Mobile Ad hoc Networking (MANET)
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# Representing multi-value time in MANETs
## draft-clausen-manet-timetlv-00

Abstract

This document describes a general and flexible TLV (type-length-value structure) for representing time using the generalized MANET packet/message format. It defines two message TLVs for representing validity and interval times for MANET routing protocols.

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## 1. Introduction

The generalized packet/message format [1] specifies a signaling format which MANET routing protocols can employ for exchanging protocol information. This format presents the ability to express and associate attributes to packets, messages or addresses, by way of a general TLV (type-length-value) mechanism.

This document specifies a general Time TLV structure, which can be used by any MANET routing protocol that needs to express either single time values or a set of time values with each value associated with a range of distances. This allows a receiving node to determine a single time value if either it knows its distance from the originator node, which [1] may provide, or the Time TLV specifies a single time value.

This document also specifies two message TLV types, which use the TLV structure proposed. These TLV types are INTERVAL_TIME and VALIDITY_TIME, specifying respectively the maximum time before another message of the same type as this message from the same originator should be received, and the duration for which the information in this message is valid after receipt. Note that, if both are present, then the latter will usually be greater than the former in order to allow for possible message loss.

## 2. Terminology

The keywords "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 [2].

Additionally, this document uses terminology from [1], and introduces the following terminology:

Distance - the number of hops from the message originator to the message recipient, as may be indicated using the <hop-count> field in the full message header defined in [1], after being incremented on reception.

Time Value - a time, measured in seconds.

Time Code - an 8 bit field, representing a time value.

## 3. Applicability Statement

The TLV described in this document is applicable whenever a single time value, or a time value that varies with distance from the originator of a message, is required in a protocol using the generalized MANET packet/message format [1].

Examples of time values that may be included in a protocol message are:

- The maximum time interval until the next message of the same type is to be generated by the message's originator node.

- The validity time of the information with which the time value is associated.

Either of these may vary with the distance between the originating and receiving nodes if messages of the same type are sent with different hop limits as defined in [1]. Note that if using [1], then distance information is available as the hop count field in a full message header (after being incremented).

Parts of this document have been generalized from material in the proactive MANET routing protocol OLSR (The Optimized Link State Routing Protocol) [3].

## 4. Protocol Overview and Functioning

This document does not specify a protocol nor does it mandate specific node or protocol behavior. Rather, it outlines mechanisms for encoding time values using the TLV mechanism of [1]. Protocols using the mechanisms and TLVs specified in this document must ensure that they do so in a coherent way.

## 5. Representing Time

This document specifies a TLV structure in which time values are each represented in an 8 bit time code, one or more of which may be used in a TLV's value field. Of these 8 bits, the least significant four bits represent the mantissa (a), and the most significant four bits represent the exponent (b), so that:

- time value = (1 + a/16) * 2^b * C

- time code = 16 * b + a

All nodes in the network MUST use the same value of C, which will be specified in seconds, hence so will be all time values. Note that ascending values of the time code represent ascending time values, time values may thus be compared by comparison of time codes.

An algorithm for computing the time code representing the smallest representable time value not less than the time value t is:

1. find the largest integer b such that t/C >= 2^b;

2. set a = 16 * (t / (C * 2^b) - 1), rounded up to the nearest integer;

3. if a == 16 then set b = b + 1 and set a = 0;

4. if a and b are in the range 0 and 15 then the required time value can be represented by the time code 16 * b + a, otherwise it can not.

The minimum time value that can be represented in this manner is C. The maximum time value that can be represented in this manner is 63488 * C.

## 6. General Time TLV Structure

A Time TLV may be a packet, message or address block TLV. If it is a packet or message TLV then it must be a single value TLV as defined in [1]; if it is an address block TLV then it may be single value or multivalue TLV. The specific Time TLVs specified in this document, in Section 7 are message, and hence single value, TLVs. Note that even a single value Time TLV may contain a multiple octet <value> field.

The purpose of a single value Time TLV is to allow a single time value to be determined by a node receiving an entity containing the Time TLV, based on its distance from the entity's originator. The Time TLV may contain information that allows that time value to be a function of distance, and thus different receiving nodes may determine different time values. If a receiving node will not be able to determine its distance from the originating node, then the form of this Time TLV with a single time code in a <value> field (or single value subfield) SHOULD be used.

The <value> field of a single value Time TLV is specified, using the regular expression syntax of [1], by:

<value> = {<time><distance>}*<time>

where:

<time> is an 8 bit field containing a time code as defined in Section 5.

<distance> is an 8 bit field specifying a distance from the message originator, in hops.

A single value <value> field thus consists of an odd number of octets; with a repetition factor of n in the regular expression syntax it contains 2n+1 octets, thus the <length> field of a single value Time TLV, which MUST always be present, is given by:

o <length> = 2n+1

A single value <value> field may be thus represented by:

<t_1><d_1><t_2><d_2> ... <t_i><d_i> ... <t_n><d_n><t_default>

<d_1>, ... <d_n>, if present, MUST be a strictly increasing sequence. Then, at the receiving node's distance from the originator node, the time value indicated is that represented by the time code:

- <t_1>, if n > 0 and distance <= <d_1>;

- <t_i+1>, if n > 1 and <d_i> < distance <= <d_i+1> for some i such that 1 <= i < n;

- <t_default> otherwise, i.e. if n == 0 or distance > <d_n>.

In a multivalue Time TLV, each single value subfield of the multivalue Time TLV is defined as above. Note that [1] requires that each single value subfield has the same length (i.e. the same value of n) but they need not use the same values of <d_1> to <d_n>.

## 7. Message TLVs

Two message TLVs are defined, for signaling message validity time (VALIDITY_TIME) and message interval (INTERVAL_TIME).

### 7.1. VALIDITY_TIME TLV

A VALIDITY TIME TLV is a message TLV that defines the validity time of the information carried in the message in which the TLV is contained. After this time the receiving node MUST consider the message content to no longer be valid (unless repeated in a later message). The validity time of a message MAY be specified to depend on the distance from its originator. (This is appropriate if messages are sent with different hop limits, so that receiving nodes at greater distances receive information less frequently and must treat is as valid for longer.)

A VALIDITY_TIME TLV is an example of a Time TLV specified as in Section 5.

### 7.2. INTERVAL_TIME TLV

An INTERVAL_TIME TLV is a message TLV that defines the maximum time before another message of the same type as this message from the same originator should be received. This interval time MAY be specified to depend on the distance from the originator. (This is appropriate if messages are sent with different hop limits, so that receiving nodes at greater distances have an increased interval time.)

An INTERVAL_TIME TLV is an example of a Time TLV specified as in Section 5.

## 8. IANA Considerations

This specification defines two message TLV types, which must be allocated from the "Assigned Message TLV Types" repository of [1].

| Mnemonic | Value | Description |
|---|---|---|
| VALIDITY_TIME | TBD | The time from receipt of the message during which the information contained in the message is to be considered valid |
| INTERVAL_TIME | TBD | The maximum time before another message of the same type as this message from the same originator should be received |

Table 1

## 9. Security Considerations

This document does not specify any security considerations.

## 10. References

### 10.1. Normative References

[1] Clausen, T., Dean, J., Dearlove, C., and C. Adjih, "Generalized MANET Packet/Message Format", Work In Progress draft-ietf-manet-packetbb-03.txt, June 2006.

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

### 10.2. Informative References

[3] Clausen, T. and P. Jacquet, "The Optimized Link State Routing Protocol", RFC 3626, October 2003.

## Appendix A. Acknowledgements

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