibLocalIfSetRowStatus
            RowStatus
    }

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 }

nhdpLibLocalIfSetIpAddressType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The type of the nhdpLibLocalIfSetIpAddress
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 }

nhdpLibLocalIfSetIpAddress OBJECT-TYPE

SYNTAX InetAddress (SIZE(4|16))

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"nhdpLibLocalIfSetIpAddress is an
address of an interface of
this router.

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

REFERENCE

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

::= { nhdpLibLocalIfSetEntry 4 }

nhdpLibLocalIfSetIpAddressPrefixLen 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 nhdpLibLocalIfSetIpAddress 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 nonvolatile (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 nonvolatile 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 RFC 4293 (ipAddressTable)"

REFERENCE

"RFC 4293 - Management Information Base for the Internet Protocol (IP), S. Routhier, Ed., April 2006.

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
        InetAddressPrefixLength,
    nhdpLibRemovedIfAddrSetIfIndex
        InterfaceIndex,
    nhdpLibRemovedIfAddrSetIRTime
        TimeStamp
}
```

```
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 }

nhdpLibRemovedIfAddrSetIpAddress OBJECT-TYPE

SYNTAX InetAddress (SIZE(4|16))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"nhdpLibRemovedIfAddrSetIpAddress 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,
C., and J. Dean, April 2011"

::= { nhdpLibRemovedIfAddrSetEntry 3 }

nhdpLibRemovedIfAddrSetIpAddressPrefixLen 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 nhdpLibRemovedIfAddrSetIpAddress 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"

::= { nhdpLibRemovedIfAddrSetEntry 4 }

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"

::= { nhdpLibRemovedIfAddrSetEntry 5 }

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"

::= { nhdpLibRemovedIfAddrSetEntry 6 }

--

-- 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 nonvolatile storage."

REFERENCE

"RFC 2863 - The Interfaces Group MIB, McCloghrie, K., and F. Kastenholz, 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 NhdDiscIfSetEntry

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
nhdpDiscIfIndex 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 }

NhdDiscIfSetEntry ::=

SEQUENCE {

nhdpDiscIfSetIndex

Integer32,

nhdpDiscIfIndex

NeighborIfIndex,

nhdpDiscRouterIndex

NeighborRouterIndex,

nhdpDiscIfSetIpAddrType

InetAddressType,

nhdpDiscIfSetIpAddr

InetAddress,

nhdpDiscIfSetIpAddrPrefixLen

InetAddressPrefixLength

}

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

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

::= { nhdpDiscIfSetEntry 2 }

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 3 }

nhdpDiscIfSetIpAddressType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The type of the nhdpDiscIfSetIpAddress 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 4 }

nhdpDiscIfSetIpAddress OBJECT-TYPE

SYNTAX InetAddress (SIZE(4|16))

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The nhdpDiscIfSetIpAddress 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 }

nhdpDiscIfSetIpAddressPrefixLen 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 nhdpDiscIfSetIpAddress 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"
    ::= { 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,
C., and J. Dean, April 2011"

```
::= { 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_lost, N2_time).

        The entries include:
        - the 2-hop neighbor addresses
          ('N2_neighbor_iface_addr_list'), which
          act as the table index,
        - the associated symmetric 1-hop
          neighbor address set ('N2_2hop_addr'), designated
          through nhdpDiscIfIndex,
        - a flag indicating if the 1-hop neighbor
          through which this 2-hop neighbor is reachable
          ('N2_lost') is considered lost due to link quality,
          or not,
        - and the expiration time ('N2_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 neighbor addresses are reachable."

REFERENCE

"RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Clausen, T., Dearlove, C., and J. Dean, April 2011
and
RFC 7466 - An Optimization for the Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP), Dearlove, C., and T. Clausen, March 2015"

```
INDEX { nhdpIfIndex,
        nhdpDiscIfIndex,
        nhdpIib2HopSetIpAddressType,
        nhdpIib2HopSetIpAddress
      }
```

```
::= { nhdpIib2HopSetTable 1 }
```

NhdpIib2HopSetEntry ::=

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

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"

```
::= { nhdpIib2HopSetEntry 1 }
```

nhdpIib2HopSetIpAddress OBJECT-TYPE

SYNTAX InetAddress (SIZE(4|16))

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"nhdpIib2HopSetIpAddr 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."

REFERENCE

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

::= { nhdpIib2HopSetEntry 4 }

nhdpIib2HopSetN2Time OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"nhdpIib2HopSetN2Time specifies the value
of sysUpTime when this entry should expire and be
removed from the nhdpIib2HopSetTable."

REFERENCE

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

::= { nhdpIib2HopSetEntry 5 }

nhdpIib2HopSetN2Lost OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"nhdpIib2HopSetN2Lost corresponds to N2_lost of NHDP and
is a boolean flag, describing if for a 2-Hop Tuple, the
corresponding Link Tuple currently is considered lost
due to link quality."

REFERENCE

"RFC 7466 - An Optimization for the Mobile Ad Hoc
Network (MANET) Neighborhood Discovery Protocol (NHDP),
Dearlove, C., and T. Clausen, March 2015"

::= { nhdpIib2HopSetEntry 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.

```

--
-- Neighbor Set
--
-- The Neighbor Set Table is small because
-- most of the corresponding information is found
-- in the nhdpDiscoveredIfTable above.
--

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

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

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

NhdpNextNeighborSetEntry ::=
    SEQUENCE {
        nhdpNibNeighborSetNSymmetric
        TruthValue
    }

nhdpNibNeighborSetNSymmetric OBJECT-TYPE
    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
--
-- Contains objects that help to characterize the performance of
-- the NHDP process, typically counters.
--
nhdpPerformanceObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 3 }

--
-- Objects per local interface
--

nhdpInterfacePerfTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF NhdpInterfacePerfEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "This table summarizes performance objects that are
        measured per local NHDP interface.
        nhdpIfPerfCounterDiscontinuityTime indicates
        the most recent occasion at which any one or more
        of this interface's counters listed in this table
        suffered a discontinuity."

```

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      NhdInterfacePerfEntry
```

```
MAX-ACCESS  not-accessible
```

```
STATUS      current
```

```
DESCRIPTION
```

"A single entry contains performance counters for
a local NHDP interface."

```
INDEX { nhdpIfIndex }
```

```
::= { nhdpInterfacePerfTable 1 }
```

```
NhdInterfacePerfEntry ::=
```

```
SEQUENCE {
```

```
    nhdpIfHelloMessageXmits
```

```
        Counter32,
```

```
    nhdpIfHelloMessageRecvd
```

```
        Counter32,
```

```
    nhdpIfHelloMessageXmitAccumulatedSize
```

```
        Counter64,
```

```
    nhdpIfHelloMessageRecvdAccumulatedSize
```

```
        Counter64,
```

```
    nhdpIfHelloMessageTriggeredXmits
```

```
        Counter32,
```

```
    nhdpIfHelloMessagePeriodicXmits
```

```
        Counter32,
```

```
    nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount
```

```
        Counter32,
```

```
    nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount
```

```
        Counter32,
```

```
    nhdpIfHelloMessageXmitAccumulatedLostNeighborCount
```

```
        Counter32,
```

```
    nhdpIfPerfCounterDiscontinuityTime
```

```
        TimeStamp
```

```
}
```

```
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 }

nhdpIfPerfCounterDiscontinuityTime  OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The value of sysUpTime on the most recent occasion at which
        any one or more of this interface's counters suffered a
        discontinuity.  If no such discontinuities have occurred
        since the last reinitialization of the local management
        subsystem, then this object contains a zero value."
 ::= { nhdpInterfacePerfEntry 10 }
```

```

--
-- Objects per discovered neighbor interface
--
nhdpDiscIfSetPerfTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF NhdDiscIfSetPerfEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "A router's set of performance properties for
         each discovered interface of a neighbor."
    REFERENCE
        "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      NhdDiscIfSetPerfEntry
    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 }

NhdDiscIfSetPerfEntry ::=
    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 NhdDiscNeighborSetPerfEntry
    MAX-ACCESS  not-accessible
    STATUS      current

```

DESCRIPTION

"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"

::= { nhdpPerformanceObjGrp 4 }

nhdpDiscNeighborSetPerfEntry OBJECT-TYPE

SYNTAX NhdDiscNeighborSetPerfEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The entries include the nhdpDiscRouterIndex of the discovered router as well as performance objects related to changes of the Neighbor Set."

REFERENCE

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

INDEX { nhdpDiscRouterIndex }

::= { nhdpDiscNeighborSetPerfTable 1 }

NhdpDiscNeighborSetPerfEntry ::=

SEQUENCE {

nhdpDiscNeighborNibNeighborSetChanges

Counter32,

nhdpDiscNeighborNibNeighborSetUpTime

TimeStamp,

nhdpDiscNeighborNibNeighborSetReachableLinkChanges

Counter32

}

nhdpDiscNeighborNibNeighborSetChanges OBJECT-TYPE

SYNTAX Counter32

UNITS "changes"

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object returns the number of changes to the given Neighbor Tuple."

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

--
-- 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."
    MODULE -- this module
    MANDATORY-GROUPS { nhdpConfigurationGroup }
    ::= { nhdpCompliances 1 }

nhdpFullCompliance2 MODULE-COMPLIANCE
    STATUS          current
    DESCRIPTION
        "The full implementation requirements for
        managed network entities that implement
        NHDP."
    MODULE -- this module
    MANDATORY-GROUPS { nhdpConfigurationGroup,
                        nhdpStateGroup2,
                        nhdpNotificationObjectGroup,
                        nhdpNotificationGroup,
                        nhdpPerformanceGroup
    }
    ::= { nhdpCompliances 3 }

--
-- Units of Conformance
--

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 }

```

```

nhdpPerformanceGroup  OBJECT-GROUP
    OBJECTS {
        nhdpIfHelloMessageXmits,
        nhdpIfHelloMessageRecvd,
        nhdpIfHelloMessageXmitAccumulatedSize,
        nhdpIfHelloMessageRecvdAccumulatedSize,
        nhdpIfHelloMessageTriggeredXmits,
        nhdpIfHelloMessagePeriodicXmits,
        nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount,
        nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount,
        nhdpIfHelloMessageXmitAccumulatedLostNeighborCount,
        nhdpIfPerfCounterDiscontinuityTime,
        nhdpDiscIfRecvdPackets,
        nhdpDiscIfExpectedPackets,
        nhdpNibNeighborSetChanges,
        nhdpDiscNeighborNibNeighborSetChanges,
        nhdpDiscNeighborNibNeighborSetUpTime,
        nhdpDiscNeighborNibNeighborSetReachableLinkChanges,
        nhdpIib2HopSetPerfChanges,
        nhdpIib2HopSetPerfUpTime
    }
STATUS          current
DESCRIPTION
    "Set of NHDP performance objects implemented
    in this module."
::= { 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 }

nhdpStateGroup2  OBJECT-GROUP
    OBJECTS {
        nhdpUpTime,
        nhdpIfStateUpTime,
        nhdpDiscRouterIndex,
        nhdpDiscIfIndex,
        nhdpDiscIfSetIpAddressType,
        nhdpDiscIfSetIpAddress,
        nhdpDiscIfSetIpAddressPrefixLen,
        nhdpIibLinkSetLHeardTime,
        nhdpIibLinkSetLSymTime,
        nhdpIibLinkSetLPending,
        nhdpIibLinkSetLLost,
        nhdpIibLinkSetLTime,
        nhdpIib2HopSetIpAddressPrefixLen,
        nhdpIib2HopSet1HopIfIndex,
        nhdpIib2HopSetN2Time,
        nhdpIib2HopSetN2Lost,
        nhdpNibNeighborSetNSymmetric,
        nhdpNibLostNeighborSetNLTime
    }
}
```



```

    STATUS      current
    DESCRIPTION
        "Set of NHDP state objects implemented
        in this module."
    ::= { nhdpMIBGroups 7 }

--
-- Deprecated compliance statements and groups
--

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

        For version-independence, this compliance statement
        is deprecated in favor of nhdpFullCompliance2."
    MODULE -- this module
    MANDATORY-GROUPS { nhdpConfigurationGroup,
                        nhdpStateGroup,
                        nhdpNotificationObjectGroup,
                        nhdpNotificationGroup,
                        nhdpPerformanceGroup
    }
    ::= { nhdpCompliances 2 }

nhdpStateGroup  OBJECT-GROUP
    OBJECTS {
        nhdpUpTime,
        nhdpIfStateUpTime,
        nhdpDiscRouterIndex,
        nhdpDiscIfIndex,
        nhdpDiscIfSetIpAddressType,
        nhdpDiscIfSetIpAddress,
        nhdpDiscIfSetIpAddressPrefixLen,
        nhdpIibLinkSetLHeardTime,
        nhdpIibLinkSetLSymTime,
        nhdpIibLinkSetLPending,
        nhdpIibLinkSetLLOst,
        nhdpIibLinkSetLTime,
        nhdpIib2HopSetIpAddressPrefixLen,
        nhdpIib2HopSet1HopIfIndex,
        nhdpIib2HopSetN2Time,
        nhdpNibNeighborSetNSymmetric,
        nhdpNibLostNeighborSetNLTime
    }

```

```

    }
    STATUS      deprecated
    DESCRIPTION
        "Set of NHDP state objects implemented
        in this module.

        For version-independence, this compliance statement
        is deprecated in favor of nhdpStateGroup2."
 ::= { nhdpMIBGroups 3 }

```

END

8. Security Considerations

This MIB module defines objects for the configuration, monitoring, and notification of the Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP) [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 opens devices to attack. These are the tables and objects and their sensitivity/vulnerability:

- o 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.
- o 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.
- o 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.

- o 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:

- o nhdpDiscIfSetTable - The object contains information on discovered neighbors, specifically their IP address in the nhdpDiscIfSetIpAddress 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 SHOULD provide the security features described by the SNMPv3 framework (see [RFC3410]), and implementations claiming compliance to the SNMPv3 standard MUST include 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 Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP) [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.

NHDP is designed to allow routers to automatically discover and track routers one hop remote (denoted "neighbors") and routers two hops remote (denoted "2-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:

- o 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 Operations 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.
- o 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.
- o 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:

Description	OBJECT IDENTIFIER value
-----	-----
NHDP-MIB	{ mib-2 213 }

11. References

11.1. Normative References

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