

# The MsgLen Packet Format

Johannes Willkomm

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## 1 The MsgLen Packet Format

A new flexible and modern packet format is proposed. MsgLen defines three families of protocols designed with the following simple principles: The packet header should be easy to interpret, as short as possible, efficiently readable and extensible. This is achieved by packets that consist of three sections: *header*, *meta* information and *data*.

The first section, the header, consists of a fixed number of 8, 16, or 24 bytes depending on the protocol family. The header contains in addition just two numbers: the meta length and the data length, which are the lengths in bytes of the meta and the data sections of the package that follow. The meta length is recommended to be a multiple of 8 bytes. Thus only two reads are required for each packet: one of the fixed header length and another with the sum of the meta length and the data length. This makes the entire packet very easy and efficient to read from a network stream and the data will be placed at a 8 byte boundary in memory.

While the data part contains the binary user data, the meta information is encoded with JSON or XML. The meta section can thus transmit arbitrary structured information. Note that by just sending header and meta and a zero-length data section, a kind of side channel can be established.

Also, the flexible nature of the protocol opens the way for all kinds of sub-protocols and quasi-standards. For example, archives and structured messages may be constructed where the main MsgLen package contains information about the archive or message contents in the meta section.

JSON data in the meta section can be converted to XML on the fly using the **json2xml** function from the js2x package. The meta information may also be compressed by one of the following compression algorithms: gzip, xz, bzip, or brötl.

## 1.1 Header formats

The family of MsgLen protocols is defined by its headers, of which there are three. In binary formats, the three relevant fields are given in the order as in the table, in decimal or hex formats, they are given in reverse order. Also for binary formats, *mx*, *msgl*, and *Msgl*, the tables show the provision of bytes for the relevant fields, which are big endian unsigned integers:

Name	Magic	Flags	Meta Length	Data Length	Total
mx	m [xh]	1 B	2 B	3 B	8 B
msgl	m s g [lbhd]	4 B	4 B	4 B	16 B
Msgl	M s g [lbhd]	4 B	8 B	8 B	24 B

The *mx* protocol family has just two members, one binary format and one ASCII variant. The binary format *mx* uses the following layout. It provides 8 bits for flags, 16 bits for the meta length and 24 bits for the data length.

Name	Format	0-1	2	3-4	5-7
		Magic	Flags	Meta Length	Data Length
mx	binary	m x	8 bit	16 bit	24 bit

In the case of the ASCII format *mh*, between one and three hexadecimal numbers are given in the order data length, meta length, flags. Whitespace must be used for padding and for separating the numbers. Trailing numbers can be omitted and are then considered as zero. The maximum data length is thus achieved when meta length and flags are not given, with 6 bytes. The maximum meta length is achieved when the data length is zero (or a single digit) and flags are not given, leaving 4 bytes for a hex number.

Name	Format	0-1	2-7
		Magic	Data Length, Meta Length, Flags
mh	ASCII hex.	m h	max 24 bit data, max 16 bit meta

The *msgl* protocol family has one binary format *msgl* and three variants which result in a pure ASCII header. It provides in the binary format 32 bits for flags, 32 bits for the meta length and 32 bits for the data length. In the case of the first ascii format *msgb* the same binary layout is used to encode lengths as base64, which results in a factor of 3/4 in the number of bits per field.

Name	Format	0-3	4-7	8-11	12-15
		Magic	Flags	Meta Length	Data Length
msgl	binary	m s g l	32 bit	32 bit	32 bit
msgb	ASCII base64	m s g b	24 bit	24 bit	24 bit

In the case of the ASCII format *msgb* and *msgd*, between one and three hexadecimal or decimal numbers are given. The maximum data length is thus achieved when meta length and flags are not given, with 12 bytes. The maximum meta length is achieved when the data length is zero (or a single digit) and flags are not given, leaving 10 bytes for a hex or decimal number.

Name	Format	0-3	4-15
		Magic	Data Length, Meta Length, Flags
msggh	ASCII hex.	m s g h	max 48 bit data, max 40 bit meta
msgd	ASCII dec.	m s g d	max 10 <sup>12</sup> data, max 10 <sup>10</sup> meta

The *Msgl* protocol family has one binary format and three variants with a pure ASCII header. It provides in the binary format 32 bits for flags, 64 bits for the meta length and 64 bits for the data length.

Name	Format	0-3	4-7	8-15	16-23
		Magic	Flags	Meta-Length	Data-Length
Msgl	binary	M s g l	32 bit	64 bit	64 bit
Msgb	ASCII base64	M s g b	24 bit	48 bit	48 bit

In the case of the ASCII formats, the maximum data length is achieved when meta length and flags are not given, with 20 bytes. The maximum meta length is achieved when the data length is zero (or a single digit) and flags is not given, leaving 18 bytes for a hex or decimal number. Some of the resulting numbers may be larger than the maximum 64 bit unsigned value.

Name	Format	0-3	4-23
		Magic	Data-Length, Meta-Length, Flags
Msggh	ASCII hex.	M s g h	max 80 bit data, max 72 bit meta
Msgd	ASCII dec.	M s g d	max 10 <sup>20</sup> data, max 10 <sup>18</sup> meta

Currently there are no flags specified, they are usually all zeros. The hope is all of the requirements regarding the transport and protocol can be placed in the meta information. When flags are added in the future, the most important flags should be placed in the lower bits.

Note that, when the ASCII header forms are used, and the meta information is not compressed, and the data is UTF-8 encoded, then the entire packet is valid UTF-8 data.

An implementation may switch at any time between the members of one protocol family, but not to that of a different family unless explicitly requested by a suitable mechanism.

## 1.2 The meta information

The meta section of the MsgLen packet may contain JSON or XML data, optionally compressed, and padded to achieve a section length divisible by 8.

The meta section data must be whitespace padded when containing JSON or XML data and one of the ASCII header forms are used, or zero padded when it contains compressed binary data.

The meta section must be encoded using UTF-8.

## 1.3 Meta headers

Currently the following fields in the meta info are defined and used by the reference implementation:

**encoding** used to automatically encode and decode the data bytes from and to strings

**pack** python struct definition string, used to automatically pack and unpack binary data

We want to preliminarily reserve the meta data fields mentioned in the following sections, like protocol, error, warning, etc. While their implementation is not specified yet, the idea is that they carry the intended meaning.

We also soft-reserve all the names used by the HTTP protocol for its headers. When these are used by an implementation, they must be used in accordance with their intended meaning.

## 1.4 Meta control messages

Zero-length data packets may be used to signal state between the peers. The following fields may be used for such operations:

**protocol** mx, msgl, or Msgl

**version**

**get-options** respond by sending with the current meta state

**reset-options** clear local meta state

**reset** reset errors

**restart** restart service

**flush**

**error**

**warning**

**msg**

**comment**

**pass** list of fields that must be passed onwards

**content-type** unpack if known MIME type, such as text/json or text/xml

Implementations must signal error and warning states, and other typical notifications using the fields error, warning, msg, comment.

## 1.5 Meta information caching

Implementations should cache the meta information being send, by continuously performing a dictionary union of their current state of meta information and the meta information in the current package.

When this process would leave the implementation in an impossible state, it must not perform the option update and respond to the sender with an error message.

A service will provide the state meta state by sending the corresponding JSON when it receives a message containing the get-options field.

The reset-options field means that the receiver reset its local meta state to the empty dictionary.

## 1.6 Flags fields

Using the mechanism outlined in the previous chapter, the implementation is expected to cache at least certain meta fields. One particular field is **set-flags-map**. This meta fields, when send, is expected to contain a list of names. Then, from the following event onwards, when the flags field in the header has the i-th bit set, the meta information from read operation must contain a field with the i-th name in that list, which may be an empty JSON dict or an empty XML element. Conversely, when the meta information provided to a write operation contains a field a non-false value:

- a non-empty dict or node-set
- a non-empty list
- a non-empty string
- a non-zero number
- a true Boolean value

then the implementation must set the i-th bit in the flags of any packet it sends, from the following event onwards after the **set-flags-map** command was send.

## 1.7 Current implementation

The current implementation in this package is incomplete.

The implementation and this spec are supposed to merge in the future but both are obviously still subject to change.

The file `msglen/msglen.py` contains the core implementation, which consists of the classes `MsglenL`, `MsglenB`, `MsglenH`, and `MsglenD`. The first is the most extensive, the others only need to overwrite to methods: `_unpackHeader` and `packHeader`.

The classes can be given an open file object and then the methods `readData`, `readMeta`, and `readHeader` can be used to read the (binary) section data.

The methods `pack` can be used to construct an entire packet out of meta data and data. The methods `packHeader` and `metaHeader` can be used to construct the header and meta section byte data individually.

The method `unpackHeader` returns the tuple (id, mlen, dlen, flags) from 8 or 16 bytes of header data. The combined header, meta and data section can be unpacked with the method `unpack`.

The method `reader` returns an asynchronous reader handle when passed an asyncio stream reader. The methods `writer` returns a regular function that writes data to a given stream with given meta dict and `packer` returns a function that packs data with a given meta dict.