Internet Engineering Task Force   M. Lichvar
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                     NTPv4 Short Extension Fields
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Abstract

   This document specifies a new packet format for the Network Time
   Protocol version 4 (NTPv4) which is compatible with RFC 7822, but
   allows NTPv4 packets to contain shorter extension fields.

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

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   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on March 30, 2019.

1. Introduction

    RFC 7822 [RFC7822] specifies a minimum length of extension fields in
    NTPv4 packets in order to prevent ambiguities in their parsing.
    Without these rules, an extension field in a valid NTPv4 packet could
    be parsed as a Message Authentication Code (MAC), or a MAC could be
    parsed as an extension field.

    The minimum length of 28 octets forces extension fields that do not
    contain enough data to reach the minimum length to waste space. With
    multiple extension fields in a packet the wasted space accumulates.

    A different issue with extension fields in NTPv4 packets is that
    servers/clients cannot pad a response/request to a specific length,
    e.g. to make their length symmetric when they contain different
    extension fields, or the sums of their lengths are different, unless
    one of the extension fields included in the request/response supports
    padding.

    This document specifies a new NTPv4 format using three new extension
    fields:

    1. An extension field which contains other extension fields with no
        requirements on minimum length

    2. An extension field which does not contain any information and can
        always be used for padding

    3. An extension field which contains MAC

    Together, these extension fields allow NTPv4 packets to contain short
    extension fields, minimize the wasted space, and allow the packets to
    be padded to any length that meets the requirements of RFC 7822.

    Older NTP implementations which follow RFC 7822 will parse a packet
    in the new format as a valid packet which contains a single unknown
    extension field, skipping all extension fields and/or MAC, and can
    respond as appropriate.

    An implementation which supports the new format will parse all
    extension fields and/or MAC contained in the packet.

1.1. Requirements Language

    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 RFC 2119 [RFC2119].

2. New extension fields

2.1. Packing Field

   The Packing Field is an NTP extension field following RFC 7822
   [RFC7822], which contains one or more other extension fields. The
   format of the extension field is shown below.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Field Type          |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Subfield 1 Type       |        Subfield 1 Length      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                                .
.                        Subfield 1 Data                         .
.                                                                .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                                .
.                                                                .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Subfield N Type       |        Subfield N Length      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                                .
.                        Subfield N Data                         .
.                                                                .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

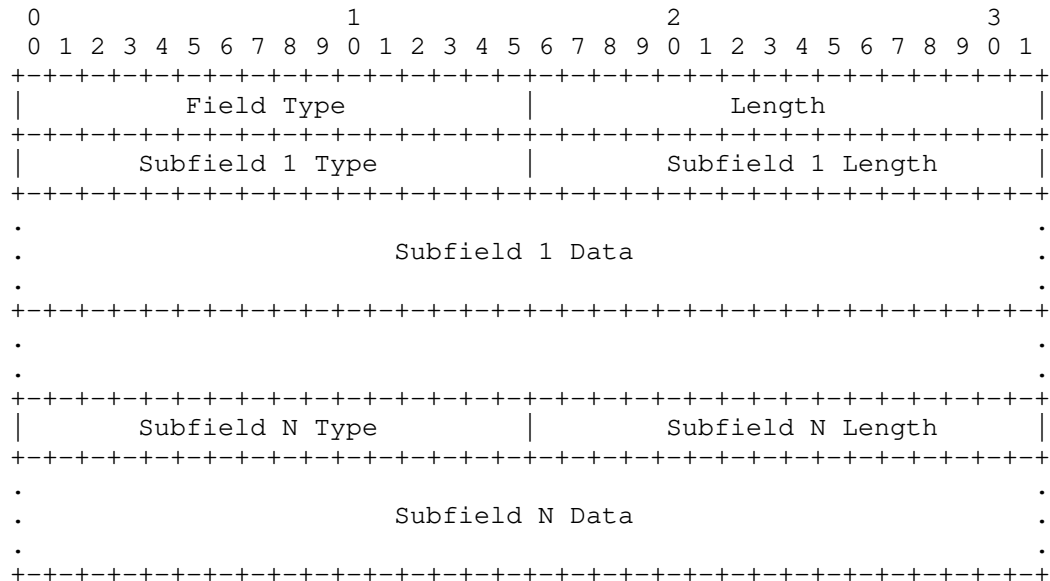   Figure 1: Format of Packing Field

   The extension field has the following fields:

   Field Type
           The type which identifies the Packing Field. TBD

   Length
           The length of the extension field, which is at least 28
           octets.

   Subfield 1..N Type
           The types of the contained extension fields.

   Subfield 1..N Length
           The lengths of the contained extension field, which are
           divisible by 4 and can be smaller than 28.

   Subfield 1..N Data

Data specific to the included extension fields.

2.2. Padding Field

The Padding Field is an NTP extension field which does not contain
any useful data. It does not follow the requirements from RFC 7822
[RFC7822] and it MUST be contained in the Packing Field.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Field Type          |             Length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                               .
.                            Padding                            .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
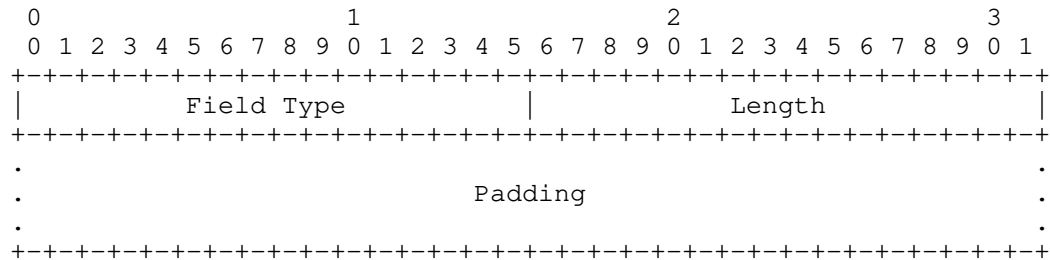
Figure 2: Format of Padding Field

The extension field has the following fields:

Field Type
        The type which identifies the Padding Field. TBD

Length
        The length of the extension field.

Padding
        Octets filling the space of the extension field with any
        value.

2.3. MAC Field

The MAC Field is an NTP extension field which contains a MAC as
specified in RFC 5905 [RFC5905]. It does not follow the requirements
from RFC 7822 [RFC7822] and it MUST be contained in the Packing
Field.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Field Type         |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Key Identifier                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                               .
.                        Message Digest                         .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
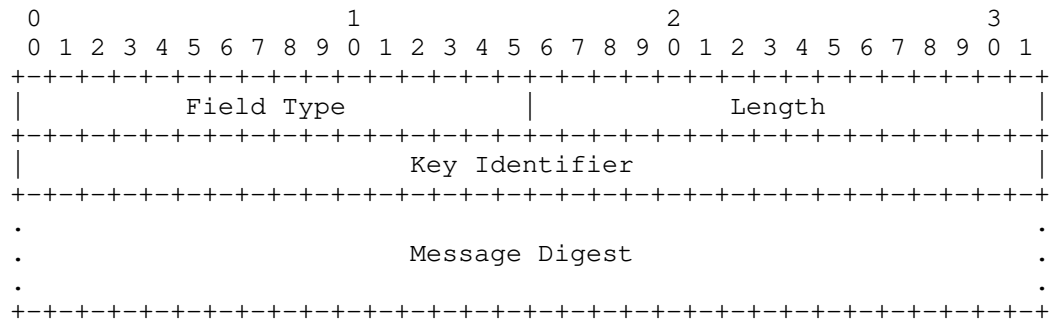
Figure 3: Format of MAC Field

The extension field has the following fields:

Field Type
        The type which identifies the MAC Field. TBD

Length
        The length of the extension field.

Key Identifier
        The ID of the key which is used for calculating the digest.

Message Digest
        Digest calculated over all UDP data before the Key
        Identifier, including the length of the MAC Field and Packing
        field.

3. New NTPv4 format

    An NTPv4 packet in the new format consists of:

    1. NTPv4 header per RFC 5905 [RFC5905](48 octets)

    2. Field Type of the Packing Field (2 octets)

    3. Length of all data following the NTP header (2 octets)

    4. Extension fields with no restrictions on their minimum length,
        optionally including the Padding and/or MAC Fields (at least 24
        octets)

    The packet MUST have exactly one Packing Field and it MUST contain
    all other extension fields. The packet MUST NOT have a MAC outside
    the Packing Field. If there is not enough data to reach the minimum

length of 28 octets, the Packing Field MUST include at least one
Padding Field to increase the length of the Packing Field.

4. Parsing of NTPv4 packets

   An implementation SHOULD check if the following applies to the UDP
   data before parsing it as an NTPv4 packet in the new format:

   1. NTP version (in the first octet) is 4.

   2. NTP mode (in the first octet) is 1, 2, 3, 4, or 5.

   3. Length is at least 76 octets.

   4. 49th and 50th octets contain the type of the Packing Field.

   5. 51st and 52nd octets contain a value that is equal to the length
       of the UDP data minus 48.

5. IANA Considerations

   IANA is requested to allocate Extension Field Types for the Packing,
   Padding, and MAC Extension Fields.

6. Normative References

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
              Requirement Levels", BCP 14, RFC 2119,
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              <https://www.rfc-editor.org/info/rfc2119>.

   [RFC5905] Mills, D., Martin, J., Ed., Burbank, J., and W. Kasch,
              "Network Time Protocol Version 4: Protocol and Algorithms
              Specification", RFC 5905, DOI 10.17487/RFC5905, June 2010,
              <https://www.rfc-editor.org/info/rfc5905>.

   [RFC7822] Mizrahi, T. and D. Mayer, "Network Time Protocol Version 4
              (NTPv4) Extension Fields", RFC 7822, DOI 10.17487/RFC7822,
              March 2016, <https://www.rfc-editor.org/info/rfc7822>.

Author's Address

Miroslav Lichvar
Red Hat
Purkynova 115
Brno 612 00
Czech Republic

Email: mlichvar@redhat.com