              Network Time Protocol (NTP) Server Option for DHCPv6

Abstract

   The NTP Server Option for Dynamic Host Configuration Protocol for
   IPv6 (DHCPv6) provides NTPv4 (Network Time Protocol version 4) server
   location information to DHCPv6 hosts.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc5908.

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1. Introduction

   This document defines a DHCPv6 option and associated suboptions to
   provide Network Time Protocol version 4 [RFC5905] or greater server
   location information to DHCPv6 hosts.

2. Requirements Notation

   The 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. Related Work and Usage Model

   The NTP service is publicly offered on the Internet by a number of
   organizations. Those servers can be used but should not be abused,
   so any method that is tasked to disseminate locations of NTP servers
   must act responsibly in a manner that does not lead to public server
   overloading. When using DHCPv6 to offer NTP server location, and if
   there is a need to distribute a host with a hardcoded configuration,
   this configuration MUST NOT include server location that is not part
   of the organization that distributes this device. Typical usage of
   this option is to specify an NTP server that is part of the
   organization that operates the DHCPv6 server.

   The location of the NTP service, like any other Internet service, can
   be specified by an IP address or a Fully Qualified Domain Name
   (FQDN). By design, DHCP offers information to multiple devices and
   is prone to amplification of mistakes, so great care must be taken to
   define its configuration. Specification of the NTP service by FQDN
   offers a level of indirection that works as a possible mitigation

tool in case of misconfiguration. DNS can be used to redirect
misconfigured clients to an IPv6 address that is not configured on
any host instead of having to change the address of the NTP server
itself.

While the NTP specification defines a comprehensive set of
configuration parameters, modification of those parameters is best
left to the decision of the client itself. The DHCPv6 option for NTP
is therefore restricted to server location.

4. NTP Server Option for DHCPv6

This option serves as a container for server location information
related to one NTP server or Simple Network Time Protocol (SNTP)
[RFC4330] server. This option can appear multiple times in a DHCPv6
message. Each instance of this option is to be considered by the NTP
client or SNTP client as a server to include in its configuration.

The option itself does not contain any value. Instead, it contains
one or several suboptions that carry NTP server or SNTP server
location. This option MUST include one, and only one, time source
suboption. The currently defined time source suboptions are
NTP_OPTION_SRV_ADDR, NTP_OPTION_SRV_MC_ADDR, and NTP_OPTION_SRV_FQDN.
It carries the NTP server or SNTP server location as a unicast or
multicast IPv6 address or as an NTP server or SNTP server FQDN. More
time source suboptions may be defined in the future. While the FQDN
option offers the most deployment flexibility, resiliency as well as
security, the IP address options are defined to cover cases where a
DNS dependency is not desirable.

If the NTP server or SNTP server location is an IPv6 multicast
address, the client SHOULD use this address as an NTP multicast group
address and listen to messages sent to this group in order to
synchronize its clock.

The format of the NTP Server Option is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        OPTION_NTP_SERVER       |           option-len          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         suboption-1                            |
:                                                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         suboption-2                            |
:                                                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
:                                                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         suboption-n                            |
:                                                               :
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
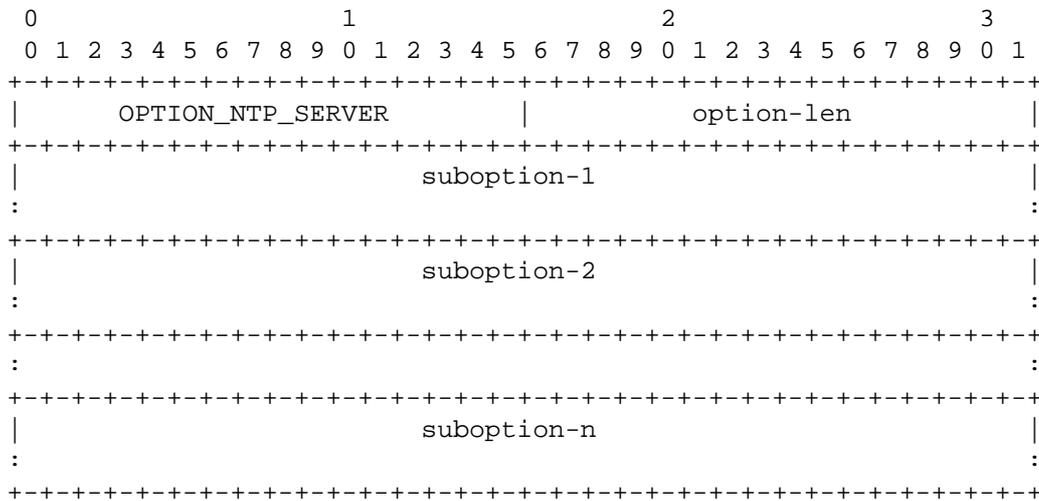
   option-code: OPTION_NTP_SERVER (56),

   option-len: Total length of the included suboptions.

This document does not define any priority relationship between the
client's embedded configuration (if any) and the NTP or SNTP servers
discovered via this option. In particular, the client is allowed to
simultaneously use its own configured NTP servers or SNTP servers and
the servers discovered via DHCP.

4.1. NTP Server Address Suboption

This suboption is intended to appear inside the OPTION_NTP_SERVER
option. It specifies the IPv6 unicast address of an NTP server or
SNTP server available to the client.

   The format of the NTP Server Address Suboption is:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     NTP_SUBOPTION_SRV_ADDR     |      suboption-len = 16       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                                                               |
   |                    IPv6 address of NTP server                 |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
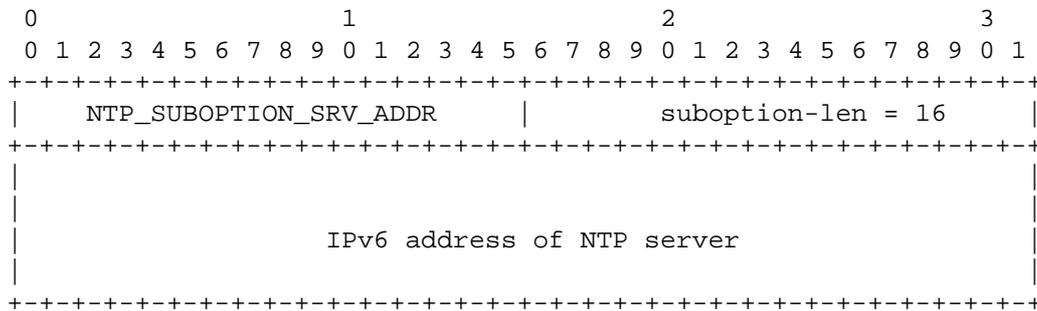
   IPv6 address of the NTP server: An IPv6 address,

      suboption-code: NTP_SUBOPTION_SRV_ADDR (1),

      suboption-len: 16.

4.2. NTP Multicast Address Suboption

   This suboption is intended to appear inside the OPTION_NTP_SERVER
   option. It specifies the IPv6 address of the IPv6 multicast group
   address used by NTP on the local network.

   The format of the NTP Multicast Address Suboption is:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     NTP_SUBOPTION_MC_ADDR      |      suboption-len = 16       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                                                               |
   |                     Multicast IPv6 address                    |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
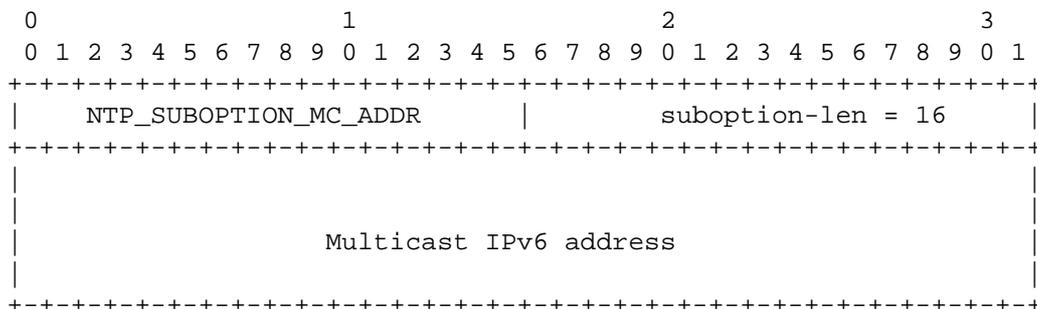
      Multicast IPv6 address: An IPv6 address,

      suboption-code: NTP_SUBOPTION_MC_ADDR (2),

      suboption-len: 16.

4.3. NTP Server FQDN Suboption

   This suboption is intended to appear inside the OPTION_NTP_SERVER
   option. It specifies the FQDN of an NTP server or SNTP server
   available to the client.

    The format of the NTP Server FQDN Suboption is:

     0   1   2   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+
    | NTP_SUBOPTION_SRV_FQDN | suboption-len |
    +-+
    | |
    | FQDN of NTP server |
    :   :
    +-+

       suboption-code: NTP_SUBOPTION_SRV_FQDN (3),

       suboption-len: Length of the included FQDN field,

       FQDN: Fully-Qualified Domain Name of the NTP server or SNTP server.
             This field MUST be encoded as described in [RFC3315],
             Section 8. Internationalized domain names are not allowed
             in this field.

5. Appearance of This Option

   The OPTION_NTP_SERVER option can appear multiple times in a DHCPv6
   message. The order in which these options appear is not significant.
   The client uses its usual algorithms to determine which server(s) or
   multicast group(s) should be preferred to synchronize its clock.

   The OPTION_NTP_SERVER option MUST NOT appear in messages other than
   the following: Solicit, Advertise, Request, Renew, Rebind,
   Information-Request, and Reply. If this option appears in messages
   other than those specified above, the receiver MUST ignore it.

   The option number for this option MAY appear in the "Option Request"
   option [RFC3315] in the following messages: Solicit, Request, Renew,
   Rebind, Information-Request, and Reconfigure. If this option number
   appears in the "Option Request" option in messages other than those
   specified above, the receiver SHOULD ignore it.

6. Security Considerations

   This option could be used by an intruder to advertise the address of
   a malicious NTP server or SNTP server and adversely affect the clock
   of clients on the network. The consequences of such an attack can be
   critical, because many security protocols depend on time
   synchronization to run their algorithms. As an example, an attacker
   could break connectivity between SEND-enabled nodes [RFC3971], simply
   by affecting the clock on these nodes.

   To prevent these attacks, it is strongly advisable to secure the use
   of this option by either:

   - using the NTPv4 Autokey public key authentication, as defined in
      [RFC5906] or,

   - using authenticated DHCP as described in [RFC3315], Section 21.

7. RFC 4075 Deprecation

   "Simple Network Time Protocol (SNTP) Configuration Option for DHCPv6"
   [RFC4075] provides some degree of automatic time server configuration
   for IPv6, as it specifies how to transmit SNTP [RFC4330] server
   addresses through DHCPv6. However, this approach is not suitable for
   all NTP deployments. It is not an extensible mechanism and
   introduces some semantic confusion through the use of the "SNTP"
   acronym. Additionally, the approach of only offering IPv6 addresses
   to specify server location does not meet NTP requirements that make
   use of an FQDN (Fully-Qualified Domain Name) as well. For all the
   abovementioned reasons, this document makes [RFC4075] deprecated.

8. IANA Considerations

   IANA has assigned 56 as an option code from the "DHCPv6 Options
   Codes" registry for OPTION_NTP_SERVER.

   IANA is required to maintain a new number space of NTP time source
   suboptions, located in the BOOTP-DHCP Parameters Registry. The
   initial suboptions are described in Section 4 of this document. IANA
   assigns future NTP time source suboptions with an "IETF Consensus"
   policy as described in [RFC5226]. Future proposed suboptions are to
   be referenced symbolically in the documents that describe them, and
   shall be assigned numeric codes by IANA when approved for publication
   as an RFC.

9. References

9.1. Normative References

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
               Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC3315]   Droms, R., Bound, J., Volz, B., Lemon, T., Perkins, C.,
               and M. Carney, "Dynamic Host Configuration Protocol for
               IPv6 (DHCPv6)", RFC 3315, July 2003.

   [RFC5226]   Narten, T. and H. Alvestrand, "Guidelines for Writing an
               IANA Considerations Section in RFCs", BCP 26, RFC 5226,
               May 2008.

   [RFC5905]   Mills, D., Martin, J., Ed., Burbank, J., and W. Kasch,
               "Network Time Protocol Version 4: Protocol and Algorithms
               Specification", RFC 5905, June 2010.

   [RFC5906]   Haberman, B., Ed. and D. Mills, "Network Time Protocol
               Version 4: Autokey Specification", RFC 5906, June 2010.

9.2. Informative References

   [RFC3971]   Arkko, J., Kempf, J., Zill, B., and P. Nikander, "SEcure
               Neighbor Discovery (SEND)", RFC 3971, March 2005.

   [RFC4075]   Kalusivalingam, V., "Simple Network Time Protocol (SNTP)
               Configuration Option for DHCPv6", RFC 4075, May 2005.

   [RFC4330]   Mills, D., "Simple Network Time Protocol (SNTP) Version 4
               for IPv4, IPv6 and OSI", RFC 4330, January 2006.

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