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## **Extended TCP Options and IPv6 Extension Headers IPFIX Information Elements**

### **Abstract**

This document specifies new IPFIX Information Elements (IEs) to solve some issues with existing ipv6ExtensionHeaders and tcpOptions IPFIX IEs, especially the ability to export any observed IPv6 Extension Headers or TCP options.

### **Discussion Venues**

This note is to be removed before publishing as an RFC.

Discussion of this document takes place on the Operations and Management Area Working Group Working Group mailing list (opsawg@ietf.org), which is archived at <https://mailarchive.ietf.org/arch/browse/opsawg/>.

Source for this draft and an issue tracker can be found at <https://github.com/boucadair/ipfix-tcpoptions-and-v6eh>.

### **Status of This Memo**

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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## 1. Introduction

This document specifies new IPFIX Information Elements (IEs) to solve a set of issues encountered with the current specifications of `ipv6ExtensionHeaders` (for IPv6 Extension Headers (EHs)) and `tcpOptions` (to export TCP options). More details about these issues are provided in the following sub-sections.

### 1.1. ipv6ExtensionHeaders Issues

The specification of `ipv6ExtensionHeaders` IPFIX IE does not:

- \*Cover the full EHs range (Section 4 of [[RFC8200](#)]).

\*Specify how to automatically update the IANA IPFIX registry ([[IANA-IPFIX](#)]) when a new value is assigned in [[IPv6-EH](#)].

\*Specify the procedure to follow when all bits are exhausted.

## 1.2. tcpOptions Issues

Only TCP options having a kind  $\leq 63$  can be included in a tcpOptions IPFIX IE. The specification of the tcpOptions IPFIX IE does not describe how any observed TCP option in a packet can be exported using IPFIX. Also, there is no way to report the observed Experimental Identifiers (ExIDs) that are carried in shared TCP options (kind=253 or 254) [[RFC6994](#)].

## 2. Conventions and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

This document uses the IPFIX-specific terminology (Information Element, Template, Collector, Data Record, Flow Record, Exporting Process, Collecting Process, etc.) defined in Section 2 of [[RFC7011](#)]. As in [[RFC7011](#)], these IPFIX-specific terms have the first letter of a word capitalized.

## 3. IPv6 Extension Header

### 3.1. ipv6ExtensionHeadersFull Information Element

**Name:** ipv6ExtensionHeadersFull

**ElementID:** TBD1

**Description:** IPv6 extension headers observed in packets of this Flow. The information is encoded in a set of bit fields. For each IPv6 option header, there is a bit in this set. The bit is set to 1 if any observed packet of this Flow contains the corresponding IPv6 extension header. Otherwise, if no observed packet of this Flow contained the respective IPv6 extension header, the value of the corresponding bit is 0. The IPv6 EH associated with each bit is provided in [[NEW\\_IPFIX\\_IPv6EH\\_SUBREGISTRY](#)].

The value should be encoded in fewer octets as per the guidelines in [Section 6.2](#) of [[RFC7011](#)].

**Abstract Data Type:** unsigned

**Data Type Semantics:**

flags

**Additional Information:** See the assigned bits to each IPv6 extension header type in [NEW\_IPFIX\_IPV6EH\_SUBREGISTRY].

See [RFC8200] for the general definition of IPv6 extension headers and [IPv6-EH] for assigned extension header types.

**Reference:** This-Document

### 3.2. ipv6ExtensionHeaderCount Information Element

**Name:** ipv6ExtensionHeaderCount

**ElementID:** TBD2

**Description:** As per [RFC8200], IPv6 nodes must accept and attempt to process extension headers in occurring any number of times in the same packet. This Information Element echoes the number of occurrences of the same EH instance in an IPv6 packet. EH Type values are taken from [IPv6-EH].

IPFIX reduced-size encoding as per [Section 6.2](#) of [RFC7011] is used as required.

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 ...
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| EH Type#1   |   Count   |...| EH Type#n   |   Count   |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
```

**Abstract Data Type:** unsigned64

**Data Type Semantics:** identifier

**Additional Information:** See the assigned IPv6 extension header types in [IPv6-EH].

See [RFC8200] for the general definition of IPv6 extension headers.

**Reference:** This-Document

## 4. Information Elements for TCP Options

### 4.1. tcpOptionsFull Information Element

This section specifies a new Information Element to cover the full TCP options range.

**Name:**

tcpOptionsFull

**ElementID:** TBD3

**Description:** TCP options in packets of this Flow. The information is encoded in a set of bit fields. For each TCP option, there is a bit in this set. The bit is set to 1 if any observed packet of this Flow contains the corresponding TCP option. Otherwise, if no observed packet of this Flow contained the respective TCP option, the value of the corresponding bit is 0.

Options are mapped to bits according to their option numbers. Option number X is mapped to bit X. TCP option numbers are maintained by IANA.

The value should be encoded in fewer octets as per the guidelines in [Section 6.2](#) of [[RFC7011](#)].

**Abstract Data Type:** unsigned

**Data Type Semantics:** flags

**Additional Information:** See the assigned TCP option kinds at [[IANA-TCP](#)].

See [[RFC9293](#)] for the general definition of TCP options.

**Reference:** This-Document

#### 4.2. New Information Elements for Shared TCP Options

ExIDs can be either 2 or 4 bytes in length [[RFC6994](#)]. Two new IPFIX IEs are defined to accomodate these two lengths without introducing extra complexity in mixing both types in the same IPFIX IE.

##### 4.2.1. tcpSharedOptionExID16 Information Element

**Name:** tcpSharedOptionExID16

**ElementID:** TBD4

**Description:** Observed 2-byte Experiments IDs (ExIDs) in a shared TCP option (Kind=253 or 254). The information is encoded in a set of 16-bit fields. Each 16-bit field carries the observed 2-byte ExID in a shared option.

**Abstract Data Type:** octetArray

**Data Type Semantics:** identifier

**Additional Information:**

See assigned 16-bit ExIDs at  
[\[IANA-TCP-EXIDs\]](#).

**Reference:** This-Document

**4.2.2. tcpSharedOptionExID32 Information Element**

**Name:** tcpSharedOptionExID32

**ElementID:** TBD5

**Description:** Observed 4-byte Experiments ID (ExIDs) in a shared TCP option (Kind=253 or 254). The information is encoded in a set of 16-bit fields. Each 32-bit field carries the observed 4-byte ExID in a shared option.

**Abstract Data Type:** octetArray

**Data Type Semantics:** identifier

**Additional Information:** See assigned 32-bit ExIDs at  
[\[IANA-TCP-EXIDs\]](#).

**Reference:** This-Document

**5. Security Considerations**

IPFIX security considerations are discussed in [Section 8](#) of [\[RFC7012\]](#).

**6. IANA Considerations**

This document requests IANA to add the following new IPFIX IEs to the IANA IPFIX registry [\[IANA-IPFIX\]](#):

Value	Name	Reference
TBD1	ipv6ExtensionHeadersFull	<a href="#">Section 3.1</a> of This-Document
TBD2	ipv6ExtensionHeaderCount	<a href="#">Section 3.2</a> of This-Document
TBD3	tcpOptionsFull	<a href="#">Section 4.1</a> of This-Document
TBD4	tcpSharedOptionExID16	<a href="#">Section 4.2.1</a> of This-Document
TBD5	tcpSharedOptionExID32	<a href="#">Section 4.2.2</a> of This-Document

Table 1: New IPFIX Information Elements

**7. Normative References**

[\[IANA-IPFIX\]](#) IANA, "IP Flow Information Export (IPFIX) Entities",  
<<https://www.iana.org/assignments/ipfix/ipfix.xhtml>>.

**[IANA-TCP]**

IANA, "Transmission Control Protocol (TCP) Parameters, TCP Option Kind Numbers", <<https://www.iana.org/assignments/tcp-parameters/tcp-parameters.xhtml#tcp-parameters-1>>.

**[IANA-TCP-EXIDS]**

IANA, "Transmission Control Protocol (TCP) Parameters, TCP Experimental Option Experiment Identifiers (TCP ExIDs)", <<https://www.iana.org/assignments/tcp-parameters/tcp-parameters.xhtml#tcp-exids>>.

**[IPv6-EH]**

IANA, "Internet Protocol Version 6 (IPv6) Parameters, IPv6 Extension Header Types", <<https://www.iana.org/assignments/ipv6-parameters/ipv6-parameters.xhtml#ipv6-parameters-1>>.

**[RFC2119]**

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

**[RFC6994]**

Touch, J., "Shared Use of Experimental TCP Options", RFC 6994, DOI 10.17487/RFC6994, August 2013, <<https://www.rfc-editor.org/rfc/rfc6994>>.

**[RFC7011]**

Claise, B., Ed., Trammell, B., Ed., and P. Aitken, "Specification of the IP Flow Information Export (IPFIX) Protocol for the Exchange of Flow Information", STD 77, RFC 7011, DOI 10.17487/RFC7011, September 2013, <<https://www.rfc-editor.org/rfc/rfc7011>>.

**[RFC7012]**

Claise, B., Ed. and B. Trammell, Ed., "Information Model for IP Flow Information Export (IPFIX)", RFC 7012, DOI 10.17487/RFC7012, September 2013, <<https://www.rfc-editor.org/rfc/rfc7012>>.

**[RFC8174]**

Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/rfc/rfc8174>>.

**[RFC8200]**

Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, RFC 8200, DOI 10.17487/RFC8200, July 2017, <<https://www.rfc-editor.org/rfc/rfc8200>>.

**[RFC9293]**

Eddy, W., Ed., "Transmission Control Protocol (TCP)", STD 7, RFC 9293, DOI 10.17487/RFC9293, August 2022, <<https://www.rfc-editor.org/rfc/rfc9293>>.

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