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Definition of Managed Objects for the Neighborhood Discovery Protocol draft-ietf-manet-nhdp-mib-17

Abstract

This document defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes objects for configuring parameters of the Neighborhood Discovery Protocol (NHDP) process on a router. The MIB module defined in this document, denoted NHDP-MIB, also reports state, performance information and notifications about NHDP. This additional state and performance information is useful to troubleshoot problems and performance issues during neighbor discovery.

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This Internet-Draft will expire on March 1, 2013.

Table of Contents

1. Introduction

This document defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes objects for configuring parameters of the Neighborhood Discovery Protocol (NHDP) [RFC6130] process on a router. The MIB module defined in this document, denoted NHDP-MIB, also reports state, performance information and notifications about NHDP. This additional state and performance information is useful to troubleshoot problems and performance issues during neighbor discovery.

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to Section 7 of [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 module are defined using the mechanisms defined in the Structure of Management Information (SMI). This document specifies a MIB module that is compliant to the SMIv2, which is described in [RFC2578], [RFC2579] and [RFC2580].

3. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and OPTIONAL" in this document are to be interpreted as described in [RFC2119].

4. Overview

[RFC6130] allows a router to discover and track topological information of routers up to two hops away by virtue of exchanging HELLO messages. This information is useful for routers running various routing and multicast flooding protocols developed within the IETF MANET Working Group.

4.1. Terms

The following definitions apply throughout this document:

- Notification Objects - triggers and associated notification messages allowing for asynchronous tracking of pre-defined events on the managed router.

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

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

- Performance Objects - automatically generated values which help an administrator or automated tool 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:

- nhdpNotifications - objects defining NHDP-MIB notifications.

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

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

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

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

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

5.1. Notifications

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

5.1.1. Introduction

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

5.1.2. Notification Generation

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

5.1.3. Limiting Frequency of Notifications

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

5.1.3.1. Ignoring Initial Activity

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

5.1.3.2. Throttling Notifications

The mechanism for throttling the notifications is the same as in [RFC4750] (i.e. the amount of transmitted notifications per time is bounded).

Appropriate values for the window time and upper bound are to be selected by the network manager and depend on the deployment of the MANET. If NHDP is deployed on a lossy, wireless medium, sending too

many notifications in a short time interval may lead to collisions and dropped packets. In particular, in dense deployments of routers running NHDP (i.e. where each router has many neighbors), a change of the local topology may trigger many notifications at the same time. [RFC4750] recommends "7 notifications 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 to choose a threshold value for the objects reflecting the change be set to a value of '10' and have set the DEFAULT values for these objects within the Notifications Group to this value. Further, a time window for the change objects is defined within this MIB module. It is RECOMMENDED that if the number of occurrences exceeds the change threshold within the previous change window, then the notification is to be sent. Furthermore, it is RECOMMENDED that the value for this window be set to at least 5 times the 'nhdpHelloInterval'.

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

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 Section 6, Section 7 and Section 8 of [RFC6130].

Two constructs, i.e., TEXTUAL CONVENTIONs, are defined to support of 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 in updating MIB tables using these indexes as the local router learns more about its neighbors' topology. These constructs are used to define indexes to the appropriate State Group tables and to correlate table entries to address sets, virtual neighbor interfaces and virtual neighbors within the MANET.

5.4. The Performance Group

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

5.5. Tables and Indexing

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

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

- other routers which are 2-hop removed from the local router.

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

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

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

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

These tables and their indexing are:

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

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

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

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

- nhdpDiscIfSetTable - include 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 }'.

- nhdpIibLinkSetTable - for-each local interface, this table records all links belonging to other routers which are, or recently were, 1-hop neighbors to this router. This table has 'INDEX { nhdpIfIndex, nhdpDiscIfIndex }'.

- nhdpIib2HopSetTable - for-each local interface, this table 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 }'.

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

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

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

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

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

- 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. Definitions imported from other MIB modules and other MIB modules that SHOULD be implemented in conjunction with the MIB module contained within this document are identified in this section.

6.1. Relationship to the SNMPv2-MIB

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

6.2. Relationship to Routing Protocol MIB Modules Relying on the NHDP-MIB Module

[RFC6130] allows routing protocols to rely on the neighborhood information that is discovered by means of HELLO message exchange. In order to allow for troubleshooting, fault isolation, and

management of such routing protocols through a routing protocol MIB module, it may be desired to align the State Group tables of the NHDP-MIB module and the routing protocol MIB module. This is accomplished through the definition of two TEXTUAL-CONVENTIONS in the NHDP-MIB module: the NeighborIfIndex and the NeighborRouterIndex. These object types are used to develop indexes into common NHDP-MIB module and routing protocol State Group tables. These objects are locally significant but should be locally common to the NHDP-MIB module and the routing protocol MIB module implemented on a common networked router. This will allow for improved cross referencing of information across the two MIB modules.

6.3. MIB Modules Required for IMPORTS

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

7. Definitions

This section contains the MIB module defined by the specification.

```
NHDP-MIB DEFINITIONS ::= BEGIN

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

IMPORTS

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

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

    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
                FROM SNMPv2-CONF  -- STD 58

    SnmpAdminString
                FROM SNMP-FRAMEWORK-MIB  -- RFC 3411

    InetAddressType, InetAddress,
    InetAddressPrefixLength
                FROM INET-ADDRESS-MIB  -- RFC 4001
```

```
    InterfaceIndex
                FROM IF-MIB  -- RFC 2863

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

nhdpMIB MODULE-IDENTITY
       LAST-UPDATED "201208281000Z" -- August 28, 2012
       ORGANIZATION "IETF MANET Working Group"
       CONTACT-INFO
       "WG E-Mail: manet@ietf.org

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       DESCRIPTION
           "This NHDP-MIB module is applicable to routers
            implementing the Neighborhood Discovery Protocol
            defined in RFC 6130.
```

```
            Copyright (C) The IETF Trust (2012). This version
            of this MIB module is part of RFC xxxx; see the RFC
            itself for full legal notices."

       -- revision
       REVISION "201208281000Z" -- August 28, 2012
       DESCRIPTION
            "The first version of this MIB module,
             published as RFC xxxx.
            "
       -- RFC-Editor assigns xxxx
       ::= { mib-2 xxxx }   -- to be assigned by IANA

--
-- 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 IpAddrs 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 which 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  which 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
        that if an application is deleted and re-created.

        The specific value is meaningful only within a given SNMP
        entity. An NeighborRouterIndex value MUST not be re-used
        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 which configure specific options
-- which determine the overall performance and operation of the
```

```
-- discovery protocol.

nhdpConfigurationObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 1 }


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

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

           The manager can create a row by setting
           rowStatus to 'createAndGo' or 'createAndWait'.
           Row objects having associated DEFVAL clauses are
           automatically defined by the agent with these
           values during row creation, unless the manager
           explicitly defines these object values during the
           row creation.

           If the corresponding entry with ifIndex value
           is deleted from the Interface Table, then the entry
           in this table is automatically deleted and
           NHDP is disabled on this interface,
           and all configuration and state information
           related to this interface is to be removed
           from memory."
      REFERENCE
         "RFC 2863 - The Interfaces Group MIB, McCloghrie,
          K., and F. Kastenholtz, June 2000"
   ::= { nhdpConfigurationObjGrp 1 }

   nhdpInterfaceEntry OBJECT-TYPE
      SYNTAX      NhdpInterfaceEntry
      MAX-ACCESS  not-accessible
```

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

          The objects in this table are persistent and when
          written the device SHOULD save the change to
          non-volatile storage.  For further information
          on the storage behavior for these objects, refer
          to the description for the nhdpIfRowStatus
          object."
      INDEX { nhdpIfIndex }
   ::= { nhdpInterfaceTable 1 }

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

```
        }

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

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

         If there is no local name, or this object is otherwise not
         applicable, then this object contains a zero-length string."
   ::= { nhdpInterfaceEntry 2 }

   nhdpIfStatus  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
         "nhdpIfStatus indicates whether this interface is
          currently running NHDP. A value of true(1) indicates
          that NHDP is running on this interface.
          A value of false(2) indicates that NHDP is not
          currently running on this interface. This corresponds
          to the I_manet parameter in the Local Interface Set
          of NHDP."
      DEFVAL { false }
   ::= { nhdpInterfaceEntry 3 }

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

```
   nhdpHelloInterval  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
         "nhdpHelloInterval corresponds to
          HELLO_INTERVAL of NHDP and represents the
          maximum time between the transmission of two
          successive HELLO messages on this MANET interface.

          Guidance for setting this object may be found
          in Section 5 of the NHDP specification (RFC 6130)
          where it indicates that:
             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)
         where it indicates that:
             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 { 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, in
         a HELLO message on this MANET interface, of
         each 1-hop neighbor network address and its
         status.

         Guidance for setting this object may be found
         in Section 5 of the NHDP specification (RFC 6130)
         where it indicates that:
             o nhdpRefreshInterval >= nhdpHelloInterval"
      REFERENCE
         "Section 5 on Protocol Parameters and
          Constraints of RFC 6130 - Mobile Ad Hoc Network
          (MANET) Neighborhood Discovery Protocol (NHDP),
          Clausen, T., Dearlove, C. and J. Dean, April 2011"
      DEFVAL { 2000 }
   ::= { nhdpInterfaceEntry 6 }

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

   nhdpLHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
         "nhdpLHoldTime corresponds to
         L_HOLD_TIME of NHDP and represents the period
         of advertisement, on this MANET interface, of
         former 1-hop neighbor network addresses as lost
         in HELLO messages, allowing recipients of these
         HELLO messages to accelerate removal of this
         information from their Link Sets.

         Guidance for setting this object may be found
         in Section 5 of the NHDP specification (RFC 6130)
         where it 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)
         where it indicates that it should be assigned a
         value significantly greather than the refresh interval
         held by nhdpRefreshInterval and must be representable
         as described in RFC 5497."
      REFERENCE
         "Section 5 on Protocol Parameters and
          Constraints of RFC 6130 - Mobile Ad Hoc Network
          (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)
        where it indicates that:
             o 0 <= nhdpHystRejectQuality
                 <= nhdpHystAcceptQuality <= 1.0"
    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" }
  ::= { 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)
        where it indicates that:
             o 0 <= nhdpHystRejectQuality
                 <= nhdpHystAcceptQuality <= 1.0"
    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" }
  ::= { 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)
         where it indicates that:
              o 0 <= nhdpInitialQuality <= 1.0"
      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" }
   ::= { nhdpInterfaceEntry 11 }

   nhdpInitialPending  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
         "nhdpInitialPending corresponds to
         INITIAL_PENDING of NHDP. If 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)
         where it 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 RFC5148 for
        periodically generated HELLO messages on
        this MANET interface.

       Guidance for setting this object may be found
        in Section 5 of the NHDP specification (RFC 6130)
        where it indicates that:
            o nhdpHpMaxJitter <= nhdpHelloInterval / 2
            o If nhdpHelloInterval > 0, then
              nhdpHpMaxJitter <= 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 { 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 RFC5148 for
       externally triggered HELLO messages on this
       MANET interface.

       Guidance for setting this object may be found
       in Section 5 of the NHDP specification (RFC 6130)
       where it indicates that:
           o nhdpHtMaxJitter <= nhdpHelloInterval / 2
           o If nhdpHelloInterval > 0, then
             nhdpHtMaxJitter <= 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 { 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, then the network manager MUST
         specify the value of this object prior to this row
         transitioning to the active(1) state.

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

         If this object is not equal to active(1), all associated
         entries in the nhdpLibLocalIfSetTable, nhdpInterfaceStateTable,
         nhdpIibLinkSetTable and the nhdpInterfacePerfTable MUST be
         deleted."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
      DEFVAL { active }
   ::= { nhdpInterfaceEntry 15 }


   --
   -- Router Parameters - Information Validity Time
   --
   nhdpNHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
```

```
      STATUS      current
      DESCRIPTION
         "nhdpNHoldTime corresponds to
         N_HOLD_TIME of NHDP and is used as the period
         during which former 1-hop neighbor network
         addresses are advertised as lost in HELLO
         messages, allowing recipients of these HELLO
         messages to accelerate removal of this information
         from their 2-Hop Sets.

         This object is persistent and when written
         the entity SHOULD save the change to
         non-volatile storage."
      REFERENCE
         "Section 5 on Protocol Parameters and
          Constraints of RFC 6130 - Mobile Ad Hoc Network
          (MANET) Neighborhood Discovery Protocol (NHDP),
          Clausen, T., Dearlove, C. and J. Dean, April 2011"
      DEFVAL { 6000 }
   ::= { nhdpConfigurationObjGrp 2 }


   nhdpIHoldTime  OBJECT-TYPE
      SYNTAX      Unsigned32
      UNITS       "milliseconds"
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "nhdpIHoldTime corresponds to
         I_HOLD_TIME of NHDP and represents the period
         for which a recently used local interface network
         address is recorded.

         This object is persistent and when written
         the entity SHOULD save the change to
         non-volatile storage."
      REFERENCE
         "Section 5 on Protocol Parameters and
          Constraints of RFC 6130 - Mobile Ad Hoc Network
          (MANET) Neighborhood Discovery Protocol (NHDP),
          Clausen, T., Dearlove, C. and J. Dean, April 2011"
      DEFVAL { 6000 }
   ::= { nhdpConfigurationObjGrp 3 }


    -- A router's Local Information Base (LIB)

    --
```

```
    -- Local Interface Set Table
    --

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

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

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

            Further guidance on the addition or removal of
            local addresses and network addresses is found
            in Section 9 of RFC 6130."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
    ::= { nhdpConfigurationObjGrp 4 }

    nhdpLibLocalIfSetEntry  OBJECT-TYPE
       SYNTAX      NhdpLibLocalIfSetEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "A router's Local Interface Set consists
           of Configured Interface Address Tuples for each network
           interface.

          The objects in this table are persistent and when
          written the device SHOULD save the change to
          non-volatile storage.  For further information
```

```
          on the storage behavior for these objects, refer
          to the description for the nhdpLibLocalIfSetRowStatus
          object."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
       INDEX { nhdpLibLocalIfSetIndex }
    ::= { nhdpLibLocalIfSetTable 1 }

    NhdpLibLocalIfSetEntry ::=
       SEQUENCE {
          nhdpLibLocalIfSetIndex
            Integer32,
          nhdpLibLocalIfSetIfIndex
            InterfaceIndex,
          nhdpLibLocalIfSetIpAddrType
            InetAddressType,
          nhdpLibLocalIfSetIpAddr
            InetAddress,
          nhdpLibLocalIfSetIpAddrPrefixLen
            InetAddressPrefixLength,
          nhdpLibLocalIfSetRowStatus
            RowStatus
         }

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

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

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

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

          Only the values ipv4(1) and
          ipv6(2) are supported."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
        Discovery Protocol (NHDP), Clausen, T., Dearlove,
        C. and J. Dean, April 2011"
   ::= { nhdpLibLocalIfSetEntry 3 }

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

          This object is interpreted according to
          the setting of nhdpLibLocalIfSetIpAddrType."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
        Discovery Protocol (NHDP), Clausen, T., Dearlove,
        C. and J. Dean, April 2011"
   ::= { nhdpLibLocalIfSetEntry 4 }

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

```
          the network address range defined by the
          address prefix."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpLibLocalIfSetEntry 5 }

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

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

         When this object transitions to active(1), all objects
         in this row SHOULD be written to non-volatile (stable)
         storage.  Read-create objects in this row MAY be modified.
         When an object in a row with nhdpIfRowStatus of active(1)
         is changed, then the updated value MUST be reflected in NHDP
         and this new object value MUST be written to non-volatile
         storage."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
      DEFVAL { notReady }
    ::= { nhdpLibLocalIfSetEntry 6 }



    --
    -- Removed Interface Addr Set Table
    --

    nhdpLibRemovedIfAddrSetTable OBJECT-TYPE
```

```
      SYNTAX       SEQUENCE OF NhdpLibRemovedIfAddrSetEntry
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
         "A router's Removed Interface Address Set records
         network addresses which were recently used as local
         interface network addresses.  If a router's interface
         network addresses are immutable then the Removed
         Interface Address Set is always empty and may be omitted.
         It consists of Removed Interface Address Tuples, one
         per network address."
      REFERENCE
         "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 addrs and
         the router's Interface is found in the
         Standard MIB II's IP address table
         (RFC 1213)."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
        Discovery Protocol (NHDP), Clausen, T., Dearlove,
        C. and J. Dean, April 2011"
      INDEX { nhdpLibRemovedIfAddrSetIndex }
   ::= { nhdpLibRemovedIfAddrSetTable 1 }

   NhdpLibRemovedIfAddrSetEntry ::=
      SEQUENCE {
         nhdpLibRemovedIfAddrSetIndex
           Integer32,
         nhdpLibRemovedIfAddrSetIpAddrType
           InetAddressType,
         nhdpLibRemovedIfAddrSetIpAddr
           InetAddress,
         nhdpLibRemovedIfAddrSetIpAddrPrefixLen
```

```
          InetAddressPrefixLength,
        nhdpLibRemovedIfAddrSetIfIndex
          InterfaceIndex,
        nhdpLibRemovedIfAddrSetIRTime
          TimeStamp
      }

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

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

          Only the values ipv4(1) and
          ipv6(2) are supported."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpLibRemovedIfAddrSetEntry 2 }

   nhdpLibRemovedIfAddrSetIpAddr  OBJECT-TYPE
      SYNTAX      InetAddress (SIZE(4|16))
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "nhdpLibRemovedIfAddrSetIpAddr is a
          recently used address of an interface of
          this router."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
```

```
         C. and J. Dean, April 2011"
   ::= { nhdpLibRemovedIfAddrSetEntry 3 }

   nhdpLibRemovedIfAddrSetIpAddrPrefixLen  OBJECT-TYPE
      SYNTAX      InetAddressPrefixLength
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "Indicates the number of leading one bits that
          form the mask. The mask is logically-AND-ed
          to the nhdpLibRemovedIfAddrSetIpAddr to determine
          the address prefix. A row match is true
          if the address used as an index falls within
          the network address range defined by the
          address prefix."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpLibRemovedIfAddrSetEntry 4 }


     nhdpLibRemovedIfAddrSetIfIndex  OBJECT-TYPE
        SYNTAX      InterfaceIndex
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
           "Specifies the local IfIndex from which this
            IP address was recently removed."
        REFERENCE
           "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
          Discovery Protocol (NHDP), Clausen, T., Dearlove,
          C. and J. Dean, April 2011"
     ::= { nhdpLibRemovedIfAddrSetEntry 5 }

     nhdpLibRemovedIfAddrSetIRTime  OBJECT-TYPE
        SYNTAX      TimeStamp
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
           "nhdpLibRemovedIfAddrSetIRTime specifies the sysUptime
           when to expire this entry and remove it from the
           'nhdpNibLostNeighborSetTable'"
        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 current NHDP
              process was initialized.
             "
    ::= { nhdpStateObjGrp 1 }


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

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

   nhdpInterfaceStateEntry OBJECT-TYPE
      SYNTAX      NhdpInterfaceStateEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "nhdpInterfaceStateEntry describes one NHDP
          local interface state as indexed by
          its nhdpIfIndex."
```

```
      INDEX { nhdpIfIndex }
   ::= { nhdpInterfaceStateTable 1 }

   NhdpInterfaceStateEntry ::=
      SEQUENCE {
         nhdpIfStateUpTime
            TimeStamp
         }

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


   --
   -- This table allows for the mapping between discovered
   -- remote interfaces and routers and their addresses.
   --

   nhdpDiscIfSetTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpDiscIfSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
           "A router's set of discovered interfaces on
            neighboring routers."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
    ::= { nhdpStateObjGrp 3 }


    nhdpDiscIfSetEntry  OBJECT-TYPE
       SYNTAX      NhdpDiscIfSetEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include the nhdpDiscRouterIndex of
           the discovered router, the nhdpDiscIfIndex
           of the discovered interface and the
           current set of addresses associated
```

```
           with this neighbor interface. The
           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 }

    NhdpDiscIfSetEntry ::=
       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 }

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

          Only the values ipv4(1) and
          ipv6(2) are supported."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpDiscIfSetEntry 4 }

   nhdpDiscIfSetIpAddr  OBJECT-TYPE
      SYNTAX      InetAddress (SIZE(4|16))
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The nhdpDiscIfSetIpAddr is a
          recently used address of a neighbor
```

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

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


   -- Interface Information Base (IIB)

   --
   -- Link Set
   --

   nhdpIibLinkSetTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpIibLinkSetEntry
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
          "A Link Set of an interface records all links
           from other routers which 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 sysUptime
          when to expire this entry and remove it from the
          'nhdpIibLinkSetTable'.
         "
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpIibLinkSetEntry 5 }


  --
  -- 2-Hop Set
  --
    nhdpIib2HopSetTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpIib2HopSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
           "A 2-Hop Set of an interface records network
           addresses of symmetric 2-hop neighbors, and
           the symmetric links to symmetric 1-hop neighbors
           through which these symmetric 2-hop neighbors
           can be reached.  It consists of 2-Hop Tuples."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
    ::= { nhdpStateObjGrp 5 }

    nhdpIib2HopSetEntry  OBJECT-TYPE
       SYNTAX      NhdpIib2HopSetEntry
       MAX-ACCESS  not-accessible
```

```
      STATUS      current
      DESCRIPTION
         "nhdpIib2HopSetTable consists of 2-Hop Tuples,
          each representing a single network address of
          a symmetric 2-hop neighbor, and a single MANET
          interface of a symmetric 1-hop neighbor.

          (N2_neighbor_iface_addr_list,
           N2_2hop_addr, N2_time).

          The entries include the 2-hop neighbor addresses,
          which act as the table index, and associated
          1-hop symmetric link address set, designated
          through 'nhdpDiscIfIndex', and an expiration time.
          The 'nhdpIfIndex' in the INDEX is
          interface index of the local interface
          through which these 2-hop addresses are
          accessible.  The 'nhdpDiscIfIndex' in the
          INDEX represents the 1-Hop neighbor interface
          through which these 2-Hop addresses are
          reachable."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
        Discovery Protocol (NHDP), Clausen, T., Dearlove,
        C. and J. Dean, April 2011"
      INDEX { nhdpIfIndex,
              nhdpDiscIfIndex,
              nhdpIib2HopSetIpAddressType,
              nhdpIib2HopSetIpAddress
             }
   ::= { nhdpIib2HopSetTable 1 }

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

   nhdpIib2HopSetIpAddressType  OBJECT-TYPE
      SYNTAX      InetAddressType
```

```
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The type of the nhdpIib2HopSetIpAddress
          in the InetAddress MIB module (RFC 4001).

          Only the values ipv4(1) and
          ipv6(2) are supported."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { 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-AND-ed
          to the nhdpIib2HopSetIpAddress to determine
          the address prefix. A row match is true
          if the address used as an index falls within
          the network address range defined by the
          address prefix."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpIib2HopSetEntry 3 }
```

```
   nhdpIib2HopSet1HopIfIndex  OBJECT-TYPE
      SYNTAX      NeighborIfIndex
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "nhdpIib2HopSet1HopIfIndex is
          nhdpDiscIfIndex of the 1-hop
          neighbor which 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 sysUptime
          when to expire this entry and remove it 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 }


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


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

   nhdpNibNeighborSetTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpNibNeighborSetEntry
```

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

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

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

    NhdpNibNeighborSetEntry ::=
       SEQUENCE {
          nhdpNibNeighborSetNSymmetric
            TruthValue
         }

   nhdpNibNeighborSetNSymmetric  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "nhdpNibNeighborNSymmetric corresponds
         to N_symmetric of NHDP and is a boolean flag,
         describing if this is a symmetric 1-hop neighbor."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
```

```
   ::= { nhdpNibNeighborSetEntry 1 }


  --
  -- Lost Neighbor Set
  --
    nhdpNibLostNeighborSetTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpNibLostNeighborSetEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
           "A router's Lost Neighbor Set records network
           addresses of routers which recently were
           symmetric 1-hop neighbors, but which are now
           advertised as lost."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
    ::= { nhdpStateObjGrp 7 }

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

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

    NhdpNibLostNeighborSetEntry ::=
       SEQUENCE {
          nhdpNibLostNeighborSetNLTime
            TimeStamp
         }

   nhdpNibLostNeighborSetNLTime  OBJECT-TYPE
      SYNTAX      TimeStamp
      MAX-ACCESS  read-only
      STATUS      current
```

```
      DESCRIPTION
         "nhdpNibLostNeighborSetNLTime
          specifies the sysUptime
          when to expire this entry and remove it 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 which help to characterize the performance of
-- the NHDP process, typically counters.
--
nhdpPerformanceObjGrp OBJECT IDENTIFIER ::= { nhdpObjects 3 }

  --
  -- Objects per local interface
  --

  nhdpInterfacePerfTable  OBJECT-TYPE
      SYNTAX      SEQUENCE OF NhdpInterfacePerfEntry
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "This table summarizes performance objects that are
          measured per local NHDP interface."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpPerformanceObjGrp 1 }

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

```
   NhdpInterfacePerfEntry ::=
      SEQUENCE {
         nhdpIfHelloMessageXmits
            Counter32,
         nhdpIfHelloMessageRecvd
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedSize
            Counter64,
         nhdpIfHelloMessageRecvdAccumulatedSize
            Counter64,
         nhdpIfHelloMessageTriggeredXmits
            Counter32,
         nhdpIfHelloMessagePeriodicXmits
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedSymmetricNeighborCount
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount
            Counter32,
         nhdpIfHelloMessageXmitAccumulatedLostNeighborCount
            Counter32
         }

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

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

   nhdpIfHelloMessageXmitAccumulatedSize  OBJECT-TYPE
      SYNTAX      Counter64
      UNITS       "octets"
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
```

```
        "A counter is incremented by the number of octets in
        a HELLO message each time a
        HELLO message has been sent."
    ::= { nhdpInterfacePerfEntry 3 }

    nhdpIfHelloMessageRecvdAccumulatedSize  OBJECT-TYPE
       SYNTAX      Counter64
       UNITS       "octets"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
          "A counter is incremented by the number of octets in
          a HELLO message each time a
          HELLO message has been received."
    ::= { nhdpInterfacePerfEntry 4 }

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

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

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

    nhdpIfHelloMessageXmitAccumulatedHeardNeighborCount  OBJECT-TYPE
```

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

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



  --
  -- Objects per discovered neighbor interface
  --
  nhdpDiscIfSetPerfTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpDiscIfSetPerfEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
          "A router's set of performance properties for
          each discovered interface of a neighbor."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpPerformanceObjGrp 2 }


   nhdpDiscIfSetPerfEntry  OBJECT-TYPE
       SYNTAX      NhdpDiscIfSetPerfEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "There is an entry for each discovered
          interface of a neighbor."
       REFERENCE
```

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

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

   nhdpDiscIfRecvdPackets  OBJECT-TYPE
      SYNTAX      Counter32
      UNITS       "packets"
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments each
         time this router receives a packet from that interface
         of the neighbor."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpDiscIfSetPerfEntry 1 }

   nhdpDiscIfExpectedPackets  OBJECT-TYPE
      SYNTAX      Counter32
      UNITS       "packets"
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This counter increments by the number
          of missed packets from this neighbor based
          on the packet sequence number each time this
          router receives a packet from that interface
          of the neighbor."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpDiscIfSetPerfEntry 2 }
```

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



   --
   -- Objects per discovered neighbor
   --
   nhdpDiscNeighborSetPerfTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF NhdpDiscNeighborSetPerfEntry
       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      NhdpDiscNeighborSetPerfEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries include the nhdpDiscRouterIndex of
           the discovered router, as well as performance
           objects related to changes of the Neighbor
           Set."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
       INDEX { nhdpDiscRouterIndex }
   ::= { nhdpDiscNeighborSetPerfTable 1 }
```

```
    NhdpDiscNeighborSetPerfEntry ::=
       SEQUENCE {
          nhdpDiscNeighborNibNeighborSetChanges
            Counter32,
          nhdpDiscNeighborNibNeighborSetUpTime
            TimeStamp,
          nhdpDiscNeighborNibNeighborSetReachableLinkChanges
            Counter32
         }

   nhdpDiscNeighborNibNeighborSetChanges  OBJECT-TYPE
      SYNTAX      Counter32
      UNITS       "changes"
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This object returns the number of changes
         to the given Neighbor Tuple."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpDiscNeighborSetPerfEntry 1 }


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

   nhdpDiscNeighborNibNeighborSetReachableLinkChanges  OBJECT-TYPE
      SYNTAX      Counter32
      UNITS       "changes"
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
```

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



   --
   -- Objects per discovered 2-hop neighbor
   --
      nhdpIib2HopSetPerfTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF NhdpIib2HopSetPerfEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
           "This table contains performance objects per
           discovered 2-hop neighbor."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
    ::= { nhdpPerformanceObjGrp 5 }

    nhdpIib2HopSetPerfEntry  OBJECT-TYPE
       SYNTAX      NhdpIib2HopSetPerfEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
          "The entries contain performance objects per
           discovered 2-hop neighbor."
       REFERENCE
          "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
       INDEX { nhdpDiscRouterIndex }
    ::= { nhdpIib2HopSetPerfTable 1 }

    NhdpIib2HopSetPerfEntry ::=
       SEQUENCE {
          nhdpIib2HopSetPerfChanges
```

```
            Counter32,
          nhdpIib2HopSetPerfUpTime
            TimeStamp
        }

   nhdpIib2HopSetPerfChanges  OBJECT-TYPE
      SYNTAX      Counter32
      UNITS       "changes"
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This object counts the changes of the union of all
         N2_neighbor_iface_addr_list of 2-Hop Tuples with an
         N2_2hop_addr equal to one of the given 2-hop
         neighbor's addresses."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpIib2HopSetPerfEntry 1 }


   nhdpIib2HopSetPerfUpTime  OBJECT-TYPE
      SYNTAX      TimeStamp
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "This object returns the sysUpTime
         when the 2-Hop Tuple
         corresponding to the given 2-hop neighbor IP address
         was registered in the nhdpIib2HopSetTable."
      REFERENCE
         "RFC 6130 - Mobile Ad Hoc Network (MANET) Neighborhood
         Discovery Protocol (NHDP), Clausen, T., Dearlove,
         C. and J. Dean, April 2011"
   ::= { nhdpIib2HopSetPerfEntry 2 }




--
-- nhdpNotifications
--

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

```
   -- nhdpNotificationsObjects

   nhdpNbrStateChange NOTIFICATION-TYPE
          OBJECTS { nhdpIfName,  -- The originator of
                                 --     the notification.
                    nhdpNbrState  -- The new state
                  }
          STATUS       current
          DESCRIPTION
             "nhdpNbrStateChange is a notification sent when
             more than nhdpNbrStateChangeThreshold neighbors change
             their status (i.e. down, asymmetric, or symmetric)
             within a time window of nhdpNbrStateChangeWindow."
          ::= { nhdpNotificationsObjects 1 }

    nhdp2HopNbrStateChange NOTIFICATION-TYPE
          OBJECTS { nhdpIfName,      -- The originator
                                     -- of the notification
                    nhdp2HopNbrState  -- The new state
             }
          STATUS       current
          DESCRIPTION
             "nhdp2HopNbrStateChange is a notification sent
             when more than nhdp2HopNbrStateChangeThreshold 2-hop
             neighbors change their status (i.e. up or down) within
             a time window of nhdp2HopNbrStateChangeWindow."
          ::= { nhdpNotificationsObjects 2 }

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


   -- nhdpNotificationsControl

   nhdpNbrStateChangeThreshold OBJECT-TYPE
          SYNTAX       Integer32 (0..255)
          UNITS        "changes"
          MAX-ACCESS   read-write
          STATUS       current
          DESCRIPTION
             "A threshold value for the
```

```
            nhdpNbrStateChange object. If the
            number of occurrences exceeds this threshold
            within the previous nhdpNbrStateChangeWindow,
            then the nhdpNbrStateChange notification
            is to be sent.

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

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

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

            This object represents the time in hundredths
            of a second.
           "
        DEFVAL { 1000 }
        ::= { nhdpNotificationsControl 2 }

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

```
              is to be sent.

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

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

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

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




    -- nhdpNotificationStates

    nhdpNbrState OBJECT-TYPE
       SYNTAX       INTEGER {
                       down(0),
                       asymmetric(1),
                       symmetric(2)
                       }
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
          "NHDP neighbor states. In NHDP it is not
```

```
            necessary to remove Protocol Tuples from Protocol Sets
            at the exact time indicated, only to behave as if the
            Protocol Tuples were removed at that time. This case is
            indicated here as 'down(0)', all other cases being
            indicated as 'asymmetric(1)' or 'symmetric(2)'. If down,
            the direct neighbor is also added to the
            nhdpNibLostNeighborSetTable.
            "
        ::= { nhdpNotificationsStates 1 }

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


--
-- nhdpConformance information
--

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


-- Compliance Statements
nhdpBasicCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
    "The basic implementation requirements for
     managed network entities that implement
     NHDP."
  MODULE -- this module

  MANDATORY-GROUPS { nhdpConfigurationGroup }
  ::= { nhdpCompliances 1 }


nhdpFullCompliance MODULE-COMPLIANCE
```

```
  STATUS current
  DESCRIPTION
    "The full implementation requirements for
     managed network entities that implement
     NHDP."
  MODULE -- this module

  MANDATORY-GROUPS { nhdpConfigurationGroup,
                     nhdpStateGroup,
                     nhdpNotificationObjectGroup,
                     nhdpNotificationGroup,
                     nhdpPerformanceGroup }
  ::= { nhdpCompliances 2 }


--
-- Units of Conformance
--

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

```
      STATUS  current
      DESCRIPTION
         "Set of NHDP configuration objects implemented
          in this module."
   ::= { nhdpMIBGroups 2 }

   nhdpStateGroup OBJECT-GROUP
      OBJECTS {
               nhdpUpTime,
               nhdpIfStateUpTime,
               nhdpDiscRouterIndex,
               nhdpDiscIfIndex,
               nhdpDiscIfSetIpAddrType,
               nhdpDiscIfSetIpAddr,
               nhdpDiscIfSetIpAddrPrefixLen,
               nhdpIibLinkSetLHeardTime,
               nhdpIibLinkSetLSymTime,
               nhdpIibLinkSetLPending,
               nhdpIibLinkSetLLost,
               nhdpIibLinkSetLTime,
               nhdpIib2HopSetIpAddrPrefixLen,
               nhdpIib2HopSet1HopIfIndex,
               nhdpIib2HopSetN2Time,
               nhdpNibNeighborSetNSymmetric,
               nhdpNibLostNeighborSetNLTime
              }
      STATUS  current
      DESCRIPTION
         "Set of NHDP state objects implemented
          in this module."
   ::= { nhdpMIBGroups 3 }

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

```
              nhdpDiscNeighborNibNeighborSetReachableLinkChanges,
              nhdpIib2HopSetPerfChanges,
              nhdpIib2HopSetPerfUpTime
            }
      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 }


END
```

8. Security Considerations

This MIB module defines objects for the configuration, monitoring and notification of the Neighborhood Discovery Protocol [RFC6130]. NHDP allows routers to acquire topological information up to two hops away by virtue of exchanging HELLO messages. The information acquired by

NHDP may be used by routing protocols. The neighborhood information, exchanged between routers using NHDP, serves these routing protocols as a baseline for calculating paths to all destinations in the MANET, relay set selection for network-wide transmissions etc.

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

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

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

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

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

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

- nhdpDiscIfSetTable - The object contains information on discovered neighbors, specifically their IP address in the nhdpDiscIfSetIpAddr object. This information provides an adversary broad information on the members of the MANET, located

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

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

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

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

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

9. Applicability Statement

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

NHDP is designed to allow routers to automatically discover and track

routers one hop remote (denoted "neighbors"), and routers two hops remote (denoted "two-hop neighbors). This information is used by other MANET protocols in operation on the router to perform routing, multicast forwarding and other functions with ad-hoc and mobile networks. In the following, three scenarios are listed where this MIB module is useful, i.e.,

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

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

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

10. IANA Considerations

IANA is requested to assign a "manet" ifType from the IANA ifType-MIB.

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

11. Acknowledgements

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Appendix A.

```
**************************************************************
* Note to the RFC Editor (to be removed prior to publication) *
*                                                            *
* The reference to RFC xxxx within the DESCRIPTION clauses    *
* of the MIB module point to this draft and are to be        *
* assigned by the RFC Editor.                                *
*                                                            *
**************************************************************
```

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