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Generalized MANET Packet/Message Format
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Abstract

This document specifies a multi-message packet format that may be used by mobile ad hoc network routing and other protocols.

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1. Introduction

This document specifies the syntax of a general purpose multi-message packet format for information exchange between MANET routers. Messages consist of a message header, which is designed for control of message dissemination, and a message body, which contains protocol information. Only the syntax of the message body is specified. All syntactical entities, including messages and packets, are specified using regular expressions.

This document specifies:

- o A packet format, allowing zero or more messages to be contained within a single transmission, and optionally including a packet header. A packet with zero messages may be sent in case the only information to exchange is contained in the packet header (such as a "keep alive" sequence number).

- o A message format, where a message is composed of a message header and a message body.

- o A message header format which allows a node to make forwarding decisions based on the node's present state and the message header, without inspecting and processing the message body, and independently of the TTL or hop limit information in the IP header. Message header information permits single- and multi-hop message diffusion.

- o A message body format, containing attributes associated with the message or the originator of the message, as well as blocks of addresses with associated attributes.

- o An address block format, where an address block represents sets of addresses in a compact (compressed) form.

- o A generalized type-length-value (TLV) format representing attributes. Multiple TLVs can be included and associated with a packet, a message, an address, or a set of addresses.

The specification has been explicitly designed with the following properties, listed in no particular order, in mind:

Parsing logic - the regular expression specification facilitates generic, protocol independent, parsing logic.

Extensibility - packets and messages defined by a protocol using this specification are extensible through defining new message types and new TLVs. Existing protocol specifications using this specification will be able to correctly identify and skip such new message types and TLVs, while correctly parsing the remainder of the packet and message.

Efficiency - when reported addresses share common bit sequences (e.g. prefixes or IPv6 interface identifiers) the address block representation allows for a compact representation. Compact message headers are ensured through permitting inclusion of only required message header elements.

Separation of forwarding and processing - duplicate detection and controlled scope message forwarding decisions can be made using information contained in the message header, without processing the message body.

2. Terminology

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. [1].

Additionally, this document uses the following terminology:

Packet - the top level entity in this specification. Packets are transmitted over a single logical hop and are not forwarded. A packet contains zero or more messages, and may contain a packet header.

Message - the fundamental entity carrying protocol information, in the form of addresses and TLVs. Messages are transmitted in packets, and may be forwarded based on their header information.

Address - a number of octets of the same length as the source IP address in the IP datagram carrying the packet. The meaning of an address is defined by the protocol using this specification.

TLV - a Type-Length-Value structure. This is a generic way in which an attribute can be represented and correctly parsed, without the parser having to understand the attribute.

Element - a syntactic entity defined in the regular expression specification, represented using the notation <foo>.

<foo> - if <foo> is an 8 or 16 bit field then <foo> is also used to represent the value of that field.

? - zero or one occurrences of the preceding element.

* - zero or more occurrences of the preceding element.

bar - a variable, usually obtained through calculations based on the value(s) of field(s). Variables are introduced into the specification solely as a means to clarify the description.

address-length - a variable whose value is the length of an address in octets, it is 4 if using IPv4, 16 if using IPv6.

3. Applicability Statement

This specification describes a generic multi-message packet format, for carrying MANET routing protocol signals. The specification has been developed from that used by OLSR (The Optimized Link State Routing Protocol) [4].

The specification is designed specifically with IP (IPv4/IPv6) in mind. All addresses within a control message are assumed to be of the same size, deduced from IP. In the case of mixed IPv6 and IPv4 addresses, IPv4 addresses are represented as IPv4-mapped IPv6 addresses as specified in [2].

The messages defined by this specification are designed to carry routing protocol signals between MANET routers, and to support scope limited diffusion, as well as point to point signaling in a multi-hop network.

The packets defined by this specification are designed to carry a number of messages in a single transmission. The packets may be unicast or multicast and may use any transport protocol (TCP, UDP, ...) appropriate to the protocol using this specification and may travel over a single logical hop which might consist of one or more IP hops.

This specification is particularly appropriate for extensible protocols. It offers external extensibility in the form of new message types. It offers internal extensibility in the form of TLVs, which may be added to existing message types.

A protocol using the multi-message packet format defined by this specification may constrain the syntax (for example requiring a full message header) and features (for example specifying the suggested diffusion mechanism) that the protocol will employ.

4. Protocol Overview and Functioning

This specification does not describe a protocol. It describes a packet format, which may be used by any mobile ad hoc network routing or other protocol.

5. Signaling Framework

This section provides syntactical specification of a packet, represented by the element <packet> and the elements from which it is composed. The specification is given in the form of regular expressions. Illustrations of specified elements are given in Appendix B.

The length of a <packet> is obtained as the size of the payload of the transport protocol employed.

5.1. Packets

<packet> is defined by:

```
<packet> = {<packet-header><pad-octet>*}?
           {<message><pad-octet>*}*
```

where <message> is defined in Section 5.2, and <pad-octet> is defined in Section 5.4. Successful parsing is terminated when all octets are used.

<packet-header> is defined by:

```
<packet-header> = <zero>
                  <packet-semantics>
                  <packet-seq-number>?
                  <tlv-block>?
```

where:

<zero> is an 8 bit field with all bits cleared ('0'). This field serves to identify that the packet starts with a packet header.

<packet-semantics> is an 8 bit field, specifying the composition of the packet header:

bit 0 (pnoseqnum): if cleared ('0'), then the packet header contains a <packet-seq-number>. If set ('1'), then the packet header does not include a <packet-seq-number>.

bit 1 (ptlv): if cleared ('0'), then the packet header does not include a TLV block. If set ('1'), then the packet header includes a TLV block.

bits 2-7: are RESERVED, and MUST each be cleared ('0') to be in conformance with this version of the specification.

<packet-seq-number> is omitted if the pnoseqnum bit is set ('1'), otherwise is a 16 bit field, specifying a packet sequence number.

<tlv-block> is omitted if the ptlv bit is cleared ('0'), and is otherwise defined in Section 5.3.

Note that since the message type zero is reserved (see Section 7), the presence or absence of a packet header can be determined by inspecting the first octet of the packet.

5.2. Messages

Information is carried through messages. Messages contain:

- A message header.
- A message TLV block that contains zero or more TLVs, associated with the whole message.
- Zero or more address blocks, each containing one or more addresses.
- A TLV block, containing zero or more TLVs, following each address block.

<message> is defined by:

```
<message>         = <msg-header>
                    <tlv-block>
                    {<addr-block><tlv-block>}*

<msg-header>      = <msg-type>
                    <msg-semantics>
                    <msg-size>
                    <msg-header-info>

<msg-header-info> = <originator-address>?
                    <hop-limit>?
                    <hop-count>?
                    <msg-seq-number>?
```

where:

<tlv-block> is defined in Section 5.3.

<addr-block> is defined in Section 5.2.1.

<msg-type> is an 8 bit field, specifying the type of message. A type with all bits cleared ('0') MUST NOT be used.

<msg-semantics> is an 8 bit field, specifying the interpretation of the remainder of the message header:

bit 0 (noorig): If cleared ('0'), then <originator-address> is included in the <msg-header-info>. If set ('1'), then <originator-address> is not included in the <msg-header-info>.

bit 1 (nohoplimit): If cleared ('0'), then <hop-limit> is included in the <msg-header-info>. If set ('1'), then <hop-limit> is not included in the <msg-header-info>.

bit 2 (nohopcount): If cleared ('0'), then <hop-count> is included in the <msg-header-info>. If set ('1'), then <hop-count> is not included in the <msg-header-info>

bit 3 (noseqnum): If cleared ('0'), then <msg-seq-number> is included in the <msg-header-info>. If set ('1'), then <msg-seq-number> is not included in the <msg-header-info>.

bit 4 (typedep): If cleared ('0'), then the message sequence number in the message is type-independent. If set ('1'), then the message sequence number contained in the message is type dependent (the message originator maintains a sequence number specific to <msg-type>). This bit MUST be cleared ('0') if the noorig bit is set ('1').

bits 5-7: are RESERVED and MUST each be cleared ('0') to be in conformance with this version of the specification.

If bit 0 (noorig) and bit 3 (noseqnum) are both cleared, then the message header provides for duplicate suppression.

If bit 1 (nohoplimit) is cleared, then the message header provides for scope-delimited forwarding.

<msg-size> is a 16 bit field, specifying the size of the <message>, counted in octets.

<originator-address> is an identifier of length equal to address-length, which serves to uniquely identify the node that originated the message.

<hop-limit> is an 8 bit field, which contains the maximum number of logical hops a message should be further transmitted.

<hop-count> is an 8 bit field, which contains the number of logical hops a message has traveled.

<msg-seq-number> is a 16 bit field, which contains a unique number, generated by the originator node. The <originator-address>, <msg-seq-number>, and, if the typedep bit in the <msg-semantics> field is set, the <msg-type> of a message serves to uniquely identify the message in the network (within the time period until <msg-seq-number> wraps around to a matching value).

5.2.1. Address Blocks

An address is specified as a sequence of address-length octets of the form head:mid:tail. An address block is an ordered set of addresses sharing the same head and tail, and having individual mids. Network addresses may be represented using the PREFIX_LENGTH TLV defined in Section 6.

<address block> is defined by:

```
    <address-block> = <num-addr>
                      <addr-semantics>
                      <head-length>?
                      <head>?
                      <tail-length>?
                      <tail>?
                      <mid>*
```

where:

<num-addr> is an 8 bit field containing the number of addresses represented in the address block, which MUST NOT be zero.

<addr-semantics> is an 8 bit field specifying the interpretation of the remainder of the address block:

bit 0 (nohead): if cleared ('0'), then <head-length> is included in <address-block>, and <head> may be included in <address-block>. If set ('1'), then <head-length> and <head> are not included in <address-block>.

bit 1 (notail) and bit 2 (zerotail): MUST NOT both be set ('1'). Otherwise, they are interpreted according to Table 1.

notail	zerotail	<tail-length>	<tail>
0	0	included	may be included
0	1	included	not included
1	0	not included	not included

Table 1

bits 3-7: are RESERVED and MUST each be cleared ('0') to be in accordance with this version of the specification.

<head-length> if present is an 8 bit field, which contains the total length (in octets) of the head of all of the addresses.

head-length is a variable, defined to equal <head-length> if present, or 0 otherwise.

<head> is omitted if head-length == 0, otherwise it is a field of the head-length leftmost octets of all the addresses.

<tail-length> if present is an 8 bit field, which contains the total length (in octets) of the tail of all of the addresses.

tail-length is a variable, defined to equal <tail-length> if present, or 0 otherwise.

<tail> is omitted if tail-length == 0 or if the zerotail bit is set ('1'), otherwise it is a field of the tail-length rightmost octets of all the addresses. If the zerotail bit is set ('1') then the tail-length rightmost octets of all the addresses are all 0.

mid-length is a variable, which MUST be non-negative, defined by:

* mid-length = address-length - head-length - tail-length

<mid> is omitted if mid-length == 0, otherwise each <mid> is a field of length mid-length octets, representing the mid of the corresponding address in the address block.

5.3. TLVs and TLV Blocks

A TLV block is defined by:

```
<tlv-block> = <tlvs-length>
              <tlv>*
```

where:

<tlvs-length> is a 16 bit field, which contains the total length (in octets) of all of the immediately following <tlv> elements.

<tlv> is defined in Section 5.3.1.

5.3.1. TLVs

There are three kinds of TLV, each represented by an element <tlv>:

- o A packet TLV, included in a packet header.
- o A message TLV, included in a message before all address blocks.
- o An address block TLV, included in a TLV block following an address block. An address block TLV applies to:
  - * all addresses in the address block; OR
  - * any continuous sequence of addresses in the address block; OR
  - * a single address in the address block.

<tlv> is defined by:

```
<tlv> = <tlv-type>
        <tlv-semantics>
        <tlv-subtype>?
        <index-start>?
        <index-stop>?
        <length>?
        <value>?
```

where:

<tlv-type> is an 8 bit field, specifying the type of the TLV, specific to the TLV kind (i.e. packet, message, or address block TLV).

<tlv-semantics> is an 8 bit field specifying the interpretation of the remainder of the TLV:

bit 0 (hassubtype): if cleared ('0'), then <tlv-subtype> is not included in the <tlv>. If set ('1'), then <tlv-subtype> is included in the <tlv>.

bit 1 (extended) and bit 2 (novalue): MUST NOT both be set ('1'). Otherwise, they are interpreted according to Table 2.

extended	novalue	<length>	<value>
0	0	8 bits	included
0	1	not included	not included
1	0	16 bits	included

Table 2

bit 3 (noindex) and bit 4 (singleindex): MUST NOT both be set ('1'). The former MUST be set ('1') and the latter MUST be cleared ('0') for packet or message TLVs. They are interpreted according to Table 3.

noindex	singleindex	<index-start>	<index-stop>
0	0	included	included
0	1	included	not included
1	0	not included	not included

Table 3

bit 5 (multivalue): this bit serves to specify how the <value> field is interpreted, as specified below. This bit MUST be cleared ('0') for packet or message TLVs, if the singleindex bit is set ('1'), or if the novalue bit is set ('1').

bits 6-7: are RESERVED and MUST each be cleared ('0') to be in accordance with this version of the specification.

<tlv-subtype> is an 8 bit field, specifying the subtype of the TLV, specific to the TLV type and kind (i.e. packet, message, or address block TLV).

tlv-subtype is a variable, defined to equal <tlv-subtype> if present, or 0 otherwise.

tlv-fulltype is a variable, defined by:

* tlv-fulltype = 256 * <tlv-type> + tlv-subtype;

<index-start> and <index-stop> when present are each an 8 bit field, interpreted as follows.

index-start and index-stop are variables, defined according to Table 4. The variable end-index is defined as follows:

* For message and packet TLVs:

  + end-index = 0

* For address block TLVs:

  + end-index = <num-addr> - 1

noindex	singleindex	index-start =	index-stop =
0	0	<index-start>	<index-stop>
0	1	<index-start>	<index-start>
1	0	0	end-index

Table 4

For an address block TLV, the TLV applies to the addresses from position index-start to position index-stop (inclusive) in the address block, where the first address has position zero.

number-values is a variable, defined by:

* number-values = index-stop - index-start + 1

<length> is omitted or is a 8 or 16 bit field according to Table 2. If the multivalue bit is set ('1') then <length> MUST be an integral multiple of number-values, and the variable single-length is defined by:

* single-length = <length> / number-values

If the multivalue bit is cleared ('0'), then the variable single-length is defined by:

* single-length = <length>

<value> if present (see Table 2) is a field of length <length> octets. In an address block TLV, <value> is associated with the addresses from index-start to index-stop, inclusive. If the multivalue bit is cleared ('0') then the whole of this field is associated with each of the indicated addresses. If the multivalue bit is set ('1') then this field is divided equally into number-values fields, each of length single-length octets and these are associated, in order, with the indicated addresses.

5.3.2. Constraints

TLVs in the same TLV block MUST be sorted in non-descending tlv-fulltype order.

Packet and message TLVs MUST be defined so as to indicate whether two TLVs with the same tlv-fulltype are, or are not, allowed in the same packet or message TLV block, respectively.

Two or more TLVs with the same tlv-fulltype in the same address block TLV block MUST NOT be associated with the same copy of an address (i.e. they must not have overlapping index ranges).

TLVs with the same tlv-fulltype associated with the same address block MUST be sorted in ascending index-start order.

5.3.3. Malformed Elements

An element is malformed if it cannot be parsed according to its syntatical specification (including if there are insufficient octets available when a length is specified) or if a constraint (including, but not only, those specified in Section 5.3.2) specified as one which MUST be satisfied, is not. A protocol using this specification MUST specify the action, or choice of actions, to be taken when a packet containing such elements is received. Typical examples will include discarding any affected message(s), or discarding the complete packet.

5.4. Padding

Packet headers and messages MAY be padded to ensure 32 bit alignment of each message contained within the packet and of the overall packet length. Padding MAY also be used to ensure that all packets/messages have the same size.

All elements are an integer multiple of octets, hence padding can be accomplished by inserting an integer number of <pad-octet> elements after the element that is to be 32 bit aligned.

The number of <pad-octet> elements required to achieve this 32 bit alignment is the smallest number (0 to 3) that, when added to the size of the preceding elements, produces an integer multiple of 4.

<pad-octet> is an 8 bit field with all bits cleared ('0').

There is no need to indicate if padding is included, since a <pad-octet> will always precede either a message or the end of the packet. In the former case, the start of a message is indicated by the next non-zero octet parsed.

The padding after a message may be freely changed when a message is forwarded without affecting the message.

6. TLV specification

This document specifies one address block TLV, which is included to allow a standardized way of representing network addresses.

6.1. Address Block TLV Specification

Name	Type	Subtype	Length	Value
PREFIX_LENGTH	0	0	8 bits	Indicates that the address is a network address, rather than a host address. The value is the length of the prefix/netmask, in bits.

Table 5

An address in an address block without an associated PREFIX_LENGTH TLV may be considered to have a prefix length equal to the address length in bits (i.e. 8 * address-length).

7. IANA Considerations

A new registry for message types must be created with initial assignments as specified in Table 6. Future values in the range 5-127 can be allocated using standards action [3]. Additionally, values in the range 128-255 are reserved for private/local use.

Type	Description
0	MUST NOT be allocated.
1-4	RESERVED

Table 6

Message type 0 MUST NOT be allocated because a zero-octet signifies a packet header and zero-octets are used for padding. Message types 1 to 4 are reserved because they are used by OLSR [4], which uses a compatible packet/message header format.

A new registry for packet TLV types must be created, with no initial assignments. Future values in the range 0-127 can be allocated using standards action [3]. Additionally, values in the range 128-255 are reserved for private/local use. If a packet TLV type is allocated then a new registry for subtypes of that type must be created. A document which defines a packet TLV type MUST also specify the mechanism by which its subtypes are allocated, from among those in [3].

A new registry for message TLV types must be created with no initial assignments. Future values in the range 0-127 can be allocated using standards action [3]. Additionally, values in the range 128-255 are reserved for private/local use. If a message TLV type is allocated then a new registry for subtypes of that type must be created. A document which defines a message TLV type MUST also specify the mechanism by which its subtypes are allocated, from among those in [3].

A new registry for address block TLV types must be created with initial assignments as specified in Table 7. Future values in the range 1-127 can be allocated using standards action [3]. Additionally, values in the range 128-255 are reserved for private/local use. If an address block TLV type is allocated then a new registry for subtypes of that type must be created. A document which defines an address block TLV type MUST also specify the mechanism by which its subtypes are allocated, from among those in [3].

Mnemonic	Type	Subtype	Description
PREFIX_LENGTH	0	0	Indicates that associated addresses are network addresses, with given prefix length, in bits.
	0	1-255	RESERVED

Table 7

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

8. Security Considerations

Messages are designed to be carriers of protocol information and MAY, at each hop, be forwarded and/or processed according to the information in the message header by the protocol using this specification.

For forwarded messages where the message is unchanged by forwarding nodes, then end-to-end security MAY be implemented, between nodes with an existing security association, by including a suitable message TLV containing a cryptographic signature in the message. Since <hop-count> and <hop-limit> are the only fields that may be modified when such a message is forwarded in this manner, this signature can be calculated based on the entire message, including the message header, with the <hop-count> and <hop-limit> fields set to zero ('0') if present.

Packets are designed to carry a number of messages between neighboring nodes in a single transmission and over a single logical hop. Hop-by-hop packet level security MAY be implemented, between nodes with an existing security association, by including a suitable packet TLV containing a cryptographic signature to the packet. Since packets are received as transmitted, this signature can be calculated based on the entire packet, or on parts thereof as appropriate.

9. References

9.1. Normative References

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

[2] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

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

9.2. Informative References

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

Appendix A. Examples

This appendix contains some examples of parts of this specification.

A.1. Address Block Examples

The following examples illustrate how some combinations of addresses may be efficiently included in address blocks. These examples are for IPv4, with address-length equal to 4. a, b, c etc. represent distinct, non-zero, octet values.

Note that it is permissible to use a less efficient representation, in particular one in which the nohead and notail bits of the semantics octet are set, and hence head-length = 0, tail-length = 0, mid-length = address-length, and the address block consists of the number of addresses, the semantics octet with value 3, and a list of the uncompressed addresses. This is also the most efficient way to represent a single address, and the only way to represent, for example, a.b.c.d and e.f.g.h in one address block.

Examples:

o To include a.b.c.d, a.b.e.f and a.b.g.h:

  * head-length = 2;

  * tail-length = 0;

  * mid-length = 2;

  * <semantics> has notail set (value 2);

  * <tail-length> and <tail> are omitted.

  The address block is then 3 2 2 a b c d e f g h (11 octets).

o To include a.b.c.g and d.e.f.g:

  * head-length = 0;

  * tail-length = 1;

  * mid-length = 3;

  * <semantics> has nohead set (value 1);

  * <head-length> and <head> are omitted.

The address block is then 2 1 1 g a b c d e f (10 octets).

o To include a.b.d.e and a.c.d.e:

* head-length = 1;

* tail-length = 2;

* mid-length = 1;

* <semantics> = 0.

The address block is then 2 0 1 a 2 d e b c (9 octets).

o To include a.b.0.0, a.c.0.0, and a.d.0.0:

* head-length = 1;

* tail-length = 2;

* mid-length = 1;

* <semantics> has zerotail set (value 4);

* <tail> is omitted.

The address block is then 3 4 1 a 2 b c d (8 octets).

o To include a.b.0.0 and c.d.0.0:

* head-length = 0;

* tail-length = 2;

* mid-length = 2;

* <semantics> has nohead and zerotail set (value 5);

* <head> and <tail> are omitted.

The address block is then 2 5 2 a b c d (7 octets).

A.2. TLV Examples

If network addresses a.b.0.0/16, c.d.0.0/16, c.d.e.0/24 and c.d.e.f/32 are to be represented using a single address block containing a.b.0.0, c.d.0.0, c.d.e.0 and c.d.e.f, with the prefix lengths added using one or more address block TLVs of type

PREFIX_LENGTH (0), then this can be done in a number of ways. Possible examples are:

- o Using one multivalue TLV covering all of the addresses:

  * <semantics> has noindex and multivalue set (value 40);

  * <index-start> and <index-stop> are omitted;

  * <length> = 4 (single-length = 1).

  * The TLV is then 0 40 4 16 16 24 32 (7 octets).

- o Using one multivalue TLV omitting the last address (a prefix length of 32 is the default):

  * <semantics> has multivalue set (value 32);

  * <index-start> = 0;

  * <index-stop> = 2

  * <length> = 3 (single-length = 1).

  * The TLV is then 0 32 0 2 3 16 16 24 (8 octets).

- o Using two single value TLVs, omitting the last address. First:

  * <semantics> = 0;

  * <index-start> = 0;

  * <index-stop> = 1;

  * <length> = 1;

  * <value> = 16.

  * The TLV is then 0 0 0 1 1 16 (6 octets).

  Second:

  * <semantics> has singlevalue set (value 16);

  * <index-start> = 2;

  * <index-stop> is omitted;

   * <length> = 1;

   * <value> = 24.

   * The TLV is then 0 16 2 1 24 (5 octets).

   Total length of TLVs is 11 octets.

In this case the first of these is the most efficient. In other cases patterns such as the others may be preferred. Regardless of efficiency, any of these may be used.

Assuming the definition of an address block TLV with type EXAMPLE which has no value (it is sufficient to simply indicate which addresses are examples), for the same address block, with the second and third addresses being examples, this can be indicated with a single TLV:

o <semantics> has novalue set (value 4);

o <index-start> = 1;

o <index-stop> = 2;

o <length> and <value> are omitted.

o The TLV is then EXAMPLE 4 1 2 (4 octets).

Assuming the definition of a message TLV with type DATA which can take a value field of any length, for such a message TLV with 8 octets of data (a to h):

o <semantics> has noindex set (value 8);

o <index-start> and <index-stop> are omitted;

o <length> = 8.

o The TLV is then DATA 8 8 a b c d e f g h (11 octets).

If, in this example, the number of data octets were 256 or greater then <semantics> would also have extended set and have value 10. The length would require two octets (most significant first). The TLV length would be 4 + N octets, where N is the number of data octets (it can be 3 + N octets if N is 255 or less).

Appendix B. Illustrations

This informative appendix illustrates the elements, which are normatively specified in Section 5 using regular expressions.

Bits labeled Reserved, Resv, or Rsv are cleared ('0'). Bits labeled N and M may be cleared ('0') or set ('1'). Octets labeled Padding are cleared ('0'), and are optional.

Appendix B.1. Packet

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 0 0| Reserved  |0|0|    Packet Sequence Number     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message + Padding                       |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    :                              ...                              :
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message + Padding                       |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 0 0| Reserved  |0|1|            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message + Padding                       |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    :                              ...                              :
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message + Padding                       |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |0 0 0 0 0 0 0 0| Reserved  |1|0|    Packet Sequence Number     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                        Packet TLV Block                       |
   |                                                               |
   |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                               |            Padding            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                        Message + Padding                      |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   :                               ...                             :
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                        Message + Padding                      |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |0 0 0 0 0 0 0 0| Reserved  |1|1|                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
   |                                                               |
   |                        Packet TLV Block                       |
   |                                                               |
   |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                               |            Padding            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                        Message + Padding                      |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   :                               ...                             :
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                        Message + Padding                      |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message + Padding                       |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    :                              ...                              :
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message + Padding                       |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix B.2. Message and Padding

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|0|0|0|0|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                      Originator Address                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |   Hop Count   |    Message Sequence Number    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |0|0|0|0|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |   Hop Count   |    Message Sequence Number    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Message Type  | Rsv |N|0|0|1|0|         Message Size          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                      Originator Address                       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   Hop Count   |    Message Sequence Number    |               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
   |                                                               |
   |                         Message Body                          |
   |                                                               |
   |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                               |            Padding            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Message Type  | Rsv |0|0|0|1|1|         Message Size          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   Hop Count   |    Message Sequence Number    |               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
   |                                                               |
   |                         Message Body                          |
   |                                                               |
   |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                               |            Padding            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Message Type  | Rsv |N|0|1|0|0|         Message Size          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                      Originator Address                       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   Hop Limit   |    Message Sequence Number    |               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
   |                                                               |
   |                         Message Body                          |
   |                                                               |
   |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                               |            Padding            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|0|1|0|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |    Message Sequence Number    |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    |                          Message Body                         |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|0|1|1|0|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                       Originator Address                      |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    Message Sequence Number    |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                          Message Body                         |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|0|1|1|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    Message Sequence Number    |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                          Message Body                         |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|0|0|0|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                      Originator Address                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |   Hop Count   |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|0|0|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |   Hop Count   |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|0|1|0|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                      Originator Address                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Count   |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|0|1|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Count   |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|1|0|0|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                      Originator Address                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|1|0|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|1|1|0|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                      Originator Address                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  | Rsv |N|1|1|1|1|         Message Size          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                         Message Body                          |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |            Padding            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix B.3. Message Body

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                       Message TLV Block                       |
    |                                               +-+-+-+-+-+-+-+-+
    |                                               |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    |                         Address Block                         |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                       Address TLV Block                       |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    :                              ...                              :
    |                                                               |
    |                                               +-+-+-+-+-+-+-+-+
    |                                               |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    |                         Address Block                         |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                       Address TLV Block                       |
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix B.4. Address Block

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Number Addrs  |  Resv   |0|0|0|  Head Length |     Head       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Head (cont)  |  Tail Length  |             Tail              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |              Mid              |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    :                              ...                              :
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Number Addrs  |  Resv   |0|0|1|  Tail Length |     Tail       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Tail (cont)  |              Mid              |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    :                              ...                              :
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Number Addrs  |  Resv   |0|1|0|  Head Length |     Head       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Head (cont)  |              Mid              |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    :                              ...                              :
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Number Addrs  |  Resv   |0|1|1|              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |          Mid (cont)           |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    :                              ...                              :
    |                                                               |
    |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |          Mid (cont)           |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Number Addrs  |  Resv   |1|0|0|  Head Length  |     Head      |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Head (cont)  |  Tail Length  |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    :                              ...                              :
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Number Addrs  |  Resv   |1|0|1|  Tail Length  |      Mid      |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Mid (cont)   |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                                                               |
    :                              ...                              :
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix B.5. TLV Block

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |            Length             |                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
   |                                                               |
   |                              TLV                              |
   |                                               +-+-+-+-+-+-+-+-+
   |                                               |               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
   |                                                               |
   :                              ...                              :
   |                                                               |
   |                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                               |                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
   |                                                               |
   |                              TLV                              |
   |                                               +-+-+-+-+-+-+-+-+
   |                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix B.6. TLV

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |      Type     |Rsv|M|0|0|0|0|0|  Index Start  |  Index Stop   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Length     |                                               |
   +-+-+-+-+-+-+-+-+                                               |
   |                             Value                             |
   |                                                               |
   |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |               |
   +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |      Type     |Rsv|M|0|0|0|0|1|    Subtype    |  Index Start  |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Index Stop   |    Length     |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |      Type     |Rsv|M|0|0|0|1|0|  Index Start  |  Index Stop   |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |             Length            |                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
    |                                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |      Type     |Rsv|M|0|0|0|1|1|    Subtype    |  Index Start  |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Index Stop   |             Length            |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|0|0|0|1|0|0|  Index Start  |  Index Stop   |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|0|0|0|1|0|1|    Subtype    |  Index Start  |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Index Stop   |
    +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|M|0|1|0|0|0|    Length     |               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               |
    |                                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|M|0|1|0|0|1|    Subtype    |    Length     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+
```

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|M|0|1|0|1|0|            Length             |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|M|0|1|0|1|1|    Subtype    |    Length     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Length (cont) |                                               |
    +-+-+-+-+-+-+-+-+                                               |
    |                             Value                             |
    |                                                               |
    |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |               |
    +-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|0|0|1|1|0|0|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+


     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |Rsv|0|0|1|1|0|1|    Subtype    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     Type      |Rsv|0|1|0|0|0|0|  Index Start  |    Length     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                             Value                             |
   |                                                               |
   |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |               |
   +-+-+-+-+-+-+-+-+

    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     Type      |Rsv|0|1|0|0|0|1|    Subtype    |  Index Start  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    Length     |                                               |
   +-+-+-+-+-+-+-+-+                                               |
   |                             Value                             |
   |                                                               |
   |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |               |
   +-+-+-+-+-+-+-+-+

    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     Type      |Rsv|0|1|0|0|1|0|  Index Start  |    Length     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Length (cont) |                                               |
   +-+-+-+-+-+-+-+-+                                               |
   |                                                               |
   |                             Value                             |
   |                                                               |
   |               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |               |
   +-+-+-+-+-+-+-+-+
```

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |Rsv|0|1|0|0|1|1|    Subtype    |  Index Start  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Length            |                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
|                                                               |
|                             Value                             |
|                                                               |
|               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               |
+-+-+-+-+-+-+-+-+
```

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |Rsv|0|1|0|1|0|0|  Index Start  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |Rsv|0|1|0|1|0|1|    Subtype    |  Index Start  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix C. Complete Example

An example packet, using IPv4 addresses (length four octets) is shown. This packet has a header, indicated by the initial octet 0. The packet header has semantics octet 0, and hence has a packet sequence number, but no packet TLV block.

The packet contains a single message. This message has semantics octet 0, and hence has a complete message header, including originator address, hop limit, hop count and message sequence number (which is type independent). The message has a message TLV block with content length 9 octets, containing a single TLV. This TLV has the noindex bit of its semantics octet 8 set, and has value length 6 octets. The message then has two address blocks each with a following TLV block.

The first address block contains 3 addresses. It has the notail bit of its semantics octet 2 set, and has head length 2 octets, hence mid length two octets. It is followed by a TLV block, with content length 9 octets, containing two TLVs. The first of these TLVs has the noindex bit of its semantics octet 8 set, and has a single value of length 2 octets, which applies to all of the addresses in the address block. The second of these TLVs has the novalue bit of its semantics octet 4 set, and hence has no length or value fields. It does have index fields, which indicate those addresses this TLV applies to.

The second address block contains 2 addresses. It has the nohead and zerotail bits of its semantics octet 5 set, and has tail length 2 octets, hence mid length two octets. The two tail octets of each address are zero. It is followed by a TLV block with content length 5 octets. This TLV block contains a single TLV of type PREFIX_LENGTH that has the multivalue and noindex bits of its semantics octet 40 set, and a value field length of 2 octets, indicating two values each of one octet length. There is one final padding octet 0 that is not included in the message length of 59 octets.

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 0 0|0 0 0 0 0 0 0 0|    Packet Sequence Number     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Message Type  |0 0 0 0 0 0 0 0|0 0 0 0 0 0 0 0 0 0 1 1 1 0 1 1|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                      Originator Address                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Hop Limit   |   Hop Count   |    Message Sequence Number    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1|   TLV Type    |0 0 0 0 1 0 0 0|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 1 1 0|                     Value                     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                 Value (cont)                  |0 0 0 0 0 0 1 1|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 1 0|0 0 0 0 0 0 1 0|             Head              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |              Mid              |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |              Mid              |0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   TLV Type    |0 0 0 0 1 0 0 0|0 0 0 0 0 0 1 0|     Value     |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Value (cont)  |   TLV Type    |0 0 0 0 0 1 0 0|  Index Start  |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |  Index Stop   |0 0 0 0 0 0 1 0|0 0 0 0 0 1 0 1|0 0 0 0 0 0 1 0|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |              Mid              |              Mid              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1| PREFIX_LENGTH |0 0 1 0 1 0 0 0|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |0 0 0 0 0 0 1 0|    Value0     |    Value1     |0 0 0 0 0 0 0 0|
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Appendix D. Contributors

This specification is the result of the joint efforts of the following contributors from the OLSRv2 Design Team -- listed alphabetically.

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