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# Extension Mechanism for the Babel Routing Protocol

## Abstract

This document defines the encoding of extensions to the Babel routing protocol, as specified in RFC 6126.

## Status of This Memo

This document is not an Internet Standards Track specification; it is published for examination, experimental implementation, and evaluation.

This document defines an Experimental Protocol for the Internet community. This is a contribution to the RFC Series, independently of any other RFC stream. The RFC Editor has chosen to publish this document at its discretion and makes no statement about its value for implementation or deployment. Documents approved for publication by the RFC Editor are not a candidate for any level of Internet Standard; see Section 2 of RFC 5741.

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## 1. Introduction

A Babel packet [RFC6126] contains a header followed by a sequence of TLVs, each of which is a sequence of octets having an explicit type and length. The original Babel protocol has the following provisions for including extension data:

- A Babel packet with a version number different from 2 MUST be silently ignored ([RFC6126], Section 4.2).

- An unknown TLV MUST be silently ignored ([RFC6126], Section 4.3).

- Except for Pad1 and PadN, all TLVs are self-terminating, and any extra data included in a TLV MUST be silently ignored ([RFC6126], Section 4.2).

- The Flags field of the Update TLV contains 6 undefined bits that MUST be silently ignored ([RFC6126], Section 4.4.9).

- Any data following the last TLV of a Babel packet MUST be silently ignored ([RFC6126], Section 4.2).

Each of these provisions provides a place to store data needed by extensions of the Babel protocol. However, in the absence of any further conventions, independently developed extensions to the Babel protocol might make conflicting uses of the available space, and therefore lead to implementations that would fail to interoperate.

This document formalises a set of rules for extending the Babel protocol that are designed to ensure that no such incompatibilities arise, and that are currently respected by a number of deployed extensions.

In the rest of this document, we use the term "original protocol" for the protocol defined in [RFC6126], and "extended protocol" for any extension of the Babel protocol that follows the rules set out in this document.

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 [RFC2119].

## 2. Mechanisms for Extending the Babel Protocol

This section describes each of the mechanisms available for extending the Babel protocol.

### 2.1. New Versions of the Babel Protocol

The header of a Babel packet contains an eight-bit protocol version. The current version of the Babel protocol is version 2; any packets containing a version number different from 2 MUST be silently ignored.

Versions 0 and 1 were earlier experimental versions of the Babel protocol that have seen some modest deployment; these version numbers SHOULD NOT be reused by future versions of the Babel protocol. Version numbers larger than 2 might be used by a future incompatible protocol.

### 2.2. New TLVs

An extension may carry its data in a new TLV type. Such new TLVs will be silently ignored by implementations of the original Babel protocol, as well as by other extended implementations of the Babel protocol, as long as the TLV types do not collide.

All new TLVs MUST have the format defined in [RFC6126], Section 4.3. New TLVs SHOULD be self-terminating, in the sense defined in the next section, and any data found after the main data section of the TLV SHOULD be treated as a series of sub-TLVs.

TLV types 224 through 254 are reserved for Experimental Use [RFC3692]. TLV type 255 is reserved for expansion of the TLV type space, in the unlikely event that eight bits turn out not to be enough.

## 2.3. Sub-TLVs

With the exception of the Pad1 TLV, all Babel TLVs carry an explicit length. With the exception of Pad1 and PadN, all TLVs defined by the original protocol are self-terminating, in the sense that the length of the meaningful data that they contain (the "natural length") can be determined without reference to the explicitly encoded length. In some cases, the natural length is trivial to determine: for example, a HELLO TLV always has a natural length of 2 (4 including the Type and Length fields). In other cases, determining the natural length is not that easy, but this needs to be done anyway by an implementation that interprets the given TLV. For example, the natural length of an Update TLV depends on both the prefix length and the amount of prefix compression being performed.

If the explicit length of a TLV defined by the original protocol is larger than its natural length, the extra space present in the TLV is silently ignored by an implementation of the original protocol; extended implementations MAY use it to store arbitrary data and SHOULD structure the additional data as a sequence of sub-TLVs. Unlike TLVs, the sub-TLVs themselves need not be self-terminating.

An extension MAY be assigned one or more sub-TLV types. Sub-TLV types are assigned independently from TLV types: the same numeric type can be assigned to a TLV and a sub-TLV. Sub-TLV types are assigned globally: once an extension is assigned a given sub-TLV number, it MAY use this number within any TLV. However, the interpretation of a given sub-TLV type can depend on which particular TLV it is embedded within.

Sub-TLV types 224 through 254 are reserved for Experimental Use [RFC3692]. TLV type 255 is reserved for expansion of the sub-TLV type space, in the unlikely event that eight bits turn out not to be enough. The format of sub-TLVs is defined in Section 3 below.

## 2.4. The Flags Field

The Flags field is an eight-bit field in the Update TLV. Bits 0 and 1 (the bits with values 80 and 40 hexadecimal) are defined by the original protocol and MUST be recognised and used by every implementation. The remaining six bits are not currently used and are silently ignored by implementations of the original protocol.

Due to the small size of the Flags field, it is NOT RECOMMENDED that one or more bits be assigned to an extension; a sub-TLV SHOULD be assigned instead. An implementation MUST ignore any bits in the Flags field that it does not know about and MUST send them as zero.

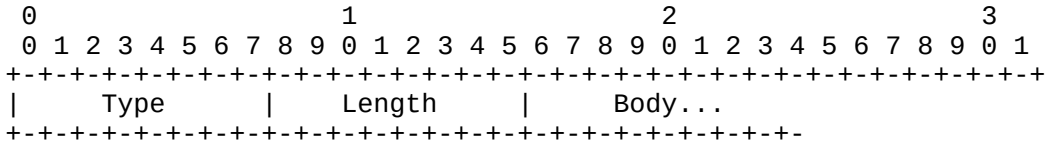
### 2.5. Packet Trailer

A Babel packet carries an explicit length in its header. A Babel packet is carried by a UDP datagram, which in turn contains an explicit length in its header. It is possible for a UDP datagram carrying a Babel packet to be larger than the size of the Babel packet. In that case, the extra space after the Babel packet, known as the packet trailer, is silently ignored by an implementation of the original protocol.

The packet trailer was originally intended to be used as a cryptographic trailer. However, the authentication extension to Babel [RFC7298] ended up using a pair of new TLVs, and no currently deployed extension of Babel uses the packet trailer. The format and purpose of the packet trailer is therefore currently left undefined.

## 3. Format of Sub-TLVs

A sub-TLV has exactly the same structure as a TLV. Except for Pad1 (Section 3.1.1), all sub-TLVs have the following structure:




Fields:

Type The type of the sub-TLV.

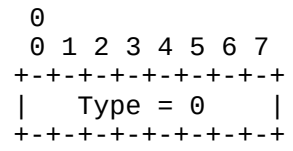
Length The length of the body, in octets, exclusive of the Type and Length fields.

Body The sub-TLV body, the interpretation of which depends on both the type of the sub-TLV and the type of the TLV within which it is embedded.

### 3.1. Sub-TLVs Specified in This Document

This document defines two types of sub-TLVs, Pad1 and PadN. These two sub-TLVs MUST be correctly parsed and ignored by any extended implementation of the Babel protocol that uses sub-TLVs.

#### 3.1.1. Pad1

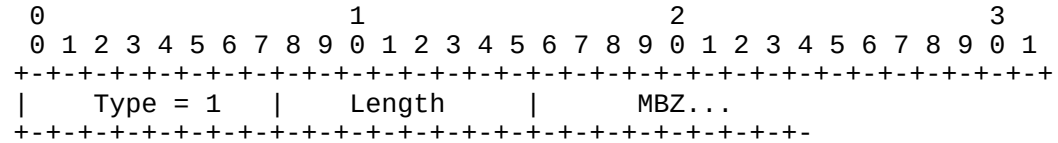



Fields:

Type Set to 0 to indicate a Pad1 sub-TLV.

This sub-TLV is silently ignored on reception.

#### 3.1.2. PadN




Fields:

Type Set to 1 to indicate a PadN sub-TLV.

Length The length of the body, in octets, exclusive of the Type and Length fields.

MBZ Set to 0 on transmission.

This sub-TLV is silently ignored on reception.

### 3.2. Unknown Sub-TLVs

Any unknown sub-TLV MUST be silently ignored by an extended implementation that uses sub-TLVs.

## 4. Choosing between Extension Mechanisms

New versions of the Babel protocol should only be defined if the new version is not backwards compatible with the original protocol.

In many cases, an extension could be implemented either by defining a new TLV or by adding a new sub-TLV to an existing TLV. For example, an extension whose purpose is to attach additional data to route updates can be implemented either by creating a new "enriched" Update TLV or by adding a sub-TLV to the Update TLV.

The two encodings are treated differently by implementations that do not understand the extension. In the case of a new TLV, the whole unknown TLV is ignored by an implementation of the original protocol, while in the case of a new sub-TLV, the TLV is parsed and acted upon, and the unknown sub-TLV is silently ignored. Therefore, a sub-TLV should be used by extensions that extend the Update in a compatible manner (the extension data may be silently ignored), while a new TLV must be used by extensions that make incompatible extensions to the meaning of the TLV (the whole TLV must be thrown away if the extension data is not understood).

Using a new bit in the Flags field is equivalent to defining a new sub-TLV while using less space in the Babel packet. Due to the limited Flags space, and the doubtful space savings, we do not recommend the use of bits in the Flags field -- a new sub-TLV should be used instead.

We refrain from making any recommendations about the usage of the packet trailer due to the lack of implementation experience.

## 5. IANA Considerations

IANA has created three new registries, called "Babel TLV Types", "Babel Sub-TLV Types", and "Babel Flags Values". The allocation policy for each of these registries is Specification Required [RFC5226].

The initial values in the "Babel TLV Types" registry are as follows:

| Type | Name | Reference |
|---|---|---|
| 0 | Pad1 | [RFC6126] |
| 1 | PadN | [RFC6126] |
| 2 | Acknowledgment Request | [RFC6126] |
| 3 | Acknowledgment | [RFC6126] |
| 4 | Hello | [RFC6126] |
| 5 | IHU | [RFC6126] |
| 6 | Router-Id | [RFC6126] |
| 7 | Next Hop | [RFC6126] |
| 8 | Update | [RFC6126] |
| 9 | Route Request | [RFC6126] |
| 10 | Seqno Request | [RFC6126] |
| 11 | TS/PC | [RFC7298] |
| 12 | HMAC | [RFC7298] |
| 13 | Source-specific Update | [BABEL-SS] |
| 14 | Source-specific Request | [BABEL-SS] |
| 15 | Source-specific Seqno Request | [BABEL-SS] |
| 224-254 | Reserved for Experimental Use | this document |
| 255 | Reserved for expansion of the type space | this document |

The initial values in the "Babel Sub-TLV Types" registry are as follows:

| Type | Name | Reference |
|---|---|---|
| 0 | Pad1 | this document |
| 1 | PadN | this document |
| 2 | Diversity | [BABEL-DIV] |
| 3 | Timestamp | [BABEL-RTT] |
| 224-254 | Reserved for Experimental Use | this document |
| 255 | Reserved for expansion of the type space | this document |

The initial values in the "Babel Flags Values" registry are as follows:

| Bit | Name | Reference |
|---|---|---|
| 0 | Default prefix | [RFC6126] |
| 1 | Default router-id | [RFC6126] |
| 2-7 | Unassigned | |

## 6. Security Considerations

This document specifies the structure of fields that are already present in the original Babel protocol and does not, by itself, raise any new security considerations. Specific extensions may change the security properties of the protocol, for example, by adding security mechanisms [RFC7298] or by enabling new kinds of attack.

# 7. References

## 7.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC3692] Narten, T., "Assigning Experimental and Testing Numbers Considered Useful", BCP 82, RFC 3692, DOI 10.17487/RFC3692, January 2004, <http://www.rfc-editor.org/info/rfc3692>.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, DOI 10.17487/RFC5226, May 2008, <http://www.rfc-editor.org/info/rfc5226>.

[RFC6126] Chroboczek, J., "The Babel Routing Protocol", RFC 6126, DOI 10.17487/RFC6126, April 2011, <http://www.rfc-editor.org/info/rfc6126>.

## 7.2. Informative References

[BABEL-DIV] Chroboczek, J., "Diversity Routing for the Babel Routing Protocol", Work in Progress, draft-chroboczek-babel-diversity-routing-00, July 2014.

[BABEL-RTT] Jonglez, B. and J. Chroboczek, "Delay-based Metric Extension for the Babel Routing Protocol", Work in Progress, draft-jonglez-babel-rtt-extension-01, May 2015.

[BABEL-SS] Boutier, M. and J. Chroboczek, "Source-Specific Routing in Babel", Work in Progress, draft-boutier-babel-source-specific-01, May 2015.

[RFC7298] Ovsienko, D., "Babel Hashed Message Authentication Code (HMAC) Cryptographic Authentication", RFC 7298, DOI 10.17487/RFC7298, July 2014, <http://www.rfc-editor.org/info/rfc7298>.

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