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Representing multi-value time in MANETs
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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 and two address block 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 time-value associated with a range of distances. Distances may be equated to hop count, as provided by [1]. This allows a receiving node to determine a single time-value if either it knows its distance from the originator node, 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.

This document also specifies two address block TLV types, which use the TLV structure proposed. These TLV types are INTERVAL_TIME and VALIDITY_TIME, defined equivalently to the two message TLVs with the same names.

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 distance from the message originator to the message recipient. If the distance is equated to the messages hop count, then this 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, e.g. if messages of the same type are sent with different hop limits as defined in [1].

Parts of this document have been generalized from material in the proactive MANET routing protocol OLSR (The Optimized Link State Routing Protocol) [4].

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].

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 3 bits represent the mantissa (a), and the most significant 5 bits represent the exponent (b), so that:

- time-value = (1 + a/8) * 2^b * C

- time-code = 8 * b + a

All nodes in the network MUST use the same value of the constant C, which will be specified in seconds, hence so will be all time-values. C MUST be greater than 0 seconds. 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 = 8 * (t / (C * 2^b) - 1), rounded up to the nearest integer;

3. if a == 8 then set b = b + 1 and set a = 0;

4. if 0 <= a <= 7, and 0 <= b <= 31, then the required time-value can be represented by the time-code 8 * 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 15 * 2^28 * C, or about 4.0 * 10^9 * C. If, for example, C = 1/1024 second, then this is about 45 days.

A protocol using this time representation MUST define the value of C. A protocol using this specification MAY specify that the all bits zero time-value (0) represents a time-value of zero and/or that the all bits one time-value (255) represents an indefinitely large time-value.

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. 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.

A single value <value> field thus consists of an odd number of octets; with a repetition factor of n for the (time, distance) pairs 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 message MUST NOT include more than one VALIDITY_TIME TLV.

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.)

A message MUST NOT include more than one INTERVAL_TIME TLV.

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

8. Address Block TLVs

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

8.1. VALIDITY_TIME TLV

A VALIDITY_TIME TLV is an address block TLV that defines the validity time of the addresses to which the TLV is associated. After this time the receiving node MUST consider the addresses to no longer be valid (unless these are repeated in a later message). The validity time of an address MAY be specified to depend on the distance from its originator. (This is appropriate if addresses are contained in messages 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 protocol using this TLV and the similarly named message TLV MUST specify how to interpret the case when both are present (typically that the former over-rides the latter for those addresses which are covered by the former).

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

8.2. INTERVAL_TIME TLV

An INTERVAL_TIME TLV is an address block TLV that defines the maximum time before this address 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 addresses are contained in messages sent with different hop limits, so that receiving nodes at greater distances have an increased interval time.)

A protocol using this TLV and the similarly named message TLV MUST specify how to interpret the case when both are present (typically that the former over-rides the latter for those addresses which are covered by the former).

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

9. IANA Considerations

This specification defines two message TLV types, which must be allocated from the "Assigned Message TLV Types" repository of [1] as specified in Table 1 and two address block TLV types, which must be allocated from the "Assigned Address Block TLV Types" repository of [1] as specified in Table 2.

IANA is requested to assign the same numerical value to the message TLV and address block TLV types with the same mnemonic.

9.1. Message TLV Types

Name	Type	Type Extension	Description
VALIDITY_TIME	TBD1	0	The time from receipt of the message during which the information contained in the message is to be considered valid
		1-255	RESERVED
INTERVAL_TIME	TBD2	0	The maximum time before another message of the same type as this message from the same originator should be received
		1-255	RESERVED

Table 1

Type extensions indicated as RESERVED may be allocated by standards action, as specified in [3].

9.2. Address Block TLV Types

Name	Type	Type extension	Description
VALIDITY_TIME	TBD1	0	The time from receipt of the address during which the information regarding this address is to be considered valid
		1-255	RESERVED
INTERVAL_TIME	TBD2	0	The maximum time before another message of the same type as this message from the same originator and containing this address should be received
		1-255	RESERVED

Table 2

Type extensions indicated as RESERVED may be allocated by standards action, as specified in [3].

10. Security Considerations

This document does not specify any security considerations.

11. References

11.1. Normative References

[1] Clausen, T., Dearlove, C., Dean, J., and C. Adjih, "Generalized MANET Packet/Message Format", Work In Progress draft-ietf-manet-packetbb-11.txt, November 2007.

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

[3] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", RFC 2434, BCP 26, October 1998.

11.2. Informative References

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

Appendix A. Acknowledgements

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