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RFC7939: Definition of Managed Objects for the Neighborhood Discovery Protocol

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 August 2016

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.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc7939>.

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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].

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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.

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- 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].

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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.

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5.1.3.3. One Notification per Event

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

5.2. The Configuration Group

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

5.3. The State Group

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

Two constructs, i.e., TEXTUAL-CONVENTIONS, are defined to support the tables in the State Group. NHDP stores and indexes information through sets of (dynamically defined) addresses, i.e., address sets. Within SMIV2, it is not possible to index tables with variably defined address sets. Hence, these TEXTUAL-CONVENTIONS are defined to provide a local mapping between NHDP-managed address sets and SMIV2 table indexing. These constructs are the NeighborIfIndex and NeighborRouterIndex. These are locally (to the router) defined, unique identifiers of virtual neighbors and neighbor interfaces. Due to the nature of NHDP, the local router may have identified distinct address sets but is not able to associate these as a single interface. Hence, two or more NeighborIfIndexes pointing to multiple distinct address sets may, in fact, be related to a common neighbor interface. This ambiguity may also hold with respect to the assignment of the NeighborRouterIndex. The local MIB agent is responsible for managing, aggregating, and retiring the defined indexes and for updating MIB tables using these indexes as the local router learns more about its neighbors' topologies. These constructs are used to define indexes to the appropriate State Group tables and to correlate table entries to address sets, virtual neighbor interfaces, and virtual neighbors within the MANET.

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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 }.

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- 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 }.

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- 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].

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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

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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,

```
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```

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```

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 }
```

```
NhdpInterfaceEntry ::=
SEQUENCE {
    nhdpIfIndex
        InterfaceIndex,
    nhdpIfName
        SnmpAdminString,
    nhdpIfStatus
        TruthValue,
    nhdpHelloInterval
        Unsigned32,
    nhdpHelloMinInterval
        Unsigned32,
    nhdpRefreshInterval
        Unsigned32,
    nhdpLHoldTime
        Unsigned32,
    nhdpPHoldTime
        Unsigned32,
    nhdpHystAcceptQuality
        Float32TC,
```

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```
    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

--

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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."

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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

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::= { 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),

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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 }
 ::= { nhdpiInterfaceEntry 15 }

```

```

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

```

```

nhdpiNHoldTime OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "milliseconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "nhdpiNHoldTime 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 }
 ::= { nhdpiConfigurationObjGrp 2 }

```

```

nhdpiIHoldTime OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "milliseconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "nhdpiIHoldTime 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 }
 ::= { nhdpcConfigurationObjGrp 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 nhdplibInterfaceTable when network addresses are being defined for the interfaces existing within the nhdplibInterfaceTable. The local interface is defined by the nhdplibIfIndex.

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"

```

 ::= { nhdpcConfigurationObjGrp 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 nhdplibIndex."

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 nhdplibIndex 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."

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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,

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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 NhdLibRemovedIfAddrSetEntry
 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)"

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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 }
```

```
nhdpLibRemovedIfAddrSetIpAddress OBJECT-TYPE
```

```
SYNTAX      InetAddressType
```

```
MAX-ACCESS  read-only
```

```
STATUS      current
```

DESCRIPTION

"The type of the nhdpLibRemovedIfAddrSetIpAddress in the InetAddress MIB (RFC 4001).

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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."

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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.

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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."

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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 nhdpiifIndex,
- 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 nhdpiifIndex in the INDEX is the interface index of the local interface through which these 2-hop addresses are accessible. The nhdpiifIndex in the INDEX

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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 { nhdpiifIndex,
        nhdpiifIndex,
        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."

```

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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 `nhdpiib2HopSet1HopIfIndex` of the 1-hop

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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.
```

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```
--
-- 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 {
    nhdpNextNeighborSetNSymmetric
        TruthValue
}
```

```
nhdpNextNeighborSetNSymmetric OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-only
```

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```
STATUS      current
DESCRIPTION
    "nhdpNextNeighborNSymmetric 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"
 ::= { nhdpNextNeighborSetEntry 1 }
```

```
--
-- Lost Neighbor Set
--
```

```
nhdpNextLostNeighborSetTable OBJECT-TYPE
SYNTAX      SEQUENCE OF NhdpNextLostNeighborSetEntry
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"
 ::= { nhdpNextStateObjGrp 7 }
```

```
nhdpNextLostNeighborSetEntry OBJECT-TYPE
SYNTAX      NhdpNextLostNeighborSetEntry
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 { nhdpNextDiscRouterIndex }
```

```
::= { nhdpNibLostNeighborSetTable 1 }
```

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```
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      NhdpInterfacePerfEntry
```

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

```
STATUS      current
```

```
DESCRIPTION
```

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

```
INDEX { nhdpIfIndex }
```

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

```
NhdpInterfacePerfEntry ::=
```

```
SEQUENCE {
```

```
  nhdpIfHelloMessageXmits
```

```
    Counter32,
```

```
  nhdpIfHelloMessageRecvd
```

```
    Counter32,
```

```
  nhdpIfHelloMessageXmitAccumulatedSize
```

```
    Counter64,
```

```
  nhdpIfHelloMessageRecvdAccumulatedSize
```

```
    Counter64,
```

```
  nhdpIfHelloMessageTriggeredXmits
```

```
    Counter32,
```

```
  nhdpIfHelloMessagePeriodicXmits
```

```
    Counter32,
```

```
  nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount
```

```
    Counter32,
```

```
  nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount
```

```
    Counter32,
```

```
  nhdpIfHelloMessageXmitAccumulatedLostNeighborCount
```

```
    Counter32,
```

```
  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

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"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 }

```

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```

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 }
```

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```
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."

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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 }

```

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```

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.

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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 }
```

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```
-- 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 }
```

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```

-- 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,
    nhdpPHoldTime,
    nhdpHystAcceptQuality,
    nhdpHystRejectQuality,
    nhdpInitialQuality,
    nhdpInitialPending,
    nhdpHpMaxJitter,
    nhdpHtMaxJitter,
    nhdpNHoldTime,
    nhdpIHoldTime,

```

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```

    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,
    nhdpDiscIfSetIpAddrType,
    nhdpDiscIfSetIpAddr,
    nhdpDiscIfSetIpAddrPrefixLen,
    nhdpIibLinkSetLHeardTime,
    nhdpIibLinkSetLSymTime,
    nhdpIibLinkSetLPending,
    nhdpIibLinkSetLLOst,
    nhdpIibLinkSetLTime,
    nhdpIib2HopSetIpAddrPrefixLen,
    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,
    nhdPDiscIfSetIpAddrType,
    nhdPDiscIfSetIpAddr,
    nhdPDiscIfSetIpAddrPrefixLen,
    nhdPIibLinkSetLHeardTime,
    nhdPIibLinkSetLSymTime,
    nhdPIibLinkSetLPending,
    nhdPIibLinkSetLLOst,
    nhdPIibLinkSetLTime,
    nhdPIib2HopSetIpAddrPrefixLen,
    nhdPIib2HopSet1HopIfIndex,
    nhdPIib2HopSetN2Time,
    nhdPNibNeighborSetNSymmetric,
    nhdPNibLostNeighborSetNLTime
  }
```

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```

}
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.

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- 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 nhdpDiscIfSetIpAddr object. This information provides an

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

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

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

Implementations 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].

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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 fixed 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

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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
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NHDP-MIB	{ mib-2 213 }

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