                   Definitions of Managed Objects for
               Network Time Protocol Version 4 (NTPv4)

Abstract

   The Network Time Protocol (NTP) is used in networks of all types and
   sizes for time synchronization of servers, workstations, and other
   networked equipment. As time synchronization is more and more a
   mission-critical service, standardized means for monitoring and
   management of this subsystem of a networked host are required to
   allow operators of such a service to set up a monitoring system that
   is platform- and vendor-independent. This document provides a
   standardized collection of data objects for monitoring the NTP entity
   of such a network participant and it is part of the NTP version 4
   standardization effort.

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1. Introduction

   The NTPv4 MIB module is designed to allow Simple Network Management
   Protocol (SNMP) to be used to monitor and manage local NTP [RFC5905]
   entities. It provides a collection of data objects that can be
   queried using the SNMP protocol and represent the current status of
   the NTP entity. This includes general information about the NTP
   entity itself (vendor, product, version) as well as connectivity to
   upstream NTP servers used as sources of reference time and to
   hardware reference clocks like radio clocks. The most important
   values are included in order to be able to detect failures before
   they can have an impact on the overall time synchronization status of
   the network. There are also a collection of notification objects to
   inform about state changes in the NTP entity. There are objects to
   control these notifications as well.

2. Conventions Used in This Document

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

3. The Internet-Standard Management Framework

   For a detailed overview of the documents that describe the current
   Internet-Standard Management Framework, please refer to section 7 of
   RFC 3410 [RFC3410].

   Managed objects are accessed via a virtual information store, termed
   the Management Information Base or MIB. MIB objects are generally
   accessed through the Simple Network Management Protocol (SNMP).
   Objects in the MIB are defined using the mechanisms defined in the
   Structure of Management Information (SMI). This memo specifies a MIB
   module that is compliant to the SMIv2, which is described in STD 58,
   RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580
   [RFC2580].

4. Technical Description

   The NTPv4 MIB module is divided into sections for general server
   information, current NTP entity status, status information of all
   mobilized associations (e.g., unicast upstream time servers,
   multicast or broadcast, time references, and hardware clocks), NTP
   entity control objects, NTP objects used only for notifications, as
   well as SNMP notification definitions for core events.

   The general server information section contains static information
   and can be queried to identify which NTP implementation is running on
   a host. This includes the vendor and product name of the running NTP
   software as well as version information, hardware/os platform
   identity, and the time resolution of the underlying OS.

   Section 2 (current NTP status) includes data objects that represent
   the current operational status of the NTP entity.

   The third section contains data objects that represent the set of
   time references ("associations") with which the NTP entity is
   currently working.

   The fourth section contains objects that can be used to control the
   NTP entity. The currently defined objects control how often the
   heartbeat interval notification is sent out and which notifications
   are enabled.

   The fifth section contains objects that are only used as varbinds in
   notifications. There is currently only one object in this section --
   a message that adds a cleartext event message to notifications.

   Certain important events can occur while the NTP entity is running.
   The notification section defines SNMP notifications for a collection
   of the most important ones ("core events") and additionally provides
   a heartbeat notification as well as a test notification to allow
   management systems to test the reception of NTP-related notifications
   as well as enable heartbeat-based monitoring systems to assure that
   the NTP entity is still up and running.

   Some values are included both in numeric and in human-readable
   (string) format. This has been done to simplify the representation
   of a status information. If the two representations of a certain
   value differ, the numeric representation takes precedence.

5. MIB Definition

```
-- *********************************************************************
--
--     The Network Time Protocol Version 4
--     Management Information Base (MIB)
--
--     Authors: Heiko Gerstung (heiko.gerstung@meinberg.de)
--              Chris Elliott (chelliot@pobox.com)
--
--     for the Internet Engineering Task Force (IETF)
--     NTP Working Group (ntpwg)
--
--
-- *********************************************************************
--   Rev 1.00
--        Published as RFC 5907
--
-- *********************************************************************


NTPv4-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE , mib-2, Integer32, NOTIFICATION-TYPE,
    Unsigned32, Counter32, TimeTicks
        FROM SNMPv2-SMI -- RFC 2578
    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
        FROM SNMPv2-CONF -- RFC 2580
    DisplayString, TEXTUAL-CONVENTION
        FROM SNMPv2-TC -- RFC 2579
```

```
     InetAddressType, InetAddress
         FROM INET-ADDRESS-MIB -- RFC 4001
     Utf8String
         FROM SYSAPPL-MIB; -- RFC 2287


ntpSnmpMIB MODULE-IDENTITY
     LAST-UPDATED "201005170000Z" -- May 17, 2010
     ORGANIZATION "The IETF NTP Working Group (ntpwg)"
     CONTACT-INFO
             "      WG Email: ntpwg@lists.ntp.isc.org
                    Subscribe:
                     https://lists.ntp.isc.org/mailman/listinfo/ntpwg

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                    Brian Haberman
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                    Email: brian@innovationslab.net"
        DESCRIPTION
          "The Management Information Base for NTP time entities.

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```

          (http://trustee.ietf.org/license-info)."

     REVISION   "201005170000Z"
     DESCRIPTION
         "This revision of the MIB module is published as RFC 5907."

     ::= { mib-2 197 }

ntpSnmpMIBObjects OBJECT IDENTIFIER ::= { ntpSnmpMIB 1 }

-- MIB contains 6 groups

ntpEntInfo   OBJECT IDENTIFIER ::= { ntpSnmpMIBObjects 1 }
ntpEntStatus   OBJECT IDENTIFIER ::= { ntpSnmpMIBObjects 2 }
ntpAssociation   OBJECT IDENTIFIER ::= { ntpSnmpMIBObjects 3 }
ntpEntControl   OBJECT IDENTIFIER ::= { ntpSnmpMIBObjects 4 }
ntpEntNotifObjects OBJECT IDENTIFIER ::= { ntpSnmpMIBObjects 5 }

--
-- Textual Conventions
--

NtpStratum ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS   current
    DESCRIPTION
        "The NTP stratum, with 16 representing no stratum."
    SYNTAX   Unsigned32 (1..16)

NtpDateTime ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "4d:4d:4d.4d"
    STATUS   current
    DESCRIPTION
        "NTP date/time on the device, in 128-bit
         NTP date format. If time is not syncronized, this
         field shall be a zero-length string.

         This trusted certificate (TC) is not to be used for objects
         that are used to set the time of the node querying this
         object. NTP should be used for this -- or at least SNTP."
    REFERENCE "RFC 5905, section 6"
    SYNTAX   OCTET STRING (SIZE (0 | 16))

--
-- Section 1: General NTP Entity information objects
--   (relatively static information)
--

ntpEntSoftwareName OBJECT-TYPE
    SYNTAX   Utf8String
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The product name of the running NTP version, e.g., 'ntpd'."
    ::= { ntpEntInfo 1 }

ntpEntSoftwareVersion OBJECT-TYPE
    SYNTAX   Utf8String
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The software version of the installed NTP implementation
         as a full version string, e.g., 'ntpd-4.2.0b@1.1433 ...'"
    ::= { ntpEntInfo 2 }

ntpEntSoftwareVendor OBJECT-TYPE
    SYNTAX   Utf8String
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The vendor/author of the installed NTP version."
    ::= { ntpEntInfo 3 }

ntpEntSystemType OBJECT-TYPE
    SYNTAX   Utf8String
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "General hardware/os platform information,
         e.g., 'Linux 2.6.12 / x86'."
    -- freely configurable, default is OS Version / Hardware platform
    ::= { ntpEntInfo 4 }

ntpEntTimeResolution OBJECT-TYPE
    SYNTAX   Unsigned32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The time resolution in integer format, where the resolution
         is represented as divisions of a second, e.g., a value of 1000
         translates to 1.0 ms."
    ::= { ntpEntInfo 5 }

```
ntpEntTimePrecision OBJECT-TYPE
    SYNTAX       Integer32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The entity's precision in integer format, shows the precision.
         A value of -5 would mean 2^-5 = 31.25 ms."
    ::= { ntpEntInfo  6 }

ntpEntTimeDistance OBJECT-TYPE
    SYNTAX       DisplayString
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The distance from this NTP entity to the root time reference
         (stratum 0) source including the unit, e.g., '13.243 ms'."
    ::= { ntpEntInfo  7 }

--
-- Section 2: Current NTP status (dynamic information)
--

ntpEntStatusCurrentMode OBJECT-TYPE
    SYNTAX       INTEGER {
                            notRunning(1),
                            notSynchronized(2),
                            noneConfigured(3),
                            syncToLocal(4),
                            syncToRefclock(5),
                            syncToRemoteServer(6),
                            unknown(99)
                         }
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The current mode of the NTP.  The definition of each possible
         value is:
             notRunning(1) - NTP is not running.
             notSynchronized(2) - NTP is not synchronized to any time
                                  source (stratum = 16).
             noneConfigured(3) - NTP is not synchronized and does not
                                  have a reference configured
                                  (stratum = 16).
             syncToLocal(4) - NTP is distributing time based on its
                                  local clock (degraded accuracy and/or
                                  reliability).
             syncToRefclock(5) - NTP is synchronized to a local
                                  hardware refclock (e.g., GPS).
```

```
           syncToRemoteServer(6) - NTP is synchronized to a remote
                                   NTP server ('upstream' server).
           unknown(99) - The state of NTP is unknown."
    ::= { ntpEntStatus 1 }

ntpEntStatusStratum OBJECT-TYPE
    SYNTAX       NtpStratum
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The NTP entity's own stratum value.  Should be a stratum of
         syspeer + 1 (or 16 if no syspeer)."
    ::= { ntpEntStatus 2 }

ntpEntStatusActiveRefSourceId OBJECT-TYPE
    SYNTAX       Unsigned32 ( 0..99999 )
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The association ID of the current syspeer."
    ::= { ntpEntStatus 3 }

ntpEntStatusActiveRefSourceName OBJECT-TYPE
    SYNTAX       Utf8String
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The hostname/descriptive name of the current reference source
         selected as syspeer, e.g., 'ntp1.ptb.de' or 'GPS' or
         'DCFi', ..."
    ::= { ntpEntStatus 4 }

ntpEntStatusActiveOffset OBJECT-TYPE
    SYNTAX       DisplayString
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The time offset to the current selected reference time source
         as a string including unit, e.g., '0.032 ms' or '1.232 s'."
    ::= { ntpEntStatus 5 }

ntpEntStatusNumberOfRefSources OBJECT-TYPE
    SYNTAX       Unsigned32 (0..99)
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The number of reference sources configured for NTP."
    ::= { ntpEntStatus 6 }
```

ntpEntStatusDispersion OBJECT-TYPE
    SYNTAX   DisplayString
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The root dispersion of the running NTP entity, e.g., '6.927'."
    ::= { ntpEntStatus 7 }

ntpEntStatusEntityUptime OBJECT-TYPE
    SYNTAX   TimeTicks
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The uptime of the NTP entity, (i.e., the time since ntpd was
         (re-)initialized not sysUptime!). The time is represented in
         hundreds of seconds since Jan 1, 1970 (00:00:00.000) UTC."
    ::= { ntpEntStatus 8 }

ntpEntStatusDateTime OBJECT-TYPE
    SYNTAX   NtpDateTime
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The current NTP date/time on the device, in 128-bit
         NTP date format. If time is not syncronized, this
         field shall be a zero-length string.

         This object can be used to timestamp events on this
         node and allow a management station to correlate
         different time objects. For example, a management
         station could query this object and sysUpTime in
         the same operation to be able to relate sysUpTime
         to NTP time.

         This object is not to be used to set the time of
         the node querying this object. NTP should be used
         for this -- or at least SNTP."
    REFERENCE "RFC 5905, section 6"
    ::= { ntpEntStatus 9 }

ntpEntStatusLeapSecond OBJECT-TYPE
    SYNTAX   NtpDateTime
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "Date the next known leap second will occur. If there is
         no leap second announced, then this object should be 0."
    ::= { ntpEntStatus 10 }

ntpEntStatusLeapSecDirection OBJECT-TYPE
    SYNTAX   Integer32 (-1..1)
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "Direction of next known leap second. If there is no
         leap second announced, then this object should be 0."
    ::= { ntpEntStatus 11 }

ntpEntStatusInPkts OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The total number of NTP messages delivered to the
         NTP entity from the transport service.
         Discountinuities in the value of this counter can occur
         upon cold start or reinitialization of the NTP entity, the
         management system and at other times as indicated by
         discontinuities in the value of sysUpTime."

    ::= { ntpEntStatus 12 }

ntpEntStatusOutPkts OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The total number of NTP messages delivered to the
         transport service by this NTP entity.
         Discountinuities in the value of this counter can occur
         upon cold start or reinitialization of the NTP entity, the
         management system and at other times as indicated by
         discontinuities in the value of sysUpTime."
    ::= { ntpEntStatus 13 }

ntpEntStatusBadVersion OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The total number of NTP messages that were delivered
         to this NTP entity and were for an unsupported NTP
         version.

          Discountinuities in the value of this counter can occur
          upon cold start or reinitialization of the NTP entity, the
          management system and at other times as indicated by
          discontinuities in the value of sysUpTime."
     ::= { ntpEntStatus 14 }

ntpEntStatusProtocolError OBJECT-TYPE
     SYNTAX   Counter32
     UNITS   "packets"
     MAX-ACCESS read-only
     STATUS   current
     DESCRIPTION
         "The total number of NTP messages that were delivered
          to this NTP entity and this entity was not able to
          process due to an NTP protocol error.
          Discountinuities in the value of this counter can occur
          upon cold start or reinitialization of the NTP entity, the
          management system and at other times as indicated by
          discontinuities in the value of sysUpTime."
     ::= { ntpEntStatus 15 }

ntpEntStatusNotifications OBJECT-TYPE
     SYNTAX   Counter32
     UNITS   "notifications"
     MAX-ACCESS read-only
     STATUS   current
     DESCRIPTION
         "The total number of SNMP notifications that this NTP
          entity has generated.
          Discountinuities in the value of this counter can occur
          upon cold start or reinitialization of the NTP entity, the
          management system and at other times as indicated by
          discontinuities in the value of sysUpTime."
     ::= { ntpEntStatus 16 }

ntpEntStatPktModeTable OBJECT-TYPE
     SYNTAX   SEQUENCE OF NtpEntStatPktModeEntry
     MAX-ACCESS   not-accessible
     STATUS   current
     DESCRIPTION
         "The number of packets sent and received by packet mode.
          One entry per packet mode."
     ::= { ntpEntStatus 17 }

ntpEntStatPktModeEntry OBJECT-TYPE
     SYNTAX   NtpEntStatPktModeEntry
     MAX-ACCESS not-accessible
     STATUS   current

    DESCRIPTION
        "A statistical record of the number of packets sent and
         received for each packet mode."
    INDEX   { ntpEntStatPktMode }
    ::= { ntpEntStatPktModeTable 1 }

NtpEntStatPktModeEntry   ::= SEQUENCE {
        ntpEntStatPktMode   INTEGER,
        ntpEntStatPktSent   Counter32,
        ntpEntStatPktReceived   Counter32
}

ntpEntStatPktMode OBJECT-TYPE
    SYNTAX   INTEGER {
                    symetricactive(1),
                    symetricpassive(2),
                    client(3),
                    server(4),
                    broadcastserver(5),
                    broadcastclient(6)
                }
    MAX-ACCESS not-accessible
    STATUS   current
    DESCRIPTION
        "The NTP packet mode."
    ::= { ntpEntStatPktModeEntry 1 }

ntpEntStatPktSent OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The number of NTP packets sent with this packet mode.
         Discountinuities in the value of this counter can occur
         upon cold start or reinitialization of the NTP entity, the
         management system and at other times as indicated by
         discontinuities in the value of sysUpTime."

    ::= { ntpEntStatPktModeEntry 2 }

ntpEntStatPktReceived OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The number of NTP packets received with this packet mode.

          Discountinuities in the value of this counter can occur
          upon cold start or reinitialization of the NTP entity, the
          management system and at other times as indicated by
          discontinuities in the value of sysUpTime."

     ::= { ntpEntStatPktModeEntry 3 }

--
-- Section 3: The status of all currently mobilized associations
--

ntpAssociationTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF NtpAssociationEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
        "The table of currently mobilized associations."
    ::= { ntpAssociation 1 }

ntpAssociationEntry OBJECT-TYPE
    SYNTAX   NtpAssociationEntry
    MAX-ACCESS not-accessible
    STATUS   current
    DESCRIPTION
        "The table entry of currently mobilized associations."
    INDEX   { ntpAssocId }
    ::= { ntpAssociationTable 1 }

NtpAssociationEntry   ::= SEQUENCE {
        ntpAssocId   Unsigned32,
        ntpAssocName   Utf8String,
        ntpAssocRefId   DisplayString,
        ntpAssocAddressType   InetAddressType,
        ntpAssocAddress   InetAddress,
        ntpAssocOffset   DisplayString,
        ntpAssocStratum   NtpStratum,
        ntpAssocStatusJitter   DisplayString,
        ntpAssocStatusDelay   DisplayString,
        ntpAssocStatusDispersion   DisplayString
}

ntpAssocId   OBJECT-TYPE
    SYNTAX   Unsigned32 (1..99999)
    MAX-ACCESS not-accessible
    STATUS   current
    DESCRIPTION
        "The association ID. This is an internal, unique ID."
    ::= { ntpAssociationEntry 1 }

ntpAssocName   OBJECT-TYPE
    SYNTAX   Utf8String
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The hostname or other descriptive name for the association."
    ::= { ntpAssociationEntry 2 }

ntpAssocRefId   OBJECT-TYPE
    SYNTAX   DisplayString
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The refclock driver ID, if available."
    -- a refclock driver ID like "127.127.1.0" for non
    -- uni/multi/broadcast associations
    ::= { ntpAssociationEntry 3 }

ntpAssocAddressType OBJECT-TYPE
    SYNTAX   InetAddressType { ipv4(1), ipv6(2), ipv4z(3), ipv6z(4) }
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The type of address of the association. Can be either IPv4 or
         IPv6 (both with or without zone index) and contains the type of
         address for unicast, multicast, and broadcast associations."
    ::= { ntpAssociationEntry 4 }

ntpAssocAddress OBJECT-TYPE
    SYNTAX   InetAddress (SIZE (4|8|16|20))
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The IP address (IPv4 or IPv6, with or without zone index) of
         the association. The type and size depends on the
         ntpAssocAddressType object. Represents the IP address of a
         uni/multi/broadcast association."
    ::= { ntpAssociationEntry 5 }

ntpAssocOffset   OBJECT-TYPE
    SYNTAX   DisplayString
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
        "The time offset to the association as a string."
    -- including unit, e.g., "0.032 ms" or "1.232 s"
    ::= { ntpAssociationEntry 6 }

ntpAssocStratum OBJECT-TYPE
    SYNTAX   NtpStratum
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The association stratum value."
    ::= { ntpAssociationEntry 7 }

ntpAssocStatusJitter OBJECT-TYPE
    SYNTAX   DisplayString
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The jitter in milliseconds as a string."
    ::= { ntpAssociationEntry 8 }

ntpAssocStatusDelay OBJECT-TYPE
    SYNTAX   DisplayString
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The network delay in milliseconds as a string."
    ::= { ntpAssociationEntry 9 }

ntpAssocStatusDispersion OBJECT-TYPE
    SYNTAX   DisplayString
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The root dispersion of the association."
    -- e.g., "6.927"
    ::= { ntpAssociationEntry 10 }

ntpAssociationStatisticsTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF NtpAssociationStatisticsEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
        "The table of statistics for current associations."
    ::= { ntpAssociation 2 }

ntpAssociationStatisticsEntry OBJECT-TYPE
    SYNTAX   NtpAssociationStatisticsEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
        "The table entry of statistics for current associations."
    INDEX   { ntpAssocId }

    ::= { ntpAssociationStatisticsTable 1 }

NtpAssociationStatisticsEntry   ::= SEQUENCE {
        ntpAssocStatInPkts   Counter32,
        ntpAssocStatOutPkts   Counter32,
        ntpAssocStatProtocolError Counter32
}

ntpAssocStatInPkts OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The total number of NTP messages delivered to the
         NTP entity from this association.
         Discountinuities in the value of this counter can occur
         upon cold start or reinitialization of the NTP entity, the
         management system and at other times as indicated by
         discontinuities in the value of sysUpTime."

    ::= { ntpAssociationStatisticsEntry 1 }

ntpAssocStatOutPkts OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The total number of NTP messages delivered to the
         transport service by this NTP entity for this
         association.
         Discountinuities in the value of this counter can occur
         upon cold start or reinitialization of the NTP entity, the
         management system and at other times as indicated by
         discontinuities in the value of sysUpTime."

    ::= { ntpAssociationStatisticsEntry 2 }

ntpAssocStatProtocolError OBJECT-TYPE
    SYNTAX   Counter32
    UNITS   "packets"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
        "The total number of NTP messages that were delivered
         to this NTP entity from this association and this entity
         was not able to process due to an NTP protocol error.

          Discountinuities in the value of this counter can occur
          upon cold start or reinitialization of the NTP entity, the
          management system and at other times as indicated by
          discontinuities in the value of sysUpTime."

     ::= { ntpAssociationStatisticsEntry 3 }

--
-- Section 4: Control objects
--

ntpEntHeartbeatInterval OBJECT-TYPE
    SYNTAX   Unsigned32
    UNITS   "seconds"
    MAX-ACCESS   read-write
    STATUS   current
    DESCRIPTION
        "The interval at which the ntpEntNotifHeartbeat notification
         should be sent, in seconds. If set to 0 and the
         entNotifHeartbeat bit in ntpEntNotifBits is 1, then
         ntpEntNotifHeartbeat is sent once.
         This value is stored persistently and will be restored to its
         last set value upon cold start or restart."
    DEFVAL { 60 }
    ::= { ntpEntControl 1 }

ntpEntNotifBits OBJECT-TYPE
    SYNTAX   BITS {
                      notUsed(0), -- Used to sync up bit and notification
                                  -- indices
                      entNotifModeChange(1),
                      entNotifStratumChange(2),
                      entNotifSyspeerChanged(3),
                      entNotifAddAssociation(4),
                      entNotifRemoveAssociation(5),
                      entNotifConfigChanged(6),
                      entNotifLeapSecondAnnounced(7),
                      entNotifHeartbeat(8)
    }
    MAX-ACCESS   read-write
    STATUS   current
    DESCRIPTION
        "A bit for each notification. A 1 for a particular bit enables
         that particular notification, a 0 disables it.
         This value is stored persistently and will be restored to its
         last set value upon cold start or restart."
    ::= { ntpEntControl 2 }

```
--
-- Section 5: Notification objects
--

ntpEntNotifMessage OBJECT-TYPE
    SYNTAX      Utf8String
    MAX-ACCESS  accessible-for-notify
    STATUS      current
    DESCRIPTION
        "Used as a payload object for all notifications.  Holds a
         cleartext event message."
    DEFVAL { "no event" }
    ::= { ntpEntNotifObjects 1 }

--
-- SNMP notification definitions
--

ntpEntNotifications OBJECT IDENTIFIER ::= { ntpSnmpMIB 0 }

ntpEntNotifModeChange NOTIFICATION-TYPE
    OBJECTS      { ntpEntStatusCurrentMode }
    STATUS       current
    DESCRIPTION
        "The notification to be sent when the NTP entity changes mode,
         including starting and stopping (if possible)."
    ::= { ntpEntNotifications 1 }

ntpEntNotifStratumChange NOTIFICATION-TYPE
    OBJECTS      { ntpEntStatusDateTime, ntpEntStatusStratum,
                   ntpEntNotifMessage }
    STATUS       current
    DESCRIPTION
        "The notification to be sent when stratum level of NTP changes."
    ::= { ntpEntNotifications 2 }

ntpEntNotifSyspeerChanged NOTIFICATION-TYPE
    OBJECTS      { ntpEntStatusDateTime, ntpEntStatusActiveRefSourceId,
                   ntpEntNotifMessage }
    STATUS       current
    DESCRIPTION
        "The notification to be sent when a (new) syspeer has been
         selected."
    ::= { ntpEntNotifications 3 }

ntpEntNotifAddAssociation NOTIFICATION-TYPE
    OBJECTS  { ntpEntStatusDateTime, ntpAssocName, ntpEntNotifMessage }
    STATUS       current
```

```
    DESCRIPTION
        "The notification to be sent when a new association is
         mobilized."
    ::= { ntpEntNotifications 4 }

ntpEntNotifRemoveAssociation NOTIFICATION-TYPE
    OBJECTS   { ntpEntStatusDateTime, ntpAssocName,  ntpEntNotifMessage }
    STATUS       current
    DESCRIPTION
        "The notification to be sent when an association is
         demobilized."
    ::= { ntpEntNotifications 5 }

ntpEntNotifConfigChanged NOTIFICATION-TYPE
    OBJECTS     { ntpEntStatusDateTime, ntpEntNotifMessage }
    STATUS       current
    DESCRIPTION
        "The notification to be sent when the NTP configuration has
         changed, e.g., when the system connected to the Internet and
         was assigned a new IP address by the ISPs DHCP server."
    ::= { ntpEntNotifications 6 }

ntpEntNotifLeapSecondAnnounced NOTIFICATION-TYPE
    OBJECTS     { ntpEntStatusDateTime, ntpEntNotifMessage }
    STATUS       current
    DESCRIPTION
        "The notification to be sent when a leap second has been
         announced."
    ::= { ntpEntNotifications 7 }

ntpEntNotifHeartbeat NOTIFICATION-TYPE
    OBJECTS     { ntpEntStatusDateTime, ntpEntStatusCurrentMode,
                  ntpEntHeartbeatInterval, ntpEntNotifMessage }
    STATUS       current
    DESCRIPTION
        "The notification to be sent periodically (as defined by
         ntpEntHeartbeatInterval) to indicate that the NTP entity is
         still alive."
    ::= { ntpEntNotifications 8 }

--
-- Conformance/Compliance statements
--

ntpEntConformance OBJECT IDENTIFIER ::= { ntpSnmpMIB 2 }

ntpEntCompliances OBJECT IDENTIFIER ::= { ntpEntConformance 1 }
ntpEntGroups      OBJECT IDENTIFIER ::= { ntpEntConformance 2 }
```

```
ntpEntNTPCompliance MODULE-COMPLIANCE
    STATUS        current
    DESCRIPTION
        "The compliance statement for SNMP entities that use NTP and
         implement the NTP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS {
                        ntpEntObjectsGroup1
        }
        ::= { ntpEntCompliances 1 }

ntpEntSNTPCompliance MODULE-COMPLIANCE
    STATUS        current
    DESCRIPTION
        "The compliance statement for SNMP entities that use SNTP and
         implement the NTP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS {
                        ntpEntObjectsGroup1
        }
        GROUP ntpEntObjectsGroup2
        DESCRIPTION
                "Optional object group."
        GROUP ntpEntNotifGroup
        DESCRIPTION
                "Optional notifications for this MIB."
        ::= { ntpEntCompliances 2 }

ntpEntObjectsGroup1 OBJECT-GROUP
    OBJECTS {
            ntpEntSoftwareName,
            ntpEntSoftwareVersion,
            ntpEntSoftwareVendor,
            ntpEntSystemType,
            ntpEntStatusEntityUptime,
            ntpEntStatusDateTime,
            ntpAssocName,
            ntpAssocRefId,
            ntpAssocAddressType,
            ntpAssocAddress
    }
    STATUS        current
    DESCRIPTION
        "A collection of objects for the NTP MIB."
    ::= { ntpEntGroups 1 }

ntpEntObjectsGroup2 OBJECT-GROUP
    OBJECTS {
```

```
            ntpEntTimeResolution,
            ntpEntTimePrecision,
            ntpEntTimeDistance,
            ntpEntStatusCurrentMode,
            ntpEntStatusStratum,
            ntpEntStatusActiveRefSourceId,
            ntpEntStatusActiveRefSourceName,
            ntpEntStatusActiveOffset,
            ntpEntStatusNumberOfRefSources,
            ntpEntStatusDispersion,
            ntpEntStatusLeapSecond,
            ntpEntStatusLeapSecDirection,
            ntpEntStatusInPkts,
            ntpEntStatusOutPkts,
            ntpEntStatusBadVersion,
            ntpEntStatusProtocolError,
            ntpEntStatusNotifications,
            ntpEntStatPktSent,
            ntpEntStatPktReceived,
            ntpAssocOffset,
            ntpAssocStratum,
            ntpAssocStatusJitter,
            ntpAssocStatusDelay,
            ntpAssocStatusDispersion,
            ntpAssocStatInPkts,
            ntpAssocStatOutPkts,
            ntpAssocStatProtocolError,
            ntpEntHeartbeatInterval,
            ntpEntNotifBits,
            ntpEntNotifMessage
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects for the NTP MIB."
    ::= { ntpEntGroups 2 }

ntpEntNotifGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
                ntpEntNotifModeChange,
                ntpEntNotifStratumChange,
                ntpEntNotifSyspeerChanged,
                ntpEntNotifAddAssociation,
                ntpEntNotifRemoveAssociation,
                ntpEntNotifConfigChanged,
                ntpEntNotifLeapSecondAnnounced,
                ntpEntNotifHeartbeat
    }
    STATUS      current
```

      DESCRIPTION
          "A collection of notifications for the NTP MIB"
      ::= { ntpEntGroups 3 }

END

6. IANA Considerations

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

            Descriptor   OBJECT IDENTIFIER value
            ----------   -----------------------

            ntpSnmp   { mib-2 197 }

7. Security Considerations

   There are currently two 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 objects and their sensitivity/
   vulnerability:

   ntpEntHeartbeatInterval controls the interval of heartbeat
   notifications. If set to 1, this will cause the NTP entity to send
   one notification each second. This is the maximum rate (1/s) that
   can be generated automatically. If it is set to 0, then one single
   hearbeat notification will be created and no further automatically
   generated notification is sent. This functionality can be used to
   create notifications at a higher rate (as high as the object can be
   written).

   ntpEntNotifBits enables/disables notifications. Could be used to
   switch off notifications in order to delay or eliminate the
   notification for critical and important events.

   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:

ntpEntSoftwareName, ntpEntSoftwareVersion, ntpEntSoftwareVendor, and
ntpEntSystemType all can be used to identify software and its version
as well as the operating system and hardware platform. This might
help a potential attacker to find security problems and therefore can
be used in the preparation of an attack.

SNMP versions prior to SNMPv3 did not include adequate security.
Even if the network itself is secure (for example by using IPsec),
even then, there is no control as to who on the secure network is
allowed to access and GET/SET (read/change/create/delete) the objects
in this MIB module. It is RECOMMENDED that implementers consider the
security features as provided by the SNMPv3 framework (see RFC 3410
[RFC3410], section 8), including full support for the SNMPv3
cryptographic mechanisms (for authentication and privacy). Further,
deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED.
Instead, it is RECOMMENDED to deploy SNMPv3 and to enable
cryptographic security. It is then a customer/operator
responsibility to ensure that the SNMP entity giving access to an
instance of this MIB module is properly configured to give access to
the objects only to those principals (users) that have legitimate
rights to indeed GET or SET (change/create/delete) them.

8. Acknowledgments

Bert Wijnen provided valuable feedback as the MIB Doctor for this
document.

9. References

9.1. Normative References

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9.2. Informative References

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