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Information Model for IP Flow Information Export
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Status of this Memo

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Abstract

This memo defines an information model for the IP Flow Information eXport (IPFIX) protocol. It is used by the IPFIX protocol for encoding measured traffic information and information related to the

traffic Observation Point, the traffic Metering Process and the Exporting Process. Although developed for the IPFIX protocol, the model is defined in an open way that easily allows using it in other protocols, interfaces, and applications.

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1. Introduction

The IP Flow Information eXport (IPFIX) protocol serves for transmitting information related to measured IP traffic over the Internet. The protocol specification in [I-D.ietf-ipfix-protocol] defines how Information Elements are transmitted. For Information Elements, it specifies the encoding of a set of basic data types. However, the list of Information Elements that can be transmitted by the protocol, such as flow attributes (source IP address, number of packets, etc.) and information about the Metering and Exporting Process (packet Observation Point, sampling rate, flow timeout interval, etc.), is not specified in [I-D.ietf-ipfix-protocol].

This document complements the IPFIX protocol specification by providing the IPFIX information model. IPFIX-specific terminology used in this document is defined in section 3 of [I-D.ietf-ipfix-protocol]. As in [I-D.ietf-ipfix-protocol], these IPFIX-specific terms have the first letter of a word capitalized when used in this document.

The main part of this document is section 5 defining the (extensible) list of Information Elements to be transmitted by the IPFIX protocol. Section 2 defines a template for specifying IPFIX Information Elements in section 4. Section 3 defines the set of abstract data types that are available for IPFIX Information Elements. Section 5 discusses extensibility of the IPFIX information model.

The main bodies of sections 2, 3 and 4 were generated from XML documents. The XML-based specification of template, abstract data types and IPFIX Information Elements can be used for automatically checking syntactical correctness of the specification of IPFIX Information Elements. It can further be used for generating IPFIX protocol implementation code that deals with processing IPFIX Information Elements. Also code for applications that further process traffic information transmitted via the IPFIX protocol can be generated with the XML specification of IPFIX Information Elements.

For that reason, the XML document that served as source for section 4 and the XML schema that served as source for sections 2 and 3 are attached to this document in Appendices A and B.

Note that although partially generated from the attached XML documents, the main body of this document is normative while the appendices are informational.

2. Properties of IPFIX Protocol Information Elements

2.1 Information Elements Specification Template

Information in messages of the IPFIX protocol is modeled in terms of Information Elements of the IPFIX information model. IPFIX Information Elements are specified in section 4. For specifying these Information Elements, a template is used that is described below.

All Information Elements specified for the IPFIX protocol either in this document or by any future extension MUST have the following properties defined:

name - A unique and meaningful name for the Information Element.

description - The semantics of this Information Element. Describes how this Information Element is derived from the flow or other information available to the observer.

dataType - One of the types listed in section 3.1 of this document or in a future extension of the information model. The type space for attributes is constrained to facilitate implementation. The existing type space does however encompass most basic types used in modern programming languages, as well as some derived types (such as ipv4Address) which are common to this domain and useful to distinguish.

status - The status of the specification of this Information Element. Allowed values are 'current', 'deprecated', and 'obsolete'.

Enterprise-specific Information Elements MUST have the following property defined:

enterpriseId - Enterprises may wish to define Information Elements without registering them with IANA, for example for enterprise-internal purposes. For such Information Elements the Information Element identifier described above is not sufficient when the Information Element is used outside the enterprise. If specifications of enterprise-specific Information Elements are made public and/or if enterprise-specific identifiers are used by the IPFIX protocol outside the enterprise, then the enterprise-specific identifier MUST be made globally unique by combining it with an enterprise identifier. Valid values for the enterpriseId are defined by IANA as SMI network management private enterprise codes. They are defined at http://www.iana.org/assignments/enterprise-numbers.

All Information Elements specified for the IPFIX protocol either in this document or by any future extension MAY have the following properties defined:

dataTypeSemantics - The integral types may be qualified by additional semantic details. Valid values for the data type semantics are specified in section 3.2 of this document or in a future extension of the information model.

units - If the Information Element is a measure of some kind, the units identify what the measure is.

range - Some Information Elements may only be able to take on a restricted set of values which can be expressed as a range (e.g. 0 through 511 inclusive). If this is the case, the valid inclusive range should be specified.

reference - Identifies additional specifications which more precisely define this item or provide additional context for its use.

2.2 Scope of Information Elements

By default, most Information Elements have a scope specified in their definitions.

- The Information Elements defined in section 5.2 have a default of "a specific Metering Process" or of "a specific Exporting Process", respectively.
- The Information Elements defined in sections 5.3 - 5.9 have a scope of "a specific flow".

Within Data Records defined by Option Templates, the IPFIX protocol allows further limiting of the Information Element scope. The new scope is specified by one or more scope fields and defined as the combination of all specified scope values.

2.3 Naming Conventions for Information Elements

The following naming conventions were used for naming Information Elements in this document. It is recommended that extensions of the model use the same conventions.

- Names of Information Elements start with non-capitalized letters.
- Composed names use capital letters for the first letter of each component (except for the first one). All other letters are

non-capitalized, even for acronyms. Exceptions are made for acronyms containing non-capitalized letter, such as 'IPv4' and 'IPv6'. Examples are sourceMacAddress and destinationIPv4Address.

- Middleboxes [RFC3234] may change flow properties, such as the DSCP value or the source IP address. There are different Information Elements required for the original values of these properties and for the modified values. As a general rule, it is recommended that names for Information Elements containing the original properties have no specific prefix while names of Information Elements containing the modified properties have the prefix "post", for example, postClassOfServiceIPv4.

3. Type Space

This section describes the abstract data types that can be used for the specification of IPFIX Information Elements in section 4. Section 3.1 describes the set of data types.

Data types octet, unsigned16, unsigned32, and unsigned64 are integral data types. As described in section 3.2, their data type semantics can be further specified, for example, by 'totalCounter', 'deltaCounter', 'identifier' or 'flags'.

3.1 Data Types

This section describes the set of valid data types of the IPFIX information model. Note that further data types may be specified by future protocol extensions.

3.1.1 octet

The type "octet" represents a non-negative integer value in the range of 0 to 255.

3.1.2 unsigned16

The type "unsigned16" represents a non-negative integer value in the range of 0 to 65535.

3.1.3 unsigned32

The type "unsigned32" represents a non-negative integer value in the range of 0 to 4294967295.

3.1.4 unsigned64

The type "unsigned64" represents a non-negative integer value in the range of 0 to 18446744073709551615.

3.1.5 float32

The type "float32" corresponds to an IEEE single-precision 32-bit floating point type as defined in [IEEE.754.1985].

3.1.6 boolean

The type "boolean" represents a binary value. The only allowed values are "true" and false.

3.1.7 macAddress

The type "macAddress" represents a string of 6 octets.

3.1.8 octetArray

The type "octetArray" represents a finite length string of octets.

3.1.9 string

The type "string" represents a finite length string of valid characters from the Unicode character encoding set [ISO.10646-1.1993]. Unicode allows for ASCII [ISO.646.1991] and many other international character sets to be used. It is expected that strings will be encoded in UTF-8 format, which is identical in encoding for ASCII characters, but also accommodates other Unicode multi-byte characters.

3.1.10 dateTimeSeconds

The type "dateTimeSeconds" represents a time value having a precision of seconds and normalized to the GMT time zone.

3.1.11 dateTimeMilliSeconds

The type "dateTimeMilliSeconds" represents a time value having a precision of milliseconds and normalized to the GMT time zone.

3.1.12 dateTimeMicroSeconds

The type "dateTimeMicroSeconds" represents a time value having a precision of microseconds and normalized to the GMT time zone.

3.1.13 dateTimeNanoSeconds

The type "dateTimeNanoSeconds" represents a time value having a precision of nanoseconds and normalized to the GMT time zone.

3.1.14 ipv4Address

The type "ipv4Address" represents a value of an IPv4 address.

3.1.15 ipv6Address

The type "ipv6Address" represents a value of an IPv6 address.

3.2 Data Type Semantics

This section describes the set of valid data type semantics of the IPFIX information model. Note that further data type semantics may be specified by future protocol extensions.

3.2.1 quantity

A quantity value represents a discrete measured value pertaining to the record. This is distinguished from counters which represent an ongoing measured value whose "odometer" reading is captured as part of a given record. If no semantic qualifier is given, the Information Elements that have an integral data type should behave as a quantity.

3.2.2 totalCounter

An integral value reporting the value of a counter. Basically the same semantics as counters in SNMP. Counters are unsigned and wrap back to zero after reaching the limit of the type. For example, an unsigned64 with counter semantics will continue to increment until reaching the value of 2**64 - 1. At this point the next increment will wrap its value to zero and continue counting from zero. A running counter counts independently of the export of its value.

3.2.3 deltaCounter

An integral value reporting the value of a counter. Basically the same semantics as counters in SNMP. Counters are unsigned and wrap back to zero after reaching the limit of the type. For example, an unsigned64 with counter semantics will continue to increment until reaching the value of 2**64 - 1. At this point the next increment will wrap its value to zero and continue counting from zero. A delta counter is reset to zero each time its value is exported.

3.2.4 identifier

An integral value which serves as an identifier. Specifically mathematical operations on two identifiers (aside from the equality operation) are meaningless. For example, Autonomous System ID 1 * Autonomous System ID 2 is meaningless.

3.2.5 flags

An integral value which actually represents a set of bit fields. Logical operations are appropriate on such values, but not other mathematical operations. Flags should always be of an unsigned type.

4. Information Element Identifiers

All Information Elements defined in section 5 of this document or in future extensions of the IPFIX information model have their identifiers assigned by IANA. Their identifiers can be retrieved at http://www.iana.org/assignments/ipfix-element-numbers.

EDITORIAL NOTE: this URL needs probably to be updated after IANA created a URL for IPFIX Information Elements

The value of these identifiers are in the range of 1 - 32767. Within this range, Information Element identifier values in the sub-range of 1-127 are compatible with field types used by NetFlow version 9 [RFC3954].

Range of IANA-assigned Information Element identifiers	Description
0	Reserved.
1 - 127	Information Element identifiers compatible with NetFlow version 9 field types [RFC3954].
128 - 32767	Further Information Element identifiers.

Enterprise-specific Information Element identifiers have the same range of 1-32767, but they are coupled with an additional enterprise identifier.

Enterprise-specific identifiers can be chosen by an enterprise arbitrarily within the range of 1-32767. The same identifier may be assigned by other enterprises for different purposes.

Still, Collecting Processes can distinguish these Information Elements because the Information Element identifier is coupled with an enterprise identifier.

Enterprise identifiers MUST be registered as SMI network management private enterprise code numbers with IANA. The registry can be found at http://www.iana.org/assignments/enterprise-numbers.

The following list gives an overview of the Information Element identifiers that are specified in section 5 and are not compatible with field types used by NetFlow version 9 [RFC3954]

ID	Name	ID	Name
1	octetDeltaCount	43	RESERVED
2	packetDeltaCount	44	sourceIPv4Prefix
3	observedFlowTotalCount	45	destinationIPv4Prefix
4	protocolIdentifier	46	mplsTopLabelType
5	classOfServiceIPv4	47	mplsTopLabelIPv4Address
6	tcpControlBits	48-51	RESERVED
7	sourceTransportPort	52	minimumTtl
8	sourceIPv4Address	53	maximumTtl
9	sourceIPv4Mask	54	identificationIPv4
10	ingressInterface	55	postClassOfServiceIPv4
11	destinationTransportPort	56	sourceMacAddress
12	destinationIPv4Address	57	postDestinationMacAddr
13	destinationIPv4Mask	58	vlanID
14	egressInterface	59	postVlanId
15	ipNextHopIPv4Address	60	ipVersion
16	bgpSourceAsNumber	61	RESERVED
17	bgpDestinationAsNumber	62	ipNextHopIPv6Address
18	bgpNexthopIPv4Address	63	bgpNexthopIPv6Address
19	postMulticastPacketCount	64	ipv6OptionHeaders
20	postMulticastOctetCount	65-69	RESERVED
21	flowEndSysUpTime	70	mplsLabelStackEntry1
22	flowStartSysUpTime	71	mplsLabelStackEntry2
23	postOctetDeltaCount	72	mplsLabelStackEntry3
24	postPacketDeltaCount	73	mplsLabelStackEntry4
25	minimumPacketLength	74	mplsLabelStackEntry5
26	maximumPacketLength	75	mplsLabelStackEntry6
27	sourceIPv6Address	76	mplsLabelStackEntry7
28	destinationIPv6Address	77	mplsLabelStackEntry8
29	sourceIPv6Mask	78	mplsLabelStackEntry9
30	destinationIPv6Mask	79	mplsLabelStackEntry10
31	flowLabelIPv6	80	destinationMacAddress
32	icmpTypeCodeIPv4	81	postSourceMacAddress
33	igmpType	82-84	RESERVED
34-35	RESERVED	85	octetTotalCount
36	flowActiveTimeOut	86	packetTotalCount
37	flowInactiveTimeout	87	RESERVED
38-39	RESERVED	88	fragmentOffsetIPv4
40	exportedOctetTotalCount	89-127	RESERVED
41	exportedMessageTotalCount		
42	exportedFlowTotalCount		

The following list gives an overview of the Information Element identifiers that are specified in section 5 and extend the list of Information Element identifiers specified already in [RFC3954].

ID	Name	ID	Name
128	bgpNextAdjacentAsNumber	150	flowStartSeconds
129	bgpPrevAdjacentAsNumber	151	flowEndSeconds
130	exporterIPv4Address	152	flowStartMilliSeconds
131	exporterIPv6Address	153	flowEndMilliSeconds
132	droppedOctetDeltaCount	154	flowStartMicroSeconds
133	droppedPacketDeltaCount	155	flowEndMicroSeconds
134	droppedOctetTotalCount	156	flowStartNanoSeconds
135	droppedPacketTotalCount	157	flowEndNanoSeconds
136	flowEndReason	158	flowStartDeltaMicroSeconds
137	classOfServiceIPv6	159	flowEndDeltaMicroSeconds
138	postClassOfServiceIPv6	160	systemInitTimeMilliSeconds
139	icmpTypeCodeIPv6	161	flowDurationMilliSeconds
140	mplsTopLabelIPv6Address	162	flowDurationMicroSeconds
141	lineCardId	163	ignoredPacketTotalCount
142	portId	164	ignoredOctetTotalCount
143	meteringProcessId	165	notSentFLowTotalCount
144	exportingProcessId	166	notSentPacketTotalCount
145	templateId	167	notSentOctetTotalCount
146	wlanChannelId	168	destinationIPv6Prefix
147	wlanSsid	169	sourceIPv6Prefix
148	flowId	170	postOctetTotalCount
149	sourceId	171	postPacketTotalCount
		172	flowKeyIndicator

5. Information Elements

This section describes the flow attributes of the IPFIX information model. The elements are grouped into 9 groups according to their semantics and their applicability:

1. Identifiers
2. Metering and Exporting Process Properties
3. IP Header Fields
4. Transport Header Fields
5. Sub-IP Header Fields
6. Derived Packet Properties
7. Min/Max Flow Properties
8. Flow Time Stamps
9. Per-Flow Counters
10. Miscellaneous Flow Properties

The Information Elements that are derived from fields of packets or from packet treatment, such as the Information Elements in groups 3.-6., can serve as Flow Keys used for mapping packets to flows. But they also may contain values that are not constant for a single flow. For example a flow using a certain source IPv4 address as flow key has sourceIPv4Address as constant property but may have destinationIPv4Address as a property that changes from packet to packet.

For such Information Elements that are derived from fields of packets or from packet treatment, the IPFIX information model makes the general assumption that their value is determined by the first packet observed for the corresponding Flow, unless the description of the Information Element explicitly specifies a different semantics. This simple rule allows writing all Information Elements related to header fields once when the first packet of the flow is observed. For further observed packets of the same flow, only flow properties that depend on more than one packet, such as the Information Elements in groups 7.-9., need to be updated.

5.1 Identifiers

Information Elements grouped in the table below are identifying components of the IPFIX architecture, of an IPFIX device, or of the IPFIX protocol. All of them have an integral data type and data type semantics "identifier" as described in section 3.2.4.

Typically, some of them are used for limiting scopes of other Information Elements. However, also other Information Elements MAY be used for limiting scopes. Note also that all Information Elements listed below MAY be used for other purposes than limiting scopes.

ID	Name	ID	Name
141	lineCardId	143	meteringProcessId
142	portId	144	exportingProcessId
10	ingressInterface	148	flowId
14	egressInterface	145	templateId
		149	sourceId

5.1.1 lineCardId

Description:
A locally unique identifier of a line card at an IPFIX Device hosting an Observation Point. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 141
Status: current

5.1.2 portId

Description:
A locally unique identifier of a line port at an IPFIX Device hosting an Observation Point. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 142
Status: current

5.1.3 ingressInterface

Description:
The index of the IP interface (ifIndex) where packets of this Flow are being received.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 10
Status: current
Reference: See RFC 2863 for the definition of the ifIndex object.

5.1.4 egressInterface

Description:
The index of the IP interface (ifIndex) where packets of this Flow are being sent.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 14
Status: current
Reference: See RFC 2863 for the definition of the ifIndex object.

5.1.5 meteringProcessId

Description:
A locally unique identifier of a Metering Process at an IPFIX Device. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 143
Status: current

5.1.6 exportingProcessId

Description:
A locally unique identifier of an Exporting Process at an IPFIX Device. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 144
Status: current

5.1.7 flowId

Description:
An identifier of a Flow that is locally unique to an Exporting Process. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 148
Status: current

5.1.8 templateId

Description:

An identifier of a Template that is locally unique to an Exporting Process. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 145
Status: current

5.1.9 sourceId

Description:
An identifier of an Observation Domain that is locally unique to an Exporting Process. Typically, this Information Element is used for limiting the scope of other Information Elements.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 149
Status: current

5.2 Metering and Exporting Process Properties

Information Elements in this section describe static and dynamic properties of the Metering Process and/or the Exporting Process. The set of these Information Elements is listed in the table below

ID	Name	ID	Name
130	exporterIPv4Address	163	ignoredPacketTotalCount
131	exporterIPv6Address	164	ignoredOctetTotalCount
41	exportedMessageTotalCount	165	notSentFLowTotalCount
40	exportedOctetTotalCount	166	notSentPacketTotalCount
42	exportedFlowTotalCount	167	notSentOctetTotalCount
3	observedFlowTotalCount	172	flowKeyIndicator

5.2.1 exporterIPv4Address

Description:
The IPv4 address used by the Exporting Process. This is used by the Collector to identify the Exporter in cases where the identity of the Exporter may have been obscured by the use of a proxy.
Abstract Data Type: ipv4Address
Data Type Semantics: identifier

ElementId: 130
Status: current

5.2.2 exporterIPv6Address

Description:
The IPv6 address used by the Exporting Process. This is used by the Collector to identify the Exporter in cases where the identity of the Exporter may have been obscured by the use of a proxy.
Abstract Data Type: ipv6Address
Data Type Semantics: identifier
ElementId: 131
Status: current

5.2.3 exportedMessageTotalCount

Description:
The total number of IPFIX Messages that the Exporting Process successfully sent since the Exporting Process (re-)initialization to the Collecting Process receiving a report that contains this Information Element.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 41
Status: current
Units: messages

5.2.4 exportedOctetTotalCount

Description:
The total number of octets that the Exporting Process successfully sent since the Exporting Process (re-)initialization to the Collecting Process receiving a report that contains this Information Element. The value of this Information Element is calculated by summing up the IPFIX Message header length values of all IPFIX messages that were successfully sent to the Collecting Process receiving a report that contains this Information Element.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 40
Status: current
Units: octets

5.2.5 exportedFlowTotalCount

Description:
The total number of Flows Records reported that the Exporting Process successfully sent as Data Records since the Exporting Process (re-)initialization to the Collecting Process receiving a report that contains this Information Element.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 42
Status: current
Units: Flows

5.2.6 observedFlowTotalCount

Description:
The total number of Flows observed in the Observation Domain since the Metering Process (re-)initialization for this Observation Point.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 3
Status: current
Units: Flows

5.2.7 ignoredPacketTotalCount

Description:
The total number of observed IP packets that the Metering Process did not process.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 163
Status: current
Units: packets

5.2.8 ignoredOctetTotalCount

Description:
The total number of octets in observed IP packets that the Metering Process did not process.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 164
Status: current
Units: octets

5.2.9 notSentFlowTotalCount

Description:
The total number of Flow Records that were generated by the Metering Process and but dropped by the Metering Process or by the Exporting Process instead of sending it to the Collecting Process. There are several potential reasons for this including resource shortage and special Flow export policies.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 165
Status: current
Units: Flows

5.2.10 notSentPacketTotalCount

Description:
The total number of packets in Flow Records that were generated by the Metering Process and but dropped by the Metering Process or by the Exporting Process instead of sending it to the Collecting Process. There are several potential reasons for this including resource shortage and special flow export policies.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 166
Status: current
Units: packets

5.2.11 notSentOctetTotalCount

Description:
The total number of octets in packets in Flow Records that were generated by the Metering Process and but dropped by the Metering Process or by the Exporting Process instead of sending it to the Collecting Process. There are several potential reasons for this including resource shortage and special Flow export policies.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 167
Status: current
Units: octets

5.2.12 flowKeyIndicator

Description:
This set of bit fields is used for marking the Information Elements of a Data Record that serve as Flow Key. Each bit represents an Information Element in the Data Record with the n-th bit representing the n-th Information Element. A set bit with value 1 indicates that the corresponding Information element is a

Flow Key of the reported Flow. A value of 0 indicates that this is not the case. If the Data Record contains more than 64 Information Elements, the corresponding Template SHOULD be designed such that all Flow Keys are among the first 64 Information Elements, because the flowKeyIndicator only contains 64 bits. If the Data Record contains less than 64 Information Elements, then the bits in the flowKeyIndicator for which no corresponding Information Element exists SHOULD have the value 0.

Abstract Data Type: unsigned64
Data Type Semantics: flags
ElementId: 172
Status: current

5.3 IP Header Fields

Information Elements in this section indicate values of IP header fields or are derived from IP header field values in combination with further information.

ID	Name	ID	Name
60	ipVersion	45	destinationIPv4Prefix
8	sourceIPv4Address	168	destinationIPv6Prefix
27	sourceIPv6Address	5	classOfServiceIPv4
9	sourceIPv4Mask	137	classOfServiceIPv6
29	sourceIPv6Mask	55	postClassOfServiceIPv4
44	sourceIPv4Prefix	138	postClassOfServiceIPv6
169	sourceIPv6Prefix	31	flowLabelIPv6
12	destinationIPv4Address	54	identificationIPv4
28	destinationIPv6Address	4	protocolIdentifier
13	destinationIPv4Mask	88	fragmentOffsetIPv4
30	destinationIPv6Mask		

5.3.1 ipVersion

Description: The IP version field in the IP packet header.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 60
Status: current
Reference:
See RFC 791 for a definition of the version field in the IPv4 packet header. See RFC 2460 for a definition of the version field in the IPv6 packet header. Additional information on defined version numbers can be found at

http://www.iana.org/assignments/version-numbers.

5.3.2 sourceIPv4Address

Description:
The IPv4 source address in the IP packet header.
Abstract Data Type: ipv4Address
Data Type Semantics: identifier
ElementId: 8
Status: current
Reference: See RFC 791 for the definition of the IPv4 source address field.

5.3.3 sourceIPv6Address

Description:
The IPv6 source address in the IP packet header.
Abstract Data Type: ipv6Address
Data Type Semantics: identifier
ElementId: 27
Status: current

5.3.4 sourceIPv4Mask

Description:
The number of contiguous bits that are relevant in the sourceIPv4Prefix Information Element.
Abstract Data Type: octet
ElementId: 9
Status: current
Units: bits
Range: The valid range is 0-32.

5.3.5 sourceIPv6Mask

Description:
The number of contiguous bits that are relevant in the sourceIPv6Prefix Information Element.
Abstract Data Type: octet
ElementId: 29
Status: current
Units: bits
Range: The valid range is 0-128.

5.3.6 sourceIPv4Prefix

Description:
IPv4 source address prefix.
Abstract Data Type: ipv4Address
ElementId: 44
Status: current

5.3.7 sourceIPv6Prefix

Description:
IPv6 source address prefix.
Abstract Data Type: ipv4Address
ElementId: 169
Status: current

5.3.8 destinationIPv4Address

Description:
The IPv4 destination address in the IP packet header.
Abstract Data Type: ipv4Address
Data Type Semantics: identifier
ElementId: 12
Status: current
Reference: See RFC 791 for the definition of the IPv4 destination address field.

5.3.9 destinationIPv6Address

Description:
The IPv6 destination address in the IP packet header.
Abstract Data Type: ipv6Address
Data Type Semantics: identifier
ElementId: 28
Status: current

5.3.10 destinationIPv4Mask

Description:
The number of contiguous bits that are relevant in the destinationIPv4Prefix Information Element.
Abstract Data Type: octet
ElementId: 13
Status: current
Units: bits
Range: The valid range is 0-32.

5.3.11 destinationIPv6Mask

Description:
The number of contiguous bits that are relevant in the destinationIPv6Prefix Information Element.
Abstract Data Type: octet
ElementId: 30
Status: current
Units: bits
Range: The valid range is 0-128.

5.3.12 destinationIPv4Prefix

Description:
IPv4 destination address prefix.
Abstract Data Type: ipv4Address
ElementId: 45
Status: current

5.3.13 destinationIPv6Prefix

Description:
IPv6 destination address prefix.
Abstract Data Type: ipv4Address
ElementId: 168
Status: current

5.3.14 classOfServiceIPv4

Description:
The value of the IPv4 TOS field in the IP packet header.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 5
Status: current
Reference: See RFC 791 for the definition of the IPv4 TOS field.

5.3.15 classOfServiceIPv6

Description:
The value of the IPv6 traffic class field in the IP packet header.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 137
Status: current
Reference: See RFC 2460 for the definition of the IPv6 traffic class field.

5.3.16 postClassOfServiceIPv4

Description:
The value of the IPv4 TOS field in the IP packet header after packet treatment by a middlebox function.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 55
Status: current
Reference: See RFC 791 for the definition of the IPv4 TOS field. See RFC 3234 for the definition of middleboxes.

5.3.17 postClassOfServiceIPv6

Description:
The value of the IPv6 traffic class field in the IP packet header after packet treatment by a middlebox function.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 138
Status: current
Reference: See RFC 2460 for the definition of the IPv6 traffic class field.

5.3.18 flowLabelIPv6

Description:
The value of the IPv6 Flow Label field in the IP packet header.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 31
Status: current
Reference: See RFC 2460 for a definition of the flow label field in the IPv6 packet header.

5.3.19 identificationIPv4

Description:
The value of the IPv4 packet identification field in the IP packet header.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 54
Status: current
Reference: See RFC 791 for the definition of the IPv4 identification field.

5.3.20 protocolIdentifier

Description:
The value of the protocol number in the IP packet header. The protocol number identifies the IP packet payload type. Protocol numbers are defined in the IANA Protocol Numbers registry. In Internet Protocol version 4 (IPv4) this is carried in the "Protocol" field. In Internet Protocol version 6 (IPv6) this is carried in the "Next Header" field in the last extension header of the packet.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 4
Status: current
Reference:
See RFC 791 for the specification of the IPv4 protocol field. See RFC 2460 for the specification of the IPv6 protocol field. See list of protocol numbers assigned by IANA at http://www.iana.org/assignments/protocol-numbers.

5.3.21 fragmentOffsetIPv4

Description:
The value of the IPv4 fragment offset field in the IP packet header.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 88
Status: current
Reference:
See RFC 791 for the specification of the IPv4 fragment offset.

5.4 Transport Header Fields

The set of Information Elements related to transport header fields includes the Information Elements listed in the table below.

ID	Name	ID	Name
7	sourceTransportPort	32	icmpTypeCodeIPv4
11	destinationTransportPort	139	icmpTypeCodeIPv6
		33	igmpType

5.4.1 sourceTransportPort

Description:
The source port identifier in the transport header. For the transport protocols UDP, TCP and SCTP this is the source port number given in the respective header. This field MAY also be used for future transport protocols that have 16 bit source port identifiers.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 7
Status: current
Reference:
See RFC 768 for the definition of the UDP source port field. See RFC 793 for the definition of the TCP source port field. See RFC 2960 for the definition of SCTP.
Additional information on defined UDP and TCP port numbers can be found at http://www.iana.org/assignments/port-numbers.

5.4.2 destinationTransportPort

Description:
The destination port identifier in the transport header. For the transport protocols UDP, TCP and SCTP this is the destination port number given in the respective header. This field MAY also be used for future transport protocols that have 16 bit destination port identifiers.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 11
Status: current
Reference:
See RFC 768 for the definition of the UDP source port field. See RFC 793 for the definition of the TCP source port field. See RFC 2960 for the definition of SCTP.
Additional information on defined UDP and TCP port numbers can be found at http://www.iana.org/assignments/port-numbers.

5.4.3 icmpTypeCodeIPv4

Description:
Type and Code of the IPv4 ICMP message. The combination of both values is reported as (ICMP type * 256) + ICMP code.
Abstract Data Type: unsigned16
Data Type Semantics: identifier

ElementId: 32
Status: current
Reference: See RFC 792 for a definition of the IPv4 ICMP type and code fields.

5.4.4 icmpTypeCodeIPv6

Description:
Type and Code of the IPv6 ICMP message. The combination of both values is reported as (ICMP type * 256) + ICMP code.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 139
Status: current
Reference: See RFC 2463 for a definition of the IPv6 ICMP type and code fields.

5.4.5 igmpType

Description: The type field of the IGMP message.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 33
Status: current
Reference: See RFC 2236 for a definition of the IGMP type field.

5.5 Sub-IP Header Fields

The set of Information Elements related to Sub-IP header fields includes the Information Elements listed in the table below.

ID	Name	ID	Name
56	sourceMacAddress	70	mplsLabelStackEntry1
57	postDestinationMacAddr	71	mplsLabelStackEntry2
58	vlanId	72	mplsLabelStackEntry3
59	postVlanId	73	mplsLabelStackEntry4
80	destinationMacAddress	74	mplsLabelStackEntry5
81	postSourceMacAddress	75	mplsLabelStackEntry6
146	wlanChannelId	76	mplsLabelStackEntry7
147	wlanSsid	77	mplsLabelStackEntry8
		78	mplsLabelStackEntry9
		79	mplsLabelStackEntry10

5.5.1 sourceMacAddress

Description:
The IEEE 802 source MAC address field.
Abstract Data Type: macAddress
Data Type Semantics: identifier
ElementId: 56
Status: current
Reference: See IEEE.802-3.2002.

5.5.2 postDestinationMacAddr

Description:
The IEEE 802 destination MAC address field after processing by a middlebox function.
Abstract Data Type: macAddress
Data Type Semantics: identifier
ElementId: 57
Status: current
Reference: See IEEE.802-3.2002.

5.5.3 vlanId

Description:
The IEEE 802.1Q VLAN identifier (VID) extracted from the Tag Control Information field that was attached to the IP packet.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 58
Status: current
Reference: See IEEE.802-1Q.2003.

5.5.4 postVlanId

Description:
The IEEE 802.1Q VLAN identifier (VID) extracted from the Tag Control Information field that was attached to the IP packet after processing by a middlebox function.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 59
Status: current
Reference: See IEEE.802-1Q.2003.

5.5.5 destinationMacAddress

Description:
The IEEE 802 destination MAC address field.
Abstract Data Type: macAddress
Data Type Semantics: identifier
ElementId: 80
Status: current
Reference: See IEEE.802-3.2002.

5.5.6 postSourceMacAddress

Description:
The IEEE 802 source MAC address field. after processing by a middlebox function.
Abstract Data Type: macAddress
Data Type Semantics: identifier
ElementId: 81
Status: current
Reference: See IEEE.802-3.2002.

5.5.7 wlanChannelId

Description:
The identifier of the 802.11 (WiFi) channel used.
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 146
Status: current
Reference: See IEEE.802-11.1999.

5.5.8 wlanSsid

Description:
The Service Set IDentifier (SSID) identifying an 802.11 (Wi-Fi) network used. According to IEEE.802-11.1999 the SSID is encoded into a string of up to 32 characters.
Abstract Data Type: string
ElementId: 147
Status: current
Reference: See IEEE.802-11.1999.

5.5.9 mplsLabelStackEntry1

Description:
The label, exp and s fields from the outermost MPLS label stack entry, i.e. the last label that was pushed.

```
 0                   1                   2
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
```

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                Label                  | Exp |S|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

Label:  Label Value, 20 bits
Exp:    Experimental Use, 3 bits
S:      Bottom of Stack, 1 bit
```

Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 70
Status: current
Reference: See RFC 3032.

5.5.10 mplsLabelStackEntry2

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry1. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 71
Status: current
Reference: See RFC 3032.

5.5.11 mplsLabelStackEntry3

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry2. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 72
Status: current
Reference: See RFC 3032.

5.5.12 mplsLabelStackEntry4

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry3. See the definition of mplsLabelStackEntry1 for further details.

Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 73
Status: current
Reference: See RFC 3032.

5.5.13 mplsLabelStackEntry5

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry4. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 74
Status: current
Reference: See RFC 3032.

5.5.14 mplsLabelStackEntry6

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry5. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 75
Status: current
Reference: See RFC 3032.

5.5.15 mplsLabelStackEntry7

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry6. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 76
Status: current
Reference: See RFC 3032.

5.5.16 mplsLabelStackEntry8

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry7. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 77
Status: current
Reference: See RFC 3032.

5.5.17 mplsLabelStackEntry9

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry8. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 78
Status: current
Reference: See RFC 3032.

5.5.18 mplsLabelStackEntry10

Description:
The label, exp, and s fields from the label stack entry that was pushed immediately before the label stack entry that would be reported by mplsLabelStackEntry9. See the definition of mplsLabelStackEntry1 for further details.
Abstract Data Type: unsigned32
Data Type Semantics: identifier
ElementId: 79
Status: current
Reference: See RFC 3032.

5.6 Derived Packet Properties

The set of Information Elements derived from values of header fields and further information includes the Information Elements listed in the table below.

ID	Name	ID	Name
15	ipNextHopIPv4Address	18	bgpNextHopIPv4Address
62	ipNextHopIPv6Address	63	bgpNextHopIPv6Address
16	bgpSourceAsNumber	46	mplsTopLabelType
17	bgpDestinationAsNumber	47	mplsTopLabelIPv4Address
128	bgpNextAdjacentAsNumber	140	mplsTopLabelIPv6Address
129	bgpPrevAdjacentAsNumber		

5.6.1 ipNextHopIPv4Address

Description:
The IPv4 address of the next IPv4 hop.
Abstract Data Type: ipv4Address
Data Type Semantics: identifier
ElementId: 15
Status: current

5.6.2 ipNextHopIPv6Address

Description:
The IPv6 address of the next IPv6 hop.
Abstract Data Type: ipv6Address
Data Type Semantics: identifier
ElementId: 62
Status: current

5.6.3 bgpSourceAsNumber

Description:
The autonomous system (AS) number of the source IP address. If AS path information for this Flow is only available as unordered AS set (and not as ordered AS sequence), then the value of this Information Element is 0.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 16
Status: current
Reference: See RFC 1771 for a description of BGP-4 and see RFC 1930 for a definition of the AS number.

5.6.4 bgpDestinationAsNumber

Description:
The autonomous system (AS) number of the destination IP address. If AS path information for this Flow is only available as unordered AS set (and not as ordered AS sequence), then the value of this Information Element is 0.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 17
Status: current
Reference: See RFC 1771 for a description of BGP-4 and see RFC 1930 for a definition of the AS number.

5.6.5 bgpNextAdjacentAsNumber

Description:
The autonomous system (AS) number of the first AS in the AS path to the destination IP address. The path is deduced by looking up the destination IP address of the Flow in the BGP routing information base. If AS path information for this Flow is only available as unordered AS set (and not as ordered AS sequence), then the value of this Information Element is 0.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 128
Status: current
Reference: See RFC 1771 for a description of BGP-4 and see RFC 1930 for a definition of the AS number.

5.6.6 bgpPrevAdjacentAsNumber

Description:
The autonomous system (AS) number of the last AS in the AS path from the source IP address. The path is deduced by looking up the source IP address of the Flow in the BGP routing information base. If AS path information for this Flow is only available as unordered AS set (and not as ordered AS sequence), then the value of this Information Element is 0. In case of BGP asymmetry, the bgpSrcAdjacentASNumber might not be able to report the correct value.
Abstract Data Type: unsigned16
Data Type Semantics: identifier
ElementId: 129
Status: current
Reference: See RFC 1771 for a description of BGP-4 and see RFC 1930 for a definition of the AS number.

5.6.7 bgpNextHopIPv4Address

Description:
The IPv4 address of the next (adjacent) BGP hop.
Abstract Data Type: ipv4Address
Data Type Semantics: identifier
ElementId: 18
Status: current
Reference: See RFC 1771 for a description of BGP-4 and

5.6.8 bgpNextHopIPv6Address

Description:
The IPv6 address of the next (adjacent) BGP hop.
Abstract Data Type: ipv6Address
Data Type Semantics: identifier
ElementId: 63
Status: current
Reference: See RFC 1771 for a description of BGP-4.

5.6.9 mplsTopLabelType

Description:
This field identifies the control protocol that allocated the top of stack label. Defined values for this field include:

- 0x01 TE-MIDPT: Any TE tunnel mid-point or tail label
- 0x02 Pseudowire: Any PWE3 or Cisco AToM based label
- 0x03 VPN: Any label associated with VPN
- 0x04 BGP: Any label associated with BGP or BGP routing
- 0x05 LDP: Any label associated with dynamically assigned labels using LDP

Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 46
Status: current
Reference: See RFC 3031 for the MPLS label structure. See RFC 2547 for the association of MPLS labels with VPNs. See RFC 1771 for BGP and BGP routing. See RFC 3036 for LDP. and IP addresses.

5.6.10 mplsTopLabelIPv4Address

Description:
The IPv4 address of the system that the MPLS top label will cause this Flow to be forwarded to.

Abstract Data Type: ipv4Address
Data Type Semantics: identifier
ElementId: 47
Status: current
Reference: See RFC 3031 for the association between MPLS labels and IP addresses.

5.6.11 mplsTopLabelIPv6Address

Description:
The IPv6 address of the system that the MPLS top label will cause this Flow to be forwarded to.
Abstract Data Type: ipv6Address
Data Type Semantics: identifier
ElementId: 140
Status: current
Reference: See RFC 3031 for the association between MPLS labels and IP addresses.

5.7 Min/Max Flow Properties

Information Elements in this section are results of minimum or maximum operations over all packets of a flow.

ID	Name	ID	Name
25	minimumPacketLength	64	ipv6OptionHeaders
26	maximumPacketLength	6	tcpControlBits
52	minimumTtl		
53	maximumTtl		

5.7.1 minimumPacketLength

Description:
Length of the smallest packet observed for this Flow.
Abstract Data Type: unsigned16
ElementId: 25
Status: current
Units: octets

5.7.2 maximumPacketLength

Description:
Length of the largest packet observed for this Flow.
Abstract Data Type: unsigned16
ElementId: 26
Status: current
Units: octets

5.7.3 minimumTtl

Description:
Minimum TTL value observed for any packet in this Flow.
Abstract Data Type: octet
ElementId: 52
Status: current

5.7.4 maximumTtl

Description:
Maximum TTL value observed for any packet in this Flow.
Abstract Data Type: octet
ElementId: 53
Status: current

5.7.5 ipv6OptionHeaders

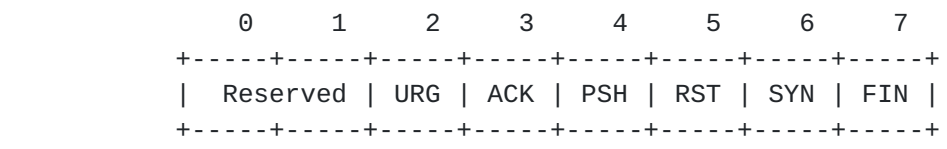
Description:
IPv6 options in the IP packet headers of this Flow. The information is encoded in a set of bit fields. For each IPv6 option header there is a bit in this set. The bit is set if any observed packet of this Flow contains the corresponding IPv6 option header.

bit	IPv6 Option	Definition
0		Reserved
1	44	Fragmentation header - not first fragment
2	43	Routing header
3	44	Fragment header - first fragment
4		Unknown Layer 4 header (compressed, encrypted, not supported)
5		Reserved
6	0	Hop-by-hop option header
7	60	Destination option header
8	108	Payload compression header
9	51	Authentication Header
10	50	Encrypted security payload
11 to 31		Reserved

Abstract Data Type: unsigned32
Data Type Semantics: flags
ElementId: 64
Status: current
Reference: See RFC 2460 for the general definition of IPv6 extensions headers and for the specification of the hop-by-hop options header, the routing header, the fragment header, and the destination options header. See RFC 2402 for the specification of the authentication header. See RFC 2406 for the specification of the encapsulating security payload.

5.7.6 tcpControlBits

Description:
TCP control bits observed for packets of this Flow. The information is encoded in a set of bit fields. For each TCP control bit there is a bit in this set. A bit is set to 1 if any observed packet of this Flow has the corresponding TCP control bit set to 1. A value of 0 for a bit indicates that the corresponding bit was not set in any of the observed packets of this Flow.



Reserved: Reserved for future use by TCP. Must be zero.
URG: Urgent Pointer field significant
ACK: Acknowledgment field significant
PSH: Push Function
RST: Reset the connection
SYN: Synchronize sequence numbers
FIN: No more data from sender

Abstract Data Type: octet
Data Type Semantics: flags
ElementId: 6
Status: current
Reference: See RFC 793 for a definition of the TCP control bits in the TCP header.

5.8 Flow Time Stamps

Information Elements in this section are time stamps of events.

Time stamps flowStartSeconds, flowEndSeconds, flowStartMilliSeconds, flowEndMilliSeconds, flowStartMicroSeconds, flowEndMicroSeconds, flowStartNanoSeconds, flowEndNanoSeconds, and

systemInitTimeMilliSeconds are absolute and have a well defined fixed time base, such as, for example, the number of seconds since 0000 UTC Jan 1st 1970.

Time stamps flowStartDeltaMicroSeconds and flowEndDeltaMicroSeconds are relative time stamps only valid within the scope of a single IPFIX message. They contain the negative time offsets relative to the export time specified in the IPFIX Message header.

Time stamps flowStartSysUpTime and flowEndSysUpTime are relative time stamps indicating the time relative to the last (re-)initialization of the IPFIX device. For reporting the time of the last (re-)initialization, systemInitTimeMilliSeconds can be reported, for example, in Data Records defined by Option Templates.

ID	Name	ID	Name
150	flowStartSeconds	156	flowStartNanoSeconds
151	flowEndSeconds	157	flowEndNanoSeconds
152	flowStartMilliSeconds	158	flowStartDeltaMicroSeconds
153	flowEndMilliSeconds	159	flowEndDeltaMicroSeconds
154	flowStartMicroSeconds	160	systemInitTimeMilliSeconds
155	flowEndMicroSeconds	22	flowStartSysUpTime
		21	flowEndSysUpTime

5.8.1 flowStartSeconds

Description: The absolute timestamp of the first packet of this Flow.
Abstract Data Type: dateTimeSeconds
ElementId: 150
Status: current
Units: seconds

5.8.2 flowEndSeconds

Description: The absolute timestamp of the last packet of this Flow.
Abstract Data Type: dateTimeSeconds
ElementId: 151
Status: current
Units: seconds

5.8.3 flowStartMilliSeconds

Description: The absolute timestamp of the first packet of this Flow.
Abstract Data Type: dateTimeMilliSeconds
ElementId: 152
Status: current
Units: milliseconds

5.8.4 flowEndMilliSeconds

Description: The absolute timestamp of the last packet of this Flow.
Abstract Data Type: dateTimeMilliSeconds
ElementId: 153
Status: current
Units: milliseconds

5.8.5 flowStartMicroSeconds

Description: The absolute timestamp of the first packet of this Flow.
Abstract Data Type: dateTimeMicroSeconds
ElementId: 154
Status: current
Units: microseconds

5.8.6 flowEndMicroSeconds

Description: The absolute timestamp of the last packet of this Flow.
Abstract Data Type: dateTimeMicroSeconds
ElementId: 155
Status: current
Units: microseconds

5.8.7 flowStartNanoSeconds

Description: The absolute timestamp of the first packet of this Flow.
Abstract Data Type: dateTimeNanoSeconds
ElementId: 156
Status: current
Units: nanoseconds

5.8.8 flowEndNanoSeconds

Description: The absolute timestamp of the last packet of this Flow.
Abstract Data Type: dateTimeNanoSeconds
ElementId: 157
Status: current
Units: nanoseconds

5.8.9 flowStartDeltaMicroSeconds

Description: This is a relative time stamp only valid within the scope of a single IPFIX message. It contains the negative time offset of the first observed packet of this Flow relative to the export time specified in the IPFIX Message header.
Abstract Data Type: unsigned32
ElementId: 158
Status: current
Units: microseconds
Reference: See [I-D.ietf-ipfix-protocol] for the definition of the IPFIX Message header.

5.8.10 flowEndDeltaMicroSeconds

Description: This is a relative time stamp only valid within the scope of a single IPFIX message. It contains the negative time offset of the last observed packet of this Flow relative to the export time specified in the IPFIX Message header.
Abstract Data Type: unsigned32
ElementId: 159
Status: current
Units: microseconds
Reference: See [I-D.ietf-ipfix-protocol] for the definition of the IPFIX Message header.

5.8.11 systemInitTimeMilliSeconds

Description: The absolute timestamp of the last (re-)initialization of the IPFIX device.
Abstract Data Type: dateTimeMilliSeconds
ElementId: 160
Status: current
Units: milliseconds

5.8.12 flowStartSysUpTime

Description: The relative timestamp of the first packet of this Flow. It indicates the number of milliseconds since the last (re-)initialization of the IPFIX device (sysUpTime).
Abstract Data Type: unsigned32
ElementId: 22
Status: current
Units: milliseconds

5.8.13 flowEndSysUpTime

Description: The relative timestamp of the last packet of this Flow.
It indicates the number of milliseconds since the last
(re-)initialization of the IPFIX device (sysUpTime).
Abstract Data Type: unsigned32
ElementId: 21
Status: current
Units: milliseconds

5.9 Per-Flow Counters

Information Elements in this section are counters all having integer values. Their values may change for every report they are used in. They cannot serve as part of a flow key used for mapping packets to flows. However, potentially they can be used for selecting exported flows, for example, by only exporting flows with more than a threshold number of observed octets.

There are running counters and delta counters. Delta counters are reset to zero each time their values are exported. Running counters continue counting independently of the Exporting Process.

There are per-flow counters and counters related to the Metering Process and/or the Exporting Process. Per-flow counters are flow properties that potentially change each time a packet belonging to the flow is observed. The set of per-flow counters includes the Information Elements listed in the table below.

ID	Name	ID	Name
1	octetDeltaCount	132	droppedOctetDeltaCount
23	postOctetDeltaCount	133	droppedPacketDeltaCount
85	octetTotalCount	134	droppedOctetTotalCount
170	postOctetTotalCount	135	droppedPacketTotalCount
2	packetDeltaCount	19	postMulticastPacketCount
24	postPacketDeltaCount	20	postMulticastOctetCount
86	packetTotalCount		
161	postPacketTotalCount		

5.9.1 octetDeltaCount

Description:
The number of octets since the previous report (if any) in incoming packets for this Flow at the Observation Point. The number of octets include IP header(s) and IP payload.

Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 1
Status: current
Units: octets

5.9.2 postOctetDeltaCount

Description:
The number of octets since the previous report (if any) in outgoing packets for this Flow at the Observation Point. The number of octets include IP header(s) and IP payload.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 23
Status: current
Units: octets

5.9.3 octetTotalCount

Description:
The total number of octets in incoming packets for this Flow at the Observation Point since the Metering Process (re-)initialization for this Observation Point. The number of octets include IP header(s) and IP payload.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 85
Status: current
Units: octets

5.9.4 postOctetTotalCount

Description:
The total number of octets in outgoing packets for this Flow at the Observation Point since the Metering Process (re-)initialization for this Observation Point. The number of octets include IP header(s) and IP payload.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 170
Status: current
Units: octets

5.9.5 packetDeltaCount

Description:
The number of incoming packets since the previous report (if any) for this Flow at the Observation Point.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 2
Status: current
Units: packets

5.9.6 postPacketDeltaCount

Description:
The number of outgoing packets since the previous report (if any) for this Flow at the Observation Point.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 24
Status: current
Units: packets

5.9.7 packetTotalCount

Description:
The total number of incoming packets for this Flow at the Observation Point since the Metering Process (re-)initialization for this Observation Point.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 86
Status: current
Units: packets

5.9.8 postPacketTotalCount

Description:
The total number of outgoing packets for this Flow at the Observation Point since the Metering Process (re-)initialization for this Observation Point.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 171
Status: current
Units: packets

5.9.9 droppedOctetDeltaCount

Description:
The number of octets since the previous report (if any) in packets of this Flow dropped by packet treatment. The number of octets include IP header(s) and IP payload.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 132
Status: current
Units: octets

5.9.10 droppedPacketDeltaCount

Description:
The number of packets since the previous report (if any) of this Flow dropped by packet treatment.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 133
Status: current
Units: packets

5.9.11 droppedOctetTotalCount

Description:
The total number of octets in packets of this Flow dropped by packet treatment since the Metering Process (re-)initialization for this Observation Point. The number of octets include IP header(s) and IP payload.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 134
Status: current
Units: octets

5.9.12 droppedPacketTotalCount

Description:
The number of packets of this Flow dropped by packet treatment since the Metering Process (re-)initialization for this Observation Point.
Abstract Data Type: unsigned64
Data Type Semantics: totalCounter
ElementId: 135
Status: current
Units: packets

5.9.13 postMulticastPacketCount

Description:
The number of outgoing multicast packets since the previous report (if any) created for packets of this Flow by an adjacent multicast daemon. Note that typically not all of the created packets can be observed at the Observation Point of this Flow.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 19
Status: current
Units: packets

5.9.14 postMulticastOctetCount

Description:
The number of octets since the previous report (if any) in outgoing multicast packets created for packets of this Flow by an adjacent multicast daemon. Note that typically not all of the created packets can be observed at the Observation Point of this Flow. The number of octets include IP header(s) and IP payload.
Abstract Data Type: unsigned64
Data Type Semantics: deltaCounter
ElementId: 20
Status: current
Units: octets

5.10 Miscellaneous Flow Properties

ID	Name	ID	Name
36	flowActiveTimeOut	161	flowDurationMilliSeconds
37	flowInactiveTimeout	162	flowDurationMicroSeconds
136	flowEndReason		

5.10.1 flowActiveTimeOut

Description:
The number of seconds after which an active Flow is timed out anyway, even if there is still a continuous flow of packets.
Abstract Data Type: unsigned16
ElementId: 36

Status: current
Units: seconds

5.10.2 flowInactiveTimeout

Description:
A Flow is considered to be timed out if no packets belonging to the Flow have been observed for the number of seconds specified by this field.
Abstract Data Type: unsigned16
ElementId: 37
Status: current
Units: seconds

5.10.3 flowEndReason

Description:
The reason for flow termination. The range of values includes
Abstract Data Type: octet
Data Type Semantics: identifier
ElementId: 136
Status: current

5.10.4 flowDurationMilliSeconds

Description: The difference between in time between the observation of the first packet of this Flow and the observation of the last packet of this Flow.
Abstract Data Type: unsigned32
ElementId: 161
Status: current
Units: milliseconds

5.10.5 flowDurationMicroSeconds

Description: The difference between in time between the observation of the first packet of this Flow and the observation of the last packet of this Flow.
Abstract Data Type: unsigned32
ElementId: 162
Status: current
Units: microseconds

6. Extending the Information Model

A key requirement for IPFIX is to allow for extending the set of Information Elements which are reported. This section defines the mechanism for extending this set.

Extension is done by defining new Information Elements. Each new information item MUST be assigned a unique Information Element identifier as part of its definition. These unique Information Element identifiers are the connection between the record structure communicated by the protocol using templates and a consuming application. For generally applicable Information Elements using IETF and IANA mechanisms for extending the information model is recommended.

Names of new Information Elements SHOULD be chosen according to the naming conventions given in section 2.3.

For extensions, the type space defined in section 3 can be used. If required, new data types can be added. New data types SHOULD be defined in IETF standards track documents.

Enterprises may wish to define Information Elements without registering them with IANA. IPFIX explicitly supports enterprise-specific Information Elements. Enterprise-specific Information Elements as described in sections 2.1 and 4.

However, before creating enterprise-specific Information Elements, the general applicability of such Information Elements should be considered. IPFIX does not support enterprise-specific data types.

7. IANA Considerations

IANA has to create a new registry for IPFIX Information Element identifiers. Names of new Information Elements MUST follow the naming conventions specified in section 2.3.

Appendix B defines an XML schema which may be used to create consistent machine readable extensions to the IPFIX information model. This schema introduces a new namespace, which will be assigned by IANA according to RFC 3688. Currently the name space for this schema is identified as http://www.ietf.org/ipfix.

8. Security Considerations

The IPFIX information model itself does not directly introduce security issues. Rather it defines a set of attributes which may for privacy or business issues be considered sensitive information.

The underlying protocol used to exchange the information described here must therefore apply appropriate procedures to guarantee the integrity and confidentiality of the exported information. Such protocols are defined in separate documents, specifically the IPFIX protocol document [I-D.ietf-ipfix-protocol].

9. Acknowledgements

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10. Open Issues

- Is the prefix "post" appropriate for packets leaving the observation domain? What about packets generated in the observation domain?
- octet count including MPLS header: Does the octet count concern IP packets only or also sub-IP layers such as MPLS?

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Appendix A. Formal Specification of IPFIX Information Element

This appendix contains a formal description of the IPFIX information model XML document. Note that this appendix is of informational nature, while the text in section 4 generated from this appendix is normative.

Using a formal and machine readable syntax for the Information model enables the creation of IPFIX aware tools which can automatically adapt to extensions to the information model, by simply reading updated information model specifications.

The wide availability of XML aware tools and libraries for client devices is a primary consideration for this choice. In particular libraries for parsing XML documents are readily available. Also mechanisms such as the Extensible Stylesheet Language (XSL) allow for transforming a source XML document into other documents. This draft was authored in XML and transformed according to RFC2629.

It should be noted that the use of XML in Exporters, Collectors or other tools is not mandatory for the deployment of IPFIX. In particular Exporting Processes do not produce or consume XML as part of their operation. It is expected that IPFIX Collectors MAY take advantage of the machine readability of the Information Model vs. hard coding their behavior or inventing proprietary means for accommodating extensions.

```
<fieldDefinitions>

  <field name="ipVersion" dataType="octet"
         group="IpHeader"
         dataTypeSemantics="identifier"
         fieldId="60" applicability="all" status="current">
    <description>
      The IP version field in the IP packet header.
    </description>
    <reference>
      <paragraph>
      See RFC 791 for a definition of the version field in the
      IPv4 packet header.
      See RFC 2460 for a definition of the version field in the
      IPv6 packet header.
      Additional information on defined version numbers
      can be found at
      http://www.iana.org/assignments/version-numbers.
      </paragraph>
```

```
      </reference>
    </field>

    <field name="sourceIPv4Address" dataType="ipv4Address"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="8" applicability="all" status="current">
      <description>
        <paragraph>
        The IPv4 source address in the IP packet header.
        </paragraph>
      </description>
      <reference>
        See RFC 791 for the definition of the IPv4 source address
        field.
      </reference>
    </field>

    <field name="sourceIPv6Address" dataType="ipv6Address"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="27" applicability="all" status="current">
      <description>
        <paragraph>
        The IPv6 source address in the IP packet header.
        </paragraph>
      </description>
    </field>

    <field name="sourceIPv4Mask" dataType="octet"
           group="IpHeader"
           fieldId="9" applicability="option" status="current">
      <description>
        <paragraph>
        The number of contiguous bits that are relevant in the
        sourceIPv4Prefix Information Element.
        </paragraph>
      </description>
      <units>bits</units>
      <range>0-32</range>
    </field>

    <field name="sourceIPv6Mask" dataType="octet"
           group="IpHeader"
           fieldId="29" applicability="option" status="current">
      <description>
        <paragraph>
        The number of contiguous bits that are relevant in the
```

```
        sourceIPv6Prefix Information Element.
        </paragraph>
      </description>
      <units>bits</units>
      <range>0-128</range>
    </field>

    <field name="sourceIPv4Prefix" dataType="ipv4Address"
           group="IpHeader"
           fieldId="44" applicability="data" status="current">
      <description>
        <paragraph>
        IPv4 source address prefix.
        </paragraph>
      </description>
    </field>

    <field name="sourceIPv6Prefix" dataType="ipv4Address"
           group="IpHeader"
           fieldId="169" applicability="data" status="current">
      <description>
        <paragraph>
        IPv6 source address prefix.
        </paragraph>
      </description>
    </field>

    <field name="destinationIPv4Address" dataType="ipv4Address"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="12" applicability="all" status="current">
      <description>
        <paragraph>
        The IPv4 destination address in the IP packet header.
        </paragraph>
      </description>
      <reference>
        See RFC 791 for the definition of the IPv4 destination address
        field.
      </reference>
    </field>

    <field name="destinationIPv6Address" dataType="ipv6Address"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="28" applicability="all" status="current">
      <description>
        <paragraph>
```

```
        The IPv6 destination address in the IP packet header.
        </paragraph>
      </description>
    </field>

    <field name="destinationIPv4Mask" dataType="octet"
           group="IpHeader"
           fieldId="13" applicability="option" status="current">
      <description>
        <paragraph>
        The number of contiguous bits that are relevant in the
        destinationIPv4Prefix Information Element.
        </paragraph>
      </description>
      <units>bits</units>
      <range>0-32</range>
    </field>

    <field name="destinationIPv6Mask" dataType="octet"
           group="IpHeader"
           fieldId="30" applicability="option" status="current">
      <description>
        <paragraph>
        The number of contiguous bits that are relevant in the
        destinationIPv6Prefix Information Element.
        </paragraph>
      </description>
      <units>bits</units>
      <range>0-128</range>
    </field>

    <field name="destinationIPv4Prefix" dataType="ipv4Address"
           group="IpHeader"
           fieldId="45" applicability="data" status="current">
      <description>
        <paragraph> IPv4 destination address prefix. </paragraph>
      </description>
    </field>

    <field name="destinationIPv6Prefix" dataType="ipv4Address"
           group="IpHeader"
           fieldId="168" applicability="data" status="current">
      <description>
        <paragraph> IPv6 destination address prefix. </paragraph>
      </description>
    </field>

    <field name="classOfServiceIPv4" dataType="octet"
```

```
            group="IpHeader"
            dataTypeSemantics="identifier"
            fieldId="5" applicability="all" status="current">
      <description>
        <paragraph>
        The value of the IPv4 TOS field in the IP packet header.
        </paragraph>
      </description>
      <reference>
        See RFC 791 for the definition of the IPv4 TOS field.
      </reference>
    </field>

    <field name="classOfServiceIPv6" dataType="octet"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="137" applicability="data" status="current">
      <description>
        <paragraph>
        The value of the IPv6 traffic class field in the IP packet header.
        </paragraph>
      </description>
      <reference>
        See RFC 2460 for the definition of the IPv6 traffic class
        field.
      </reference>
    </field>

    <field name="postClassOfServiceIPv4" dataType="octet"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="55" applicability="all" status="current">
      <description>
        <paragraph>
        The value of the IPv4 TOS field in the IP packet header
        after packet treatment by a middlebox function.
        </paragraph>
      </description>
      <reference>
        See RFC 791 for the definition of the IPv4 TOS field.
        See RFC 3234 for the definition of middleboxes.
      </reference>
    </field>

    <field name="postClassOfServiceIPv6" dataType="octet"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="138" applicability="data" status="current">
```

```
      <description>
        <paragraph>
        The value of the IPv6 traffic class field in the IP packet
        header after packet treatment by a middlebox function.
        </paragraph>
      </description>
      <reference>
        See RFC 2460 for the definition of the IPv6 traffic class
        field.
      </reference>
    </field>

    <field name="flowLabelIPv6" dataType="unsigned32"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="31" applicability="all" status="current">
      <description>
        <paragraph>
        The value of the IPv6 Flow Label field in the IP packet header.
        </paragraph>
      </description>
      <reference>
        See RFC 2460 for a definition of the flow label field in the
        IPv6 packet header.
      </reference>
    </field>

    <field name="identificationIPv4" dataType="unsigned16"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="54" applicability="data" status="current">
      <description>
        <paragraph>
        The value of the IPv4 packet identification field
        in the IP packet header.
        </paragraph>
      </description>
      <reference>
        See RFC 791 for the definition of the IPv4 identification
        field.
      </reference>
    </field>

    <field name="protocolIdentifier" dataType="octet"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="4" applicability="all" status="current">
      <description>
```

```
        <paragraph>
        The value of the protocol number in the IP packet header.
        The protocol number identifies the IP packet payload type.
        Protocol numbers are defined in the IANA Protocol Numbers
        registry.</paragraph>

        <paragraph>
        In Internet Protocol version 4 (IPv4) this is carried in the
        "Protocol" field. In Internet Protocol version 6 (IPv6) this
        is carried in the "Next Header" field in the last extension
        header of the packet.</paragraph>
      </description>
      <reference>
        <paragraph>
        See RFC 791 for the specification of the IPv4 protocol field.
        See RFC 2460 for the specification of the IPv6 protocol field.
        See list of protocol numbers assigned by IANA at
        http://www.iana.org/assignments/protocol-numbers.
        </paragraph>
      </reference>
    </field>

      <field name="fragmentOffsetIPv4" dataType="unsigned16"
           group="IpHeader"
           dataTypeSemantics="identifier"
           fieldId="88" applicability="all" status="current">
      <description>
        <paragraph>
        The value of the IPv4 fragment offset field
        in the IP packet header.
        </paragraph>
      </description>
      <reference>
        <paragraph>
        See RFC 791 for the specification of the IPv4 fragment offset.
        </paragraph>
      </reference>
    </field>

    <field name="sourceTransportPort" dataType="unsigned16"
           group="transportHeader"
           dataTypeSemantics="identifier"
           fieldId="7" applicability="all" status="current">
      <description>
        <paragraph>
        The source port identifier in the transport header.
        For the transport
        protocols UDP, TCP and SCTP this is the source port number
```

```
      given in the respective header.  This field MAY also be used
      for future transport protocols that have 16 bit source port
      identifiers.
      </paragraph>
    </description>
    <reference>
      <paragraph>
      See RFC 768 for the definition of the UDP source port field.
      See RFC 793 for the definition of the TCP source port field.
      See RFC 2960 for the definition of SCTP.</paragraph>
      <paragraph>
      Additional information on defined UDP and TCP port numbers can
      be found at http://www.iana.org/assignments/port-numbers.
      </paragraph>
    </reference>
  </field>

  <field name="destinationTransportPort" dataType="unsigned16"
         group="transportHeader"
         dataTypeSemantics="identifier"
         fieldId="11" applicability="all" status="current">
    <description>
      <paragraph>
      The destination port identifier in the transport header.
      For the transport protocols UDP, TCP and SCTP this is the
      destination port number given in the respective header.
      This field MAY also be used for future transport protocols
      that have 16 bit destination port identifiers.
      </paragraph>
    </description>
    <reference>
      <paragraph>
      See RFC 768 for the definition of the UDP source port field.
      See RFC 793 for the definition of the TCP source port field.
      See RFC 2960 for the definition of SCTP.  </paragraph>

      <paragraph>
      Additional information on defined UDP and TCP port numbers can
      be found at http://www.iana.org/assignments/port-numbers.
      </paragraph>
    </reference>
  </field>

  <field name="icmpTypeCodeIPv4" dataType="unsigned16"
         group="transportHeader"
         dataTypeSemantics="identifier"
         fieldId="32" applicability="all" status="current">
    <description>
```

```
      <paragraph>
      Type and Code of the IPv4 ICMP message. The combination of
      both values is reported as (ICMP type * 256) + ICMP code.
      </paragraph>
    </description>
    <reference>
      See RFC 792 for a definition of the IPv4 ICMP type and code
      fields.
    </reference>
  </field>

  <field name="icmpTypeCodeIPv6" dataType="unsigned16"
         group="transportHeader"
         dataTypeSemantics="identifier"
         fieldId="139" applicability="all" status="current">
    <description>
      <paragraph>
      Type and Code of the IPv6 ICMP message. The combination of
      both values is reported as (ICMP type * 256) + ICMP code.
      </paragraph>
    </description>
    <reference>
      See RFC 2463 for a definition of the IPv6 ICMP type and code
      fields.
    </reference>
  </field>

  <field name="igmpType" dataType="octet"
         group="transportHeader"
         dataTypeSemantics="identifier"
         fieldId="33" applicability="all" status="current">
    <description>
      The type field of the IGMP message.
    </description>
    <reference>
      See RFC 2236 for a definition of the IGMP type field.
    </reference>
  </field>

  <field name="sourceMacAddress" dataType="macAddress"
         group="subIpHeader"
         dataTypeSemantics="identifier"
         fieldId="56" applicability="data" status="current">
    <description>
      <paragraph>
        The IEEE 802 source MAC address field.
      </paragraph>
    </description>
```

```
      <reference>
        See IEEE.802-3.2002.
      </reference>
    </field>

    <field name="postDestinationMacAddr" dataType="macAddress"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="57" applicability="data" status="current">
      <description>
        <paragraph>
          The IEEE 802 destination MAC address field
          after processing by a middlebox function.
        </paragraph>
      </description>
      <reference>
        See IEEE.802-3.2002.
      </reference>
    </field>

    <field name="vlanId" dataType="unsigned16"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="58" applicability="data" status="current">
      <description>
        <paragraph>
          The IEEE 802.1Q VLAN identifier (VID) extracted from the Tag
          Control Information field that was attached to the IP packet.
        </paragraph>
      </description>
      <reference>
        See IEEE.802-1Q.2003.
      </reference>
    </field>

    <field name="postVlanId" dataType="unsigned16"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="59" applicability="data" status="current">
      <description>
        <paragraph>
          The IEEE 802.1Q VLAN identifier (VID) extracted from the Tag
          Control Information field that was attached to the IP packet
          after processing by a middlebox function.
         </paragraph>
      </description>
      <reference>
        See IEEE.802-1Q.2003.
```

```
      </reference>
    </field>

    <field name="destinationMacAddress" dataType="macAddress"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="80" applicability="data" status="current">
      <description>
        <paragraph>
          The IEEE 802 destination MAC address field.
        </paragraph>
      </description>
      <reference>
        See IEEE.802-3.2002.
      </reference>
    </field>

    <field name="postSourceMacAddress" dataType="macAddress"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="81" applicability="data" status="current">
      <description>
        <paragraph>
          The IEEE 802 source MAC address field.
          after processing by a middlebox function.
        </paragraph>
      </description>
      <reference>
        See IEEE.802-3.2002.
      </reference>
    </field>

    <field name="wlanChannelId" dataType="octet"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="146" applicability="data" status="current">
      <description>
        <paragraph>
          The identifier of the 802.11 (WiFi) channel used.
        </paragraph>
      </description>
      <reference>
        See IEEE.802-11.1999.
      </reference>
    </field>

    <field name="wlanSsid" dataType="string"
           group="subIpHeader"
```

```
          fieldId="147" applicability="data" status="current">
      <description>
        <paragraph>
          The Service Set IDentifier (SSID) identifying an 802.11
          (Wi-Fi) network used.  According to IEEE.802-11.1999 the
          SSID is encoded into a string of up to 32 characters.
        </paragraph>
      </description>
      <reference>
        See IEEE.802-11.1999.
      </reference>
    </field>

    <field name="mplsLabelStackEntry1" dataType="unsigned32"
          group="subIpHeader"
          dataTypeSemantics="identifier"
          fieldId="70" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp and s fields from the outermost MPLS label
        stack entry, i.e. the last label that was pushed.
        </paragraph>
        <artwork>
      0                   1                   2
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                Label                  | Exp |S|
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

     Label:  Label Value, 20 bits
     Exp:    Experimental Use, 3 bits
     S:      Bottom of Stack, 1 bit
        </artwork>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>

    <field name="mplsLabelStackEntry2" dataType="unsigned32"
          group="subIpHeader"
          dataTypeSemantics="identifier"
          fieldId="71" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp, and s fields from the label stack entry that
        was pushed immediately before the label stack entry that would
        be reported by mplsLabelStackEntry1. See the definition of
```

```
        mplsLabelStackEntry1 for further details.
        </paragraph>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>

    <field name="mplsLabelStackEntry3" dataType="unsigned32"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="72" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp, and s fields from the label stack entry that
        was pushed immediately before the label stack entry that would
        be reported by mplsLabelStackEntry2. See the definition of
        mplsLabelStackEntry1 for further details.
        </paragraph>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>

    <field name="mplsLabelStackEntry4" dataType="unsigned32"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="73" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp, and s fields from the label stack entry that
        was pushed immediately before the label stack entry that would
        be reported by mplsLabelStackEntry3. See the definition of
        mplsLabelStackEntry1 for further details.
        </paragraph>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>

    <field name="mplsLabelStackEntry5" dataType="unsigned32"
           group="subIpHeader"
           dataTypeSemantics="identifier"
           fieldId="74" applicability="all" status="current">
      <description>
        <paragraph>
```

```
      The label, exp, and s fields from the label stack entry that
      was pushed immediately before the label stack entry that would
      be reported by mplsLabelStackEntry4. See the definition of
      mplsLabelStackEntry1 for further details.
      </paragraph>
    </description>
    <reference>
      See RFC 3032.
    </reference>
  </field>

  <field name="mplsLabelStackEntry6" dataType="unsigned32"
         group="subIpHeader"
         dataTypeSemantics="identifier"
         fieldId="75" applicability="all" status="current">
    <description>
      <paragraph>
      The label, exp, and s fields from the label stack entry that
      was pushed immediately before the label stack entry that would
      be reported by mplsLabelStackEntry5. See the definition of
      mplsLabelStackEntry1 for further details.
      </paragraph>
    </description>
    <reference>
      See RFC 3032.
    </reference>
  </field>

  <field name="mplsLabelStackEntry7" dataType="unsigned32"
         group="subIpHeader"
         dataTypeSemantics="identifier"
         fieldId="76" applicability="all" status="current">
    <description>
      <paragraph>
      The label, exp, and s fields from the label stack entry that
      was pushed immediately before the label stack entry that would
      be reported by mplsLabelStackEntry6. See the definition of
      mplsLabelStackEntry1 for further details.
      </paragraph>
    </description>
    <reference>
      See RFC 3032.
    </reference>
  </field>

  <field name="mplsLabelStackEntry8" dataType="unsigned32"
         group="subIpHeader"
         dataTypeSemantics="identifier"
```

```
          fieldId="77" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp, and s fields from the label stack entry that
        was pushed immediately before the label stack entry that would
        be reported by mplsLabelStackEntry7. See the definition of
        mplsLabelStackEntry1 for further details.
        </paragraph>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>

    <field name="mplsLabelStackEntry9" dataType="unsigned32"
          group="subIpHeader"
          dataTypeSemantics="identifier"
          fieldId="78" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp, and s fields from the label stack entry that
        was pushed immediately before the label stack entry that would
        be reported by mplsLabelStackEntry8. See the definition of
        mplsLabelStackEntry1 for further details.
        </paragraph>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>

    <field name="mplsLabelStackEntry10" dataType="unsigned32"
          group="subIpHeader"
          dataTypeSemantics="identifier"
          fieldId="79" applicability="all" status="current">
      <description>
        <paragraph>
        The label, exp, and s fields from the label stack entry that
        was pushed immediately before the label stack entry that would
        be reported by mplsLabelStackEntry9. See the definition of
        mplsLabelStackEntry1 for further details.
        </paragraph>
      </description>
      <reference>
        See RFC 3032.
      </reference>
    </field>
```

```
    <field name="ipNextHopIPv4Address" dataType="ipv4Address"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="15" applicability="data" status="current">
      <description>
        <paragraph>
        The IPv4 address of the next IPv4 hop.
        </paragraph>
      </description>
    </field>

    <field name="ipNextHopIPv6Address" dataType="ipv6Address"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="62" applicability="data" status="current">
      <description>
        <paragraph>
        The IPv6 address of the next IPv6 hop.
        </paragraph>
      </description>
    </field>

  <!--
    <field name="ipNextHopAsNumber" dataType="unsigned16"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="162" applicability="all" status="current">
      <description>
        <paragraph>
        The autonomous system (AS) number of the next IP hop.
        </paragraph>
      </description>
      <reference>
        See RFC 1771 for a description of BGP-4 and
        see RFC 1930 for a definition of the AS number.
      </reference>
    </field>
  -->

    <field name="bgpSourceAsNumber" dataType="unsigned16"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="16" applicability="all" status="current">
      <description>
        <paragraph>
        The autonomous system (AS) number of the source IP address.
        If AS path information for this Flow is only available as
        unordered AS set (and not as ordered AS sequence),
```

```
        then the value of this Information Element is 0.
        </paragraph>
      </description>
      <reference>
        See RFC 1771 for a description of BGP-4 and
        see RFC 1930 for a definition of the AS number.
      </reference>
    </field>

    <field name="bgpDestinationAsNumber" dataType="unsigned16"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="17" applicability="all" status="current">
      <description>
        <paragraph>
        The autonomous system (AS) number of the destination IP
        address.  If AS path information for this Flow is only
        available as unordered AS set (and not as ordered AS
        sequence), then the value of this Information Element is 0.
        </paragraph>
      </description>
      <reference>
        See RFC 1771 for a description of BGP-4 and
        see RFC 1930 for a definition of the AS number.
      </reference>
    </field>

    <field name="bgpNextAdjacentAsNumber" dataType="unsigned16"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="128" applicability="all" status="current">
      <description>
        <paragraph>
        The autonomous system (AS) number of the first AS in the AS
        path to the destination IP address.  The path is deduced
        by looking up the destination IP address of the Flow in the
        BGP routing information base.  If AS path information for
        this Flow is only available as unordered AS set (and not as
        ordered AS sequence),
        then the value of this Information Element is 0.
        </paragraph>
      </description>
      <reference>
        See RFC 1771 for a description of BGP-4 and
        see RFC 1930 for a definition of the AS number.
      </reference>
    </field>
```

```
<field name="bgpPrevAdjacentAsNumber" dataType="unsigned16"
       group="derived"
       dataTypeSemantics="identifier"
       fieldId="129" applicability="all" status="current">
  <description>
    <paragraph>
    The autonomous system (AS) number of the last AS in the AS
    path from the source IP address.  The path is deduced
    by looking up the source IP address of the Flow in the BGP
    routing information base.  If AS path information for this
    Flow is only available as unordered AS set (and not as
    ordered AS sequence), then the value of this Information
    Element is 0.  In case of BGP asymmetry, the
    bgpSrcAdjacentASNumber might not be
    able to report the correct value.
    </paragraph>
  </description>
  <reference>
    See RFC 1771 for a description of BGP-4 and
    see RFC 1930 for a definition of the AS number.
  </reference>
</field>

<field name="bgpNextHopIPv4Address" dataType="ipv4Address"
       group="derived"
       dataTypeSemantics="identifier"
       fieldId="18" applicability="all" status="current">
  <description>
    <paragraph>
    The IPv4 address of the next (adjacent) BGP hop.
    </paragraph>
  </description>
  <reference>
    See RFC 1771 for a description of BGP-4 and
  </reference>
</field>

<field name="bgpNextHopIPv6Address" dataType="ipv6Address"
       group="derived"
       dataTypeSemantics="identifier"
       fieldId="63" applicability="all" status="current">
  <description>
    <paragraph>
    The IPv6 address of the next (adjacent) BGP hop.
    </paragraph>
  </description>
  <reference>
    See RFC 1771 for a description of BGP-4.
```

```
      </reference>
    </field>

    <field name="mplsTopLabelType" dataType="octet"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="46" applicability="data" status="current">
      <description>
        <paragraph>
        This field identifies the control protocol that allocated the
        top of stack label.  Defined values for this field include:
        <artwork>
       - 0x01 TE-MIDPT: Any TE tunnel mid-point or tail label
       - 0x02 Pseudowire: Any PWE3 or Cisco AToM based label
       - 0x03 VPN: Any label associated with VPN
       - 0x04 BGP: Any label associated with BGP or BGP routing
       - 0x05 LDP: Any label associated with dynamically assigned
                   labels using LDP
        </artwork>
        </paragraph>
      </description>
      <reference>
        See RFC 3031 for the MPLS label structure.
        See RFC 2547 for the association of MPLS labels with VPNs.
        See RFC 1771 for BGP and BGP routing.
        See RFC 3036 for LDP.
        and IP addresses.
      </reference>
    </field>

    <field name="mplsTopLabelIPv4Address" dataType="ipv4Address"
           group="derived"
           dataTypeSemantics="identifier"
           fieldId="47" applicability="data" status="current">
      <description>
        <paragraph>
          The IPv4 address of the system that the MPLS top label will
          cause this Flow to be forwarded to.
        </paragraph>
      </description>
      <reference>
        See RFC 3031 for the association between MPLS labels
        and IP addresses.
      </reference>
    </field>

    <field name="mplsTopLabelIPv6Address" dataType="ipv6Address"
           group="derived"
```

```
          dataTypeSemantics="identifier"
          fieldId="140" applicability="data" status="current">
    <description>
      <paragraph>
        The IPv6 address of the system that the MPLS top label will
        cause this Flow to be forwarded to.
      </paragraph>
    </description>
    <reference>
      See RFC 3031 for the association between MPLS labels
      and IP addresses.
    </reference>
  </field>

  <field name="exporterIPv4Address" dataType="ipv4Address"
         dataTypeSemantics="identifier"
         group="config"
         fieldId="130" applicability="all" status="current">
    <description>
      <paragraph>
      The IPv4 address used by the Exporting Process.  This is used
      by the Collector to identify the Exporter in cases where the
      identity of the Exporter may have been obscured by the use of
      a proxy.
      </paragraph>
    </description>
  </field>

  <field name="exporterIPv6Address" dataType="ipv6Address"
         dataTypeSemantics="identifier"
         group="config"
         fieldId="131" applicability="all" status="current">
    <description>
      <paragraph>
      The IPv6 address used by the Exporting Process.  This is used
      by the Collector to identify the Exporter in cases where the
      identity of the Exporter may have been obscured by the use of
      a proxy.
      </paragraph>
    </description>
  </field>

  <field name="minimumPacketLength" dataType="unsigned16"
         group="minMax"
         fieldId="25" applicability="all" status="current">
    <description>
      <paragraph>
      Length of the smallest packet observed for this Flow.
```

```
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="maximumPacketLength" dataType="unsigned16"
           group="minMax"
           fieldId="26" applicability="all" status="current">
      <description>
        <paragraph>
        Length of the largest packet observed for this Flow.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="minimumTtl" dataType="octet"
           group="minMax"
           fieldId="52" applicability="data" status="current">
      <description>
        <paragraph>
          Minimum TTL value observed for any packet in this Flow.
        </paragraph>
      </description>
    </field>

    <field name="maximumTtl" dataType="octet"
           group="minMax"
           fieldId="53" applicability="data" status="current">
      <description>
        <paragraph>
          Maximum TTL value observed for any packet in this Flow.
        </paragraph>
      </description>
    </field>

    <field name="ipv6OptionHeaders" dataType="unsigned32"
           dataTypeSemantics="flags"
           group="minMax"
           fieldId="64" applicability="all" status="current">
      <description>
        <paragraph>
        IPv6 options in the IP packet headers 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 if any observed packet of this
        Flow contains the corresponding IPv6 option header.
        </paragraph>
```

```
      <artwork>
 bit      IPv6 Option    Definition

  0                       Reserved
  1        44             Fragmentation header - not first fragment
  2        43             Routing header
  3        44             Fragment header - first fragment
  4                       Unknown Layer 4 header (compressed,
                          encrypted, not supported)
  5                       Reserved
  6         0             Hop-by-hop option header
  7        60             Destination option header
  8       108             Payload compression header
  9        51             Authentication Header
 10        50             Encrypted security payload
 11 to 31                 Reserved
    </artwork>
  </description>
  <reference>
   See RFC 2460 for the general definition of IPv6 extensions
   headers and for the specification of the hop-by-hop options
   header, the routing header, the fragment header, and the
   destination options header.
   See RFC 2402 for the specification of the authentication
   header.
   See RFC 2406 for the specification of the encapsulating
   security payload.
  </reference>
</field>

<field name="tcpControlBits" dataType="octet"
       dataTypeSemantics="flags"
       group="minMax"
       fieldId="6" applicability="all" status="current">
  <description>
    <paragraph>
    TCP control bits observed for packets of this Flow.
    The information is encoded in a set of bit fields.
    For each TCP control bit there is a bit in this
    set.  A bit is set to 1 if any observed packet of this
    Flow has the corresponding TCP control bit set to 1.
    A value of 0 for a bit indicates that the corresponding
    bit was not set in any of the observed packets
    of this Flow.
    </paragraph>
    <artwork>
     0     1     2     3     4     5     6     7
  +-----+-----+-----+-----+-----+-----+-----+-----+
```

```
 |  Reserved | URG | ACK | PSH | RST | SYN | FIN |
 +-----+-----+-----+-----+-----+-----+-----+-----+

 Reserved:  Reserved for future use by TCP.  Must be zero.
      URG:  Urgent Pointer field significant
      ACK:  Acknowledgment field significant
      PSH:  Push Function
      RST:  Reset the connection
      SYN:  Synchronize sequence numbers
      FIN:  No more data from sender
    </artwork>
  </description>
  <reference>See RFC 793 for a definition of the TCP control bits
  in the TCP header.</reference>
</field>

<field name="flowStartSeconds" dataType="dateTimeSeconds"
       group="timestamp"
       fieldId="150" applicability="data" status="current">
  <description>
    The absolute timestamp of the first packet of this Flow.
  </description>
  <units>seconds</units>
</field>

<field name="flowEndSeconds" dataType="dateTimeSeconds"
       group="timestamp"
       fieldId="151" applicability="data" status="current">
  <description>
    The absolute timestamp of the last packet of this Flow.
  </description>
  <units>seconds</units>
</field>

<field name="flowStartMilliSeconds" dataType="dateTimeMilliSeconds"
       group="timestamp"
       fieldId="152" applicability="data" status="current">
  <description>
    The absolute timestamp of the first packet of this Flow.
  </description>
  <units>milliseconds</units>
</field>

<field name="flowEndMilliSeconds" dataType="dateTimeMilliSeconds"
       group="timestamp"
       fieldId="153" applicability="data" status="current">
  <description>
    The absolute timestamp of the last packet of this Flow.
```

```
      </description>
      <units>milliseconds</units>
    </field>

    <field name="flowStartMicroSeconds" dataType="dateTimeMicroSeconds"
           group="timestamp"
           fieldId="154" applicability="data" status="current">
      <description>
        The absolute timestamp of the first packet of this Flow.
      </description>
      <units>microseconds</units>
    </field>

    <field name="flowEndMicroSeconds" dataType="dateTimeMicroSeconds"
           group="timestamp"
           fieldId="155" applicability="data" status="current">
      <description>
        The absolute timestamp of the last packet of this Flow.
      </description>
      <units>microseconds</units>
    </field>

    <field name="flowStartNanoSeconds" dataType="dateTimeNanoSeconds"
           group="timestamp"
           fieldId="156" applicability="data" status="current">
      <description>
        The absolute timestamp of the first packet of this Flow.
      </description>
      <units>nanoseconds</units>
    </field>

    <field name="flowEndNanoSeconds" dataType="dateTimeNanoSeconds"
           group="timestamp"
           fieldId="157" applicability="data" status="current">
      <description>
        The absolute timestamp of the last packet of this Flow.
      </description>
      <units>nanoseconds</units>
    </field>

    <field name="flowStartDeltaMicroSeconds" dataType="unsigned32"
           group="timestamp"
           fieldId="158" applicability="data" status="current">
      <description>
        This is a relative time stamp only valid within the scope
        of a single IPFIX message.  It contains the negative time
        offset of the first observed packet of this Flow relative
        to the export time specified in the IPFIX Message header.
```

```
      </description>
      <reference>
        See [I-D.ietf-ipfix-protocol] for the definition of the IPFIX
        Message header.
      </reference>
      <units>microseconds</units>
    </field>

    <field name="flowEndDeltaMicroSeconds" dataType="unsigned32"
           group="timestamp"
           fieldId="159" applicability="data" status="current">
      <description>
        This is a relative time stamp only valid within the scope
        of a single IPFIX message.  It contains the negative time
        offset of the last observed packet of this Flow relative
        to the export time specified in the IPFIX Message header.
      </description>
      <reference>
        See [I-D.ietf-ipfix-protocol] for the definition of the IPFIX
        Message header.
      </reference>
      <units>microseconds</units>
    </field>

    <field name="systemInitTimeMilliSeconds" dataType="dateTimeMilliSeconds"
           group="timestamp"
           fieldId="160" applicability="data" status="current">
      <description>
        The absolute timestamp of the last (re-)initialization of the
        IPFIX device.
      </description>
      <units>milliseconds</units>
    </field>

    <field name="flowStartSysUpTime" dataType="unsigned32"
           group="timestamp"
           fieldId="22" applicability="data" status="current">
      <description>
        The relative timestamp of the first packet of this Flow.
        It indicates the number of milliseconds since the
        last (re-)initialization of the IPFIX device (sysUpTime).
      </description>
      <units>milliseconds</units>
    </field>

    <field name="flowEndSysUpTime" dataType="unsigned32"
           group="timestamp"
           fieldId="21" applicability="data" status="current">
```

```
      <description>
        The relative timestamp of the last packet of this Flow.
        It indicates the number of milliseconds since the
        last (re-)initialization of the IPFIX device (sysUpTime).
      </description>
      <units>milliseconds</units>
    </field>

    <field name="flowActiveTimeOut" dataType="unsigned16"
           group="misc"
           fieldId="36" applicability="all" status="current">
      <description>
        <paragraph>
        The number of seconds after which an active Flow is timed out
        anyway, even if there is still a continuous flow of packets.
        </paragraph>
      </description>
      <units>seconds</units>
    </field>

    <field name="flowInactiveTimeout" dataType="unsigned16"
           group="misc"
           fieldId="37" applicability="all" status="current">
      <description>
        <paragraph>
         A Flow is considered to be timed out if no packets belonging
         to the Flow have been observed for the number of seconds
         specified by this field.
        </paragraph>
      </description>
      <units>seconds</units>
    </field>

    <field name="flowEndReason" dataType="octet"
           group="misc"
           dataTypeSemantics="identifier"
           fieldId="136" applicability="data" status="current">
      <description>
        <paragraph>
        The reason for flow termination. The range of values includes
        <itemlist>
        <item>0x01: idle timeout</item>
        <item>0x02: active timeout</item>
        <item>0x03: end of flow detected (e.g. TCP FIN)</item>
        <item>0x04: forced end</item>
        <item>0x05: cache full</item>
        </itemlist>
        </paragraph>
```

```
      </description>
    </field>

    <field name="flowDurationMilliSeconds" dataType="unsigned32"
           group="misc"
           fieldId="161" applicability="data" status="current">
      <description>
        The difference between in time between the observation of the
        first packet of this Flow and the observation of the last
        packet of this Flow.
      </description>
      <units>milliseconds</units>
    </field>

    <field name="flowDurationMicroSeconds" dataType="unsigned32"
           group="misc"
           fieldId="162" applicability="data" status="current">
      <description>
        The difference between in time between the observation of the
        first packet of this Flow and the observation of the last
        packet of this Flow.
      </description>
      <units>microseconds</units>
    </field>

    <field name="octetDeltaCount" dataType="unsigned64"
           dataTypeSemantics="deltaCounter"
           group="flowCounter"
           fieldId="1" applicability="data" status="current">
      <description>
        <paragraph>
        The number of octets since the previous report (if any)
        in incoming packets for this Flow at the Observation Point.
        The number of octets include IP header(s) and IP payload.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="postOctetDeltaCount" dataType="unsigned64"
           dataTypeSemantics="deltaCounter"
           group="flowCounter"
           fieldId="23" applicability="data" status="current">
      <description>
        <paragraph>
        The number of octets since the previous report (if any)
        in outgoing packets for this Flow at the Observation Point.
        The number of octets include IP header(s) and IP payload.
```

```
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="octetTotalCount" dataType="unsigned64"
           dataTypeSemantics="totalCounter"
           group="flowCounter"
           fieldId="85" applicability="all" status="current">
      <description>
        <paragraph>
        The total number of octets in incoming packets
        for this Flow at the Observation Point since the Metering
        Process (re-)initialization for this Observation Point. The
        number of octets include IP header(s) and IP payload.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="postOctetTotalCount" dataType="unsigned64"
           dataTypeSemantics="totalCounter"
           group="flowCounter"
           fieldId="170" applicability="all" status="current">
      <description>
        <paragraph>
        The total number of octets in outgoing packets
        for this Flow at the Observation Point since the Metering
        Process (re-)initialization for this Observation Point. The
        number of octets include IP header(s) and IP payload.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="packetDeltaCount" dataType="unsigned64"
           dataTypeSemantics="deltaCounter"
           group="flowCounter"
           fieldId="2" applicability="data" status="current">
      <description>
        <paragraph>
        The number of incoming packets since the previous report
        (if any) for this Flow at the Observation Point.
        </paragraph>
      </description>
      <units>packets</units>
    </field>
```

```
<field name="postPacketDeltaCount" dataType="unsigned64"
       dataTypeSemantics="deltaCounter"
       group="flowCounter"
       fieldId="24" applicability="data" status="current">
  <description>
    <paragraph>
    The number of outgoing packets since the previous report
    (if any) for this Flow at the Observation Point.
    </paragraph>
  </description>
  <units>packets</units>
</field>

<field name="packetTotalCount" dataType="unsigned64"
       dataTypeSemantics="totalCounter"
       group="flowCounter"
       fieldId="86" applicability="all" status="current">
  <description>
    <paragraph>
    The total number of incoming packets for this Flow
    at the Observation Point since the Metering Process
    (re-)initialization for this Observation Point.
    </paragraph>
  </description>
  <units>packets</units>
</field>

<field name="postPacketTotalCount" dataType="unsigned64"
       dataTypeSemantics="totalCounter"
       group="flowCounter"
       fieldId="171" applicability="all" status="current">
  <description>
    <paragraph>
    The total number of outgoing packets for this Flow
    at the Observation Point since the Metering Process
    (re-)initialization for this Observation Point.
    </paragraph>
  </description>
  <units>packets</units>
</field>

<field name="droppedOctetDeltaCount" dataType="unsigned64"
       dataTypeSemantics="deltaCounter"
       group="flowCounter"
       fieldId="132" applicability="data" status="current">
  <description>
    <paragraph>
    The number of octets since the previous report (if any)
```

```
        in packets of this Flow dropped by packet treatment.
        The number of octets include IP header(s) and IP payload.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="droppedPacketDeltaCount" dataType="unsigned64"
           dataTypeSemantics="deltaCounter"
           group="flowCounter"
           fieldId="133" applicability="data" status="current">
      <description>
        <paragraph>
        The number of packets since the previous report (if any)
        of this Flow dropped by packet treatment.
        </paragraph>
      </description>
      <units>packets</units>
    </field>

    <field name="droppedOctetTotalCount" dataType="unsigned64"
           dataTypeSemantics="totalCounter"
           group="flowCounter"
           fieldId="134" applicability="data" status="current">
      <description>
        <paragraph>
        The total number of octets in packets of this Flow dropped
        by packet treatment since the Metering Process
        (re-)initialization for this Observation Point.
        The number of octets include IP header(s) and IP payload.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="droppedPacketTotalCount" dataType="unsigned64"
           dataTypeSemantics="totalCounter"
           group="flowCounter"
           fieldId="135" applicability="data" status="current">
      <description>
        <paragraph>
        The number of packets of this Flow dropped by packet
        treatment since the Metering Process
        (re-)initialization for this Observation Point.
        </paragraph>
      </description>
      <units>packets</units>
    </field>
```

```
    <field name="postMulticastPacketCount" dataType="unsigned64"
           dataTypeSemantics="deltaCounter"
           group="flowCounter"
           fieldId="19" applicability="data" status="current">
      <description>
        <paragraph>
        The number of outgoing multicast packets since the
        previous report (if any) created for packets
        of this Flow by an adjacent multicast daemon.
        Note that typically not all of the created packets can be
        observed at the Observation Point of this Flow.
        </paragraph>
      </description>
      <units>packets</units>
    </field>

    <field name="postMulticastOctetCount" dataType="unsigned64"
           dataTypeSemantics="deltaCounter"
           group="flowCounter"
           fieldId="20" applicability="data" status="current">
      <description>
        <paragraph>
        The number of octets since the previous report (if any)
        in outgoing multicast packets created
        for packets of this Flow by an adjacent multicast daemon.
        Note that typically not all of the created packets can be
        observed at the Observation Point of this Flow.
        The number of octets include IP header(s) and IP payload.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="exportedMessageTotalCount" dataType="unsigned64"
           dataTypeSemantics="totalCounter"
           group="processCounter"
           fieldId="41" applicability="data" status="current">
      <description>
        <paragraph>
        The total number of IPFIX Messages that the Exporting Process
        successfully sent since the Exporting Process (re-)initialization
        to the Collecting Process receiving a report that contains
        this Information Element.
        </paragraph>
      </description>
      <units>messages</units>
    </field>
```

```
<field name="exportedOctetTotalCount" dataType="unsigned64"
       dataTypeSemantics="totalCounter"
       group="processCounter"
       fieldId="40" applicability="data" status="current">
  <description>
    <paragraph>
       The total number of octets that the Exporting Process
       successfully sent since the Exporting Process
       (re-)initialization to the Collecting Process receiving a report
       that contains this Information Element.  The value of this
       Information Element is calculated by summing up the IPFIX
       Message header length values of all IPFIX messages that
       were successfully sent to the Collecting Process receiving
       a report that contains this Information Element.
    </paragraph>
  </description>
  <units>octets</units>
</field>

<field name="exportedFlowTotalCount" dataType="unsigned64"
       group="processCounter"
       dataTypeSemantics="totalCounter"
       fieldId="42" applicability="data" status="current">
  <description>
    <paragraph>
    The total number of Flows Records reported that the Exporting
    Process successfully sent as Data Records since the Exporting
    Process (re-)initialization to the Collecting Process receiving a
    report that contains this Information Element.
    </paragraph>
  </description>
  <units>Flows</units>
</field>

<field name="observedFlowTotalCount" dataType="unsigned64"
       dataTypeSemantics="totalCounter"
       group="processCounter"
       fieldId="3" applicability="data" status="current">
  <description>
    <paragraph>
    The total number of Flows observed in the Observation Domain
    since the Metering Process (re-)initialization for this
    Observation Point.
    </paragraph>
  </description>
  <units>Flows</units>
</field>
```

```
     <field name="ignoredPacketTotalCount" dataType="unsigned64"
            dataTypeSemantics="totalCounter"
            group="processCounter"
            fieldId="163" applicability="data" status="current">
       <description>
         <paragraph>
            The total number of observed IP packets that the
            Metering Process did not process.
         </paragraph>
       </description>
       <units>packets</units>
     </field>

     <field name="ignoredOctetTotalCount" dataType="unsigned64"
            dataTypeSemantics="totalCounter"
            group="processCounter"
            fieldId="164" applicability="data" status="current">
       <description>
         <paragraph>
            The total number of octets in observed IP packets
            that the Metering Process did not process.
         </paragraph>
       </description>
       <units>octets</units>
     </field>

     <field name="notSentFlowTotalCount" dataType="unsigned64"
            dataTypeSemantics="totalCounter"
            group="processCounter"
            fieldId="165" applicability="data" status="current">
       <description>
         <paragraph>
            The total number of Flow Records that were generated by the
            Metering Process and but dropped by the Metering Process or
            by the Exporting Process
            instead of sending it to the Collecting Process.
            There are several potential reasons for this including
            resource shortage and special Flow export policies.
         </paragraph>
       </description>
       <units>Flows</units>
     </field>

     <field name="notSentPacketTotalCount" dataType="unsigned64"
            dataTypeSemantics="totalCounter"
            group="processCounter"
            fieldId="166" applicability="data" status="current">
       <description>
```

```
        <paragraph>
           The total number of packets in Flow Records that were
           generated by the Metering Process and but dropped
           by the Metering Process or by the Exporting Process
           instead of sending it to the Collecting Process.
           There are several potential reasons for this including
           resource shortage and special flow export policies.
        </paragraph>
      </description>
      <units>packets</units>
    </field>

    <field name="notSentOctetTotalCount" dataType="unsigned64"
           dataTypeSemantics="totalCounter"
           group="processCounter"
           fieldId="167" applicability="data" status="current">
      <description>
        <paragraph>
           The total number of octets in  packets in Flow Records
           that were generated by the Metering Process and but
           dropped by the Metering Process or by the Exporting
           Process instead of sending it to the Collecting Process.
           There are several potential reasons for this including
           resource shortage and special Flow export policies.
        </paragraph>
      </description>
      <units>octets</units>
    </field>

    <field name="flowKeyIndicator" dataType="unsigned64"
           dataTypeSemantics="flags"
           group="processCounter"
           fieldId="172" applicability="all" status="current">
      <description>
        <paragraph>
        This set of bit fields is used for marking the Information
        Elements of a Data Record that serve as Flow Key.  Each bit
        represents an Information Element in the Data Record with
        the n-th bit representing the n-th Information Element.
        A set bit with value 1 indicates that the corresponding
        Information element is a Flow Key of the reported Flow.
        A value of 0 indicates that this is not the case.  If the
        Data Record contains more than 64 Information Elements, the
        corresponding Template SHOULD be designed such that all Flow
        Keys are among the first 64 Information Elements, because the
        flowKeyIndicator only contains 64 bits.  If the Data Record
        contains less than 64 Information Elements, then the bits in
        the flowKeyIndicator for which no corresponding Information
```

```
      Element exists SHOULD have the value 0.
      </paragraph>
    </description>
  </field>

  <field name="lineCardId" dataType="unsigned32"
         group="scope"
         dataTypeSemantics="identifier"
         fieldId="141" applicability="option" status="current">
    <description>
      <paragraph>
        A locally unique identifier of a line card at an IPFIX
        Device hosting an Observation Point.  Typically, this
        Information Element is used for limiting the scope
        of other Information Elements.
      </paragraph>
    </description>
  </field>

  <field name="portId" dataType="unsigned32"
         group="scope"
         dataTypeSemantics="identifier"
         fieldId="142" applicability="option" status="current">
    <description>
      <paragraph>
        A locally unique identifier of a line port at an IPFIX
        Device hosting an Observation Point.  Typically, this
        Information Element is used for limiting the scope
        of other Information Elements.
      </paragraph>
    </description>
  </field>

  <field name="ingressInterface" dataType="unsigned32"
         group="scope"
         dataTypeSemantics="identifier"
         fieldId="10" applicability="all" status="current">
    <description>
      <paragraph>
        The index of the IP interface (ifIndex) where packets of
        this Flow are being received.
      </paragraph>
    </description>
    <reference>
      See RFC 2863 for the definition of the ifIndex object.
    </reference>
  </field>
```

```
    <field name="egressInterface" dataType="unsigned32"
           group="scope"
           dataTypeSemantics="identifier"
           fieldId="14" applicability="all" status="current">
      <description>
        <paragraph>
          The index of the IP interface (ifIndex) where packets of
          this Flow are being sent.
        </paragraph>
      </description>
      <reference>
        See RFC 2863 for the definition of the ifIndex object.
      </reference>
    </field>

    <field name="meteringProcessId" dataType="unsigned32"
           group="scope"
           dataTypeSemantics="identifier"
           fieldId="143" applicability="option" status="current">
      <description>
        <paragraph>
          A locally unique identifier of a Metering Process
          at an IPFIX Device.  Typically, this
          Information Element is used for limiting the scope
          of other Information Elements.
        </paragraph>
      </description>
    </field>

    <field name="exportingProcessId" dataType="unsigned32"
           group="scope"
           dataTypeSemantics="identifier"
           fieldId="144" applicability="option" status="current">
      <description>
        <paragraph>
          A locally unique identifier of an Exporting Process
          at an IPFIX Device.  Typically, this
          Information Element is used for limiting the scope
          of other Information Elements.
        </paragraph>
      </description>
    </field>

    <field name="flowId" dataType="unsigned32"
           group="scope"
           dataTypeSemantics="identifier"
           fieldId="148" applicability="option" status="current">
      <description>
```

```
        <paragraph>
          An identifier of a Flow that is locally unique to an
          Exporting Process.  Typically, this Information Element is
          used for limiting the scope of other Information Elements.
        </paragraph>
      </description>
    </field>

    <field name="templateId" dataType="unsigned32"
           group="scope"
           dataTypeSemantics="identifier"
           fieldId="145" applicability="option" status="current">
      <description>
        <paragraph>
          An identifier of a Template that is locally unique to an
          Exporting Process.  Typically, this Information Element is
          used for limiting the scope of other Information Elements.
        </paragraph>
      </description>
    </field>

    <field name="sourceId" dataType="unsigned32"
           group="scope"
           dataTypeSemantics="identifier"
           fieldId="149" applicability="option" status="current">
      <description>
        <paragraph>
          An identifier of an Observation Domain that is locally
          unique to an Exporting Process.  Typically, this Information
          Element is used for limiting the scope of other Information
          Elements.
        </paragraph>
      </description>
    </field>

  </fieldDefinitions>
```

Appendix B. Formal Specification of Abstract Data Types

This appendix containfs a formal description of the abstract data types to be used for IPFIX Information Elements and a formal description of the template used for defining IPFIX Information Elements. Note that this appendix is of informational nature, while the text in sections 2 and 3 generated from this appendix is normative.

```
<?xml version="1.0" encoding="UTF-8"?>
<schema>
<!-- <schema elementFormDefault="qualified"
        targetNamespace="http://www.ietf.org/ipfix"
        xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:ipfix="http://www.ietf.org/ipfix">  -->

  <simpleType name="dataType">
    <restriction base="string">
      <enumeration value="octet">
        <annotation>
          <documentation>The type "octet" represents a
            non-negative integer value in the range of 0 to 255.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="unsigned16">
        <annotation>
          <documentation>The type "unsigned16" represents a
            non-negative integer value in the range of 0 to 65535.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="unsigned32">
        <annotation>
          <documentation>The type "unsigned32" represents a
             non-negative integer value in the range of 0 to
             4294967295.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="unsigned64">
        <annotation>
          <documentation>The type "unsigned64" represents a
            non-negative integer value in the range of 0 to
```

```
      18446744073709551615.
    </documentation>
  </annotation>
</enumeration>

<enumeration value="float32">
  <annotation>
    <documentation>The type "float32" corresponds to an IEEE
      single-precision 32-bit floating point type as defined
      in [IEEE.754.1985].
    </documentation>
  </annotation>
</enumeration>

<enumeration value="boolean">
  <annotation>
    <documentation>The type "boolean" represents a binary
      value.  The only allowed values are "true" and false.
    </documentation>
  </annotation>
</enumeration>

<enumeration value="macAddress">
  <annotation>
    <documentation>The type "macAddress" represents a
      string of 6 octets.
    </documentation>
  </annotation>
</enumeration>

<enumeration value="octetArray">
  <annotation>
    <documentation>The type "octetArray" represents a finite
    length string of octets.
    </documentation>
  </annotation>
</enumeration>

<enumeration value="string">
  <annotation>
    <documentation>
      The type "string" represents a finite length string
      of valid characters from the Unicode character encoding
      set [ISO.10646-1.1993].  Unicode allows for ASCII
      [ISO.646.1991] and many other international character
      sets to be used.  It is expected that strings will be
      encoded in UTF-8 format, which is identical in encoding
      for ASCII characters, but also accommodates other Unicode
```

```
            multi-byte characters.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="dateTimeSeconds">
        <annotation>
          <documentation>
            The type "dateTimeSeconds" represents a time value
            having a precision of seconds and normalized to the
            GMT time zone.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="dateTimeMilliSeconds">
        <annotation>
          <documentation>The type "dateTimeMilliSeconds" represents
            a time value having a precision of milliseconds and
            normalized to the GMT time zone.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="dateTimeMicroSeconds">
        <annotation>
          <documentation>The type "dateTimeMicroSeconds" represents
            a time value having a precision of microseconds and
            normalized to the GMT time zone.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="dateTimeNanoSeconds">
        <annotation>
          <documentation>The type "dateTimeNanoSeconds" represents a
            time value having a precision of nanoseconds and
            normalized to the GMT time zone.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="ipv4Address">
        <annotation>
          <documentation>The type "ipv4Address" represents a value
            of an IPv4 address.
          </documentation>
        </annotation>
```

```
        </enumeration>

        <enumeration value="ipv6Address">
          <annotation>
            <documentation>The type "ipv6Address" represents a value
              of an IPv6 address.
            </documentation>
          </annotation>
        </enumeration>
      </restriction>
    </simpleType>

    <simpleType name="dataTypeSemantics">
      <restriction base="string">
        <enumeration value="quantity">
          <annotation>
            <documentation>
              A quantity value represents a discrete
              measured value pertaining to the record. This is
              distinguished from counters which represent an ongoing
              measured value whose "odometer" reading is captured as
              part of a given record. If no semantic qualifier is
              given, the Information Elements that have an integral
              data type should behave as a quantity.
            </documentation>
          </annotation>
        </enumeration>

        <enumeration value="totalCounter">
          <annotation>
            <documentation>
              An integral value reporting the value of a counter.
              Basically the same semantics as counters in SNMP.
              Counters are unsigned and wrap back to zero after
              reaching the limit of the type. For example, an
              unsigned64 with counter semantics will continue to
              increment until reaching the value of 2**64 - 1.  At
              this point the next increment will wrap its value to
              zero and continue counting from zero.  A running counter
              counts independently of the export of its value.
            </documentation>
          </annotation>
        </enumeration>

        <enumeration value="deltaCounter">
          <annotation>
            <documentation>
              An integral value reporting the value of a counter.
```

```
            Basically the same semantics as counters in SNMP.
            Counters are unsigned and wrap back to zero after
            reaching the limit of the type. For example, an
            unsigned64 with counter semantics will continue to
            increment until reaching the value of 2**64 - 1.  At
            this point the next increment will wrap its value to
            zero and continue counting from zero.  A delta counter
            is reset to zero each time its value is exported.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="identifier">
        <annotation>
          <documentation>
            An integral value which serves as an identifier.
            Specifically mathematical operations on two
            identifiers (aside from the equality operation) are
            meaningless. For example, Autonomous System ID 1 *
            Autonomous System ID 2 is meaningless.
          </documentation>
        </annotation>
      </enumeration>

      <enumeration value="flags">
        <annotation>
          <documentation>
            An integral value which actually represents a set of
            bit fields.  Logical operations are appropriate on
            such values, but not other mathematical operations.
            Flags should always be of an unsigned type.
          </documentation>
        </annotation>
      </enumeration>
    </restriction>
  </simpleType>

  <simpleType name="applicability">
    <restriction base="string">
      <enumeration value="data">
        <annotation>
          <documentation>
            Used for Information Elements that are applicable to
            flow records only.
          </documentation>
        </annotation>
      </enumeration>
```

```
        <enumeration value="option">
          <annotation>
            <documentation>
              Used for Information Elements that are applicable to
              option records only.
            </documentation>
          </annotation>
        </enumeration>

        <enumeration value="all">
          <annotation>
            <documentation>
              Used for Information Elements that are applicable to
              flow records as well as to option records.
            </documentation>
          </annotation>
        </enumeration>
      </restriction>
    </simpleType>

    <simpleType name="status">
      <restriction base="string">
        <enumeration value="current">
          <annotation>
            <documentation>
              Indicates that the Information Element definition
              is that the definition is current and valid.
            </documentation>
          </annotation>
        </enumeration>

        <enumeration value="deprecated">
          <annotation>
            <documentation>
              Indicates that the Information Element definition is
              obsolete, but it permits new/continued implementation
              in order to foster interoperability with older/existing
              implementations.
            </documentation>
          </annotation>
        </enumeration>

        <enumeration value="obsolete">
          <annotation>
            <documentation>
              Indicates that the Information Element definition is
              obsolete and should not be implemented and/or can be
              removed if previously implemented.
```

```
            </documentation>
          </annotation>
        </enumeration>
      </restriction>
    </simpleType>

  <!--
    <simpleType name="enumRange">
      <restriction base="string"/>
    </simpleType>
  -->

    <simpleType name="range">
      <restriction base="string"/>
    </simpleType>

    <complexType name="descriptionList">
      <sequence>
        <element maxOccurs="unbounded" minOccurs="1"
                 name="item" type="string">
          <annotation>
            <documentation>to be done ...</documentation>
          </annotation>
        </element>
      </sequence>
    </complexType>

    <complexType name="text" mixed="true">
      <sequence>
        <element maxOccurs="unbounded" minOccurs="0"
                 name="paragraph" type="string">
          <annotation>
            <documentation>to be done ...</documentation>
          </annotation>
        </element>
        <element maxOccurs="unbounded" minOccurs="0"
                 name="list" type="ipfix:descriptionList">
          <annotation>
            <documentation>to be done ...</documentation>
          </annotation>
        </element>
      </sequence>
    </complexType>

    <element name="fieldDefinitions">
      <complexType>
        <sequence>
          <element maxOccurs="unbounded" minOccurs="1" name="field">
```

```
            <complexType>
              <sequence>
                <element maxOccurs="1" minOccurs="1" name="description"
                         type="ipfix:text">
                  <annotation>
                    <documentation>
                      The semantics of this Information Element.
                      Describes how this Information Element is
                      derived from the flow or other information
                      available to the observer.
                    </documentation>
                  </annotation>
                </element>
  <!--
                <element maxOccurs="1" minOccurs="0" name="usage"
                         type="ipfix:text">
                  <annotation>
                    <documentation>to be done ...</documentation>
                  </annotation>
                </element>
  -->
                <element maxOccurs="1" minOccurs="0" name="units"
                         type="string">
                  <annotation>
                    <documentation>
                      If the Information Element is a measure of some
                      kind, the units identify what the measure is.
                    </documentation>
                  </annotation>
                </element>

                <element maxOccurs="1" minOccurs="0" name="reference"
                         type="ipfix:text">
                  <annotation>
                    <documentation>
                      Identifies additional specifications which more
                      precisely define this item or provide additional
                      context for its use.
                    </documentation>
                  </annotation>
                </element>

  <!--
                <element maxOccurs="1" minOccurs="0"
                         name="enumeratedRange" type="ipfix:enumRange">
                  <annotation>
                    <documentation>
                      Some items may have a specific set of numeric
```

```
                    identifiers associated with a set of discrete
                    values this Information Element may take. The
                    meaning of each discrete value and a human
                    readable name should be assigned.
                  </documentation>
                </annotation>
              </element>
   -->

              <element maxOccurs="1" minOccurs="0" name="range"
                       type="ipfix:range">
                <annotation>
                  <documentation>
                    Some Information Elements may only be able to
                    take on a restricted set of values which can be
                    expressed as a range (e.g. 0 through 511
                    inclusive). If this is the case, the valid
                    inclusive range should be specified.
                  </documentation>
                </annotation>
              </element>
            </sequence>

            <attribute name="name" type="string" use="required">
              <annotation>
                <documentation>
                  A unique and meaningful name for the Information
                  Element.
                </documentation>
              </annotation>
            </attribute>

            <attribute name="dataType" type="ipfix:dataType"
                       use="required">
              <annotation>
                <documentation>
                  One of the types listed in section 3.1 of this
                  document or in a future extension of the
                  information model. The type space for attributes
                  is constrained to facilitate implementation.  The
                  existing type space does however encompass most
                  basic types used in modern programming languages,
                  as well as some derived types (such as ipv4Address)
                  which are common to this domain and useful
                  to distinguish.
                </documentation>
              </annotation>
            </attribute>
```

```
<attribute name="dataTypeSemantics"
           type="ipfix:dataTypeSemantics" use="optional">
  <annotation>
    <documentation>
      The integral types may be qualified by additional
      semantic details. Valid values for the data type
      semantics are specified in section 3.2 of this
      document or in a future extension of the
      information model.
    </documentation>
  </annotation>
</attribute>

<attribute name="elementId" type="nonNegativeInteger"
           use="required">
  <annotation>
    <documentation>
      A numeric identifier of the Information Element.
      If this identifier is used without an enterprise
      identifier (see below), then it is globally unique
      and the list of allowed values is administered by IANA.
      It is used for compact identification of an
      Information Element when encoding templates in the
      protocol.
    </documentation>
  </annotation>
</attribute>

<attribute name="enterpriseId" type="nonNegativeInteger"
           use="optional">
  <annotation>
    <documentation>
      Enterprises may wish to define Information Elements
      without registering them with IANA, for example for
      enterprise-internal purposes. For such Information
      Elements the Information Element identifier described
      above is not sufficient when the Information Element
      is used outside the enterprise.  If specifications
      of enterprise-specific Information Elements are made
      public and/or if enterprise-specific identifiers are
      used by the IPFIX protocol outside the enterprise,
      then the enterprise-specific identifier MUST be made
      globally unique by combining it with an enterprise
      identifier.  Valid values for the enterpriseId are
      defined by IANA as SMI network management private
      enterprise codes.  They are defined at
      http://www.iana.org/assignments/enterprise-numbers.
    </documentation>
```

```
              </annotation>
            </attribute>

            <attribute name="applicability"
                       type="ipfix:applicability" use="required">
              <annotation>
                <documentation>This propoerty of an Information
                Element indicates in which kind of records the
                Information Element can be used.
                Allowed values for this property are 'data',
                'option', and 'all'.</documentation>
              </annotation>
            </attribute>

            <attribute name="status" type="ipfix:status"
                       use="required">
              <annotation>
                <documentation>The status of the specification of this
                  Information Element.  Allowed values are 'current',
                  'deprecated', and 'obsolete'.
                </documentation>
              </annotation>
            </attribute>

            <attribute name="group" type="string"
                       use="required">
              <annotation>
                <documentation>to be done ...</documentation>
              </annotation>
            </attribute>

          </complexType>
        </element>
      </sequence>
    </complexType>

    <unique name="infoElementIdUnique">
      <selector xpath="field"/>

      <field xpath="infoElementId"/>
    </unique>
  </element>
</schema>
```

Intellectual Property Statement

Disclaimer of Validity

Copyright Statement

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