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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.

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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.

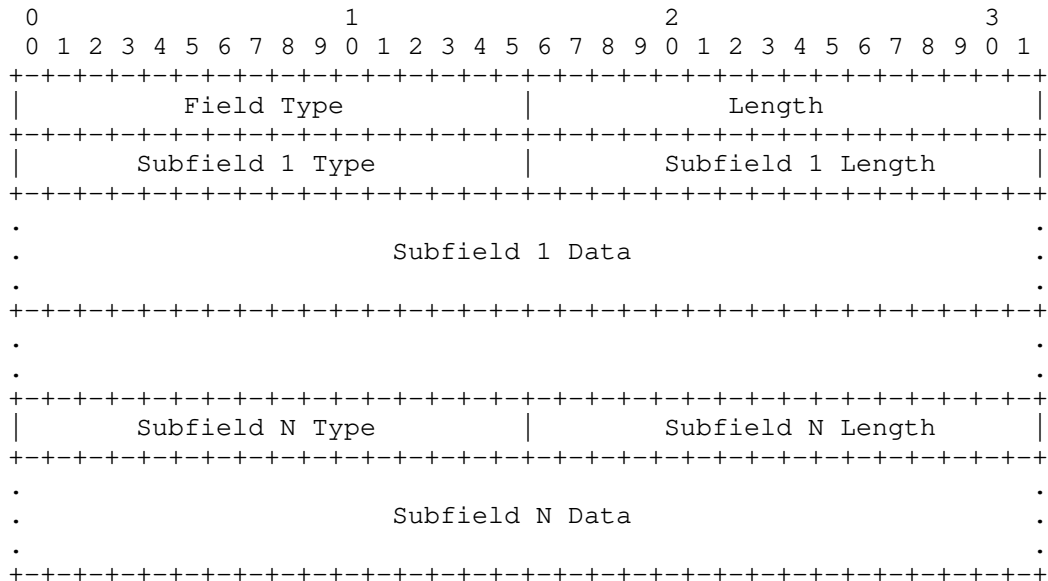


Figure 1: Format of Packing Field

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.

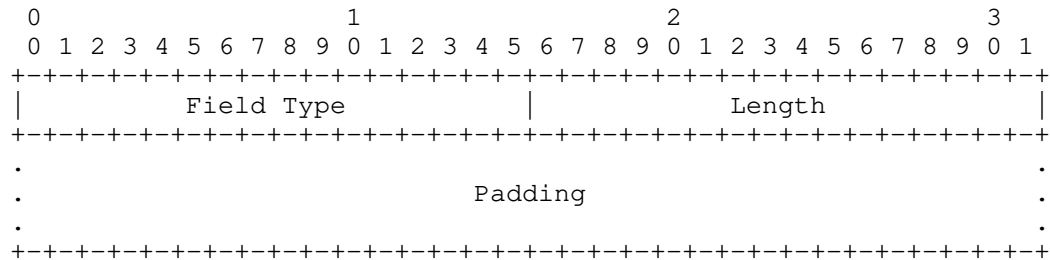


Figure 2: Format of Padding Field

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.

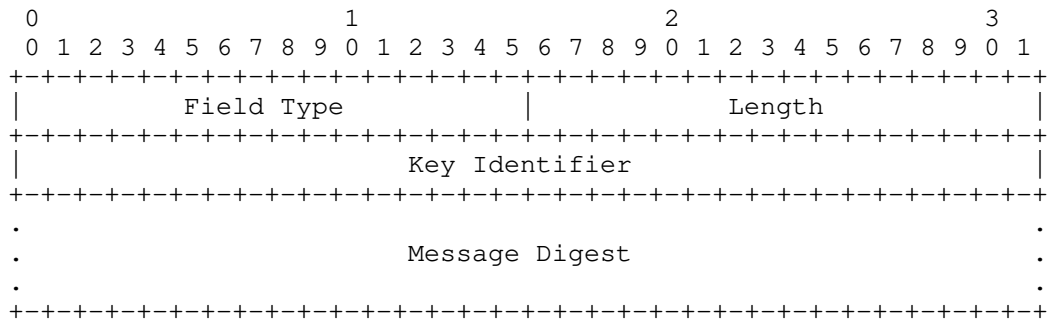


Figure 3: Format of MAC Field

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, DOI 10.17487/RFC2119, March 1997, <<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>>.

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