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Export BGP community information in IP Flow Information Export (IPFIX)
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Abstract

This draft updates [RFC7012](#) IPFIX information model by introducing several information elements to enable IPFIX to export the BGP community information, including BGP standard community defined in [RFC1997](#), BGP extended community defined in [RFC4360](#), and BGP large community defined in [RFC8092](#). Network traffic flow information can then be accumulated and analysed at the granularity specified by the BGP communities, which is suitable for and needed by some traffic optimization applications located in IPFIX collector, SDN controller or PCE (Path Computation Element).

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Export BGP Community in IPFIX

October 2017

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[1.](#) Introduction

IP Flow Information Export (IPFIX) [[RFC7011](#)] provides network administrators with traffic flow information using the information elements (IEs) defined in [[IANA-IPFIX](#)] registries. Based on the traffic flow information, network administrators know the amount and direction of the traffic in their network, then they can optimize their network when needed. For example, they can shift some flows

from the congested links to the low utilized links through a SDN controller or PCE [[RFC4655](#)].

[IANA-IPFIX] has already defined the following IEs for traffic flow information exporting in different granularities: sourceIPv4Address,

sourceIPv4Prefix, destinationIPv4Address, destinationIPv4Prefix, bgpSourceAsNumber, bgpDestinationAsNumber, bgpNextHopIPv4Address, etc. In some circumstances, however, especially when traffic engineering and optimization are executed in the Tier 1 or Tier 2 operators' backbone networks, traffic flow information based on these IEs may not be suitable. Flow information based on IP address or IP prefix may provide much too fine granularity for a large network. On the contrary, flow information based on AS number may be too coarse. BGP community [[RFC1997](#)], which describes a group of routes sharing some common properties, is preferably used for traffic engineering at the proper granularity [[Community-TE](#)] [[RFC4384](#)]. There is no IE defined for BGP community information in [[IANA-IPFIX](#)] yet.

Flow information based on BGP community may be collected by a mediator defined in [[RFC6183](#)]. Mediator is responsible for the correlation between flow information and BGP community. However no IEs are defined in [[RFC6183](#)] for exporting BGP community information in IPFIX. Furthermore, to correlate the BGP community with the flow information, mediator needs to learn BGP routes and perform lookup in the BGP routing table to get the matching entry for specific flow. Neither BGP route learning nor routing table lookup is trivial for a mediator. Mediator is mainly introduced to release the performance requirement for the exporter [[RFC5982](#)]. In fact, to obtain the information for BGP related IEs that have already been defined, such as bgpSourceAsNumber, bgpDestinationAsNumber, and bgpNextHopIPv4Address, etc, exporter has to hold the up-to-date BGP routing table and perform lookup in the BGP routing table. The exporter can obtain the BGP community information in the same procedure, thus exporting BGP community information adds no more requirement for exporter. It is RECOMMENDED that the BGP community information be exported by the exporter directly using IPFIX.

This draft introduces new IEs to extend the IPFIX information model defined in [[RFC7012](#)] to export the BGP community information, including BGP standard community defined in [[RFC1997](#)], BGP extended community defined in [[RFC4360](#)], and BGP large community defined in

[RFC8092]. Flow information, including packetDeltaCount, octetDeltaCount [RFC7012] etc, can then be accumulated and analysed by the collector or other applications, such as SDN controller or PCE [RFC4655], at the granularity specified by BGP community, which is useful for traffic engineering or traffic optimization applications, especially in the backbone network.

The IEs introduced in this document are applicable for both IPv4 and IPv6 traffic. Both exporter and mediator can use these IEs to export BGP community information in IPFIX.

[2.](#) Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

[3.](#) IEs for BGP Standard Community

[RFC1997] defines the BGP Communities attribute, called BGP Standard Community in this document, which describes a group of routes sharing some common properties. BGP Standard Communities are treated as 32 bit values as stated in [RFC1997].

In order to export BGP standard community information along with other flow information defined by IPFIX, three new IEs are introduced. One is bgpCommunity, which is used to identify that the value in this IE is a BGP standard community. The other two are bgpSourceCommunityList and bgpDestinationCommunityList, which are both basicList [RFC6313] of bgpCommunity, and are used to export BGP standard community information corresponding to a specific flow's source IP and destination IP respectively.

The detailed information of the three new IEs are shown in the following sections.

[3.1.](#) bgpCommunity

ElementID	to be assigned by IANA
-----------	------------------------

Name	bgpCommunity
Data Type	unsigned32
Data Type Semantics	identifier
Description	BGP community as defined in [RFC1997]
Units	none

Figure 1: bgpCommunity

[3.2.](#) bgpSourceCommunityList

ElementID	to be assigned by IANA
Name	bgpSourceCommunityList
Data Type	basicList, as specified in [RFC6313]
Data Type Semantics	list
Description	zero or more BGP communities corresponding with source IP address of a specific flow
Units	none

Figure 2: bgpSourceCommunityList

[3.3.](#) bgpDestinationCommunityList

ElementID	to be assigned by IANA
-----------	------------------------

Name	bgpDestinationCommunityList
Data Type	basicList, as specified in [RFC6313]
Data Type Semantics	list
Description	zero or more BGP communities corresponding with destination IP address of a specific flow
Units	none

Figure 3: bgpDestinationCommunityList

4. IEs for BGP Extended Community

[RFC4360] defines the BGP Extended Communities attribute, which provides a mechanism for labeling the information carried in BGP. Each Extended Community is encoded as an 8-octet quantity with the format defined in [\[RFC4360\]](#).

In order to export BGP Extended Community information together with other flow information by IPFIX, three new IEs are introduced. The first one is bgpExtendedCommunity, which is used to identify that the value in this IE is a BGP Extended Community. The other two are bgpSourceExtendedCommunityList and

bgpDestinationExtendedCommunityList, which are both basicList [\[RFC6313\]](#) of bgpExtendedCommunity, and are used to export the BGP Extended Community information corresponding to a specific flow's source IP and destination IP respectively.

The detailed information of the three new IEs are shown in the following sections.

4.1. bgpExtendedCommunity

ElementID	to be assigned by IANA
Name	bgpExtendedCommunity

Data Type	octetArray
Data Type Semantics	default
Description	BGP Extended Community as defined in [RFC4360] The size of this Information Element is 8 octets.
Units	none

Figure 4: bgpExtendedCommunity

[4.2.](#) bgpSourceExtendedCommunityList

ElementID	to be assigned by IANA
Name	bgpSourceExtendedCommunityList
Data Type	basicList, as specified in [RFC6313]
Data Type Semantics	list

Description	zero or more BGP Extended Communities corresponding with source IP address of a specific flow
Units	none

Figure 5: bgpSourceExtendedCommunityList

4.3. bgpDestinationExtendedCommunityList

ElementID	to be assigned by IANA
Name	bgpDestinationExtendedCommunityList
Data Type	basicList, as specified in [RFC6313]
Data Type Semantics	list
Description	zero or more BGP Extended communities corresponding with destination IP address of a specific flow
Units	none

Figure 6: bgpDestinationExtendedCommunityList

5. IEs for BGP Large Community

[RFC8092] defines the BGP Large Communities attribute, which is suitable for use with all Autonomous System Numbers (ASNs) including four-octet ASNs. Each BGP Large Community is encoded as a 12-octet quantity with the format defined in [\[RFC8092\]](#).

other flow information by IPFIX, three new IEs are introduced. The first one is `bgpLargeCommunity`, which is used to identify that the value in this IE is a BGP Large Community. The other two are `bgpSourceLargeCommunityList` and `bgpDestinationLargeCommunityList`, which are both `basicList` [RFC6313] of `bgpLargeCommunity`, and are used to export the BGP Large Community information corresponding to a specific flow's source IP and destination IP respectively.

The detailed information of the three new IEs are shown in the following sections.

5.1. `bgpLargeCommunity`

ElementID	to be assigned by IANA
Name	<code>bgpLargeCommunity</code>
Data Type	<code>octetArray</code>
Data Type Semantics	default
Description	BGP Large Community as defined in [RFC8092] The size of this Information Element is 12 octets.
Units	none

Figure 7: `bgpLargeCommunity`

5.2. `bgpSourceLargeCommunityList`

ElementID	to be assigned by IANA
Name	bgpSourceLargeCommunityList
Data Type	basicList, as specified in [RFC6313]
Data Type Semantics	list
Description	zero or more BGP Large Communities corresponding with source IP address of a specific flow
Units	none

Figure 8: bgpSourceLargeCommunityList

5.3. [bgpDestinationLargeCommunityList](#)

ElementID	to be assigned by IANA
Name	bgpDestinationLargeCommunityList
Data Type	basicList, as specified in [RFC6313]
Data Type Semantics	list
Description	zero or more BGP Large communities corresponding with destination IP address of a specific flow
Units	none

Figure 9: bgpDestinationLargeCommunityList

6. Operational Considerations

The maximum length of an IPFIX message is 65535 bytes as per [\[RFC7011\]](#), and the maximum length of a normal BGP message is 4096 bytes as per [\[RFC4271\]](#). Since BGP communities, including standard, extended, and large communities, are BGP path attributes carried in

BGP Update messages, the total length of these attributes can not exceed the length of a BGP message, i.e. 4096 bytes. So one IPFIX

message with maximum length of 65535 bytes has enough space to fit all the communities related to a specific flow, both the source IP and the destination IP related.

[I-D.ietf-idr-bgp-extended-messages] extends the maximum size of a BGP Update message to 65535 bytes. Then theoretically the BGP community information related to a specific flow may exceed the length one IPFIX message. However, according to the information about the networks in the field, the number of BGP communities in one BGP route is usually no more than 10. Nevertheless, BGP speakers that support the extended message SHOULD be careful to export the BGP communities in the IPFIX message properly, such as only convey as many communities as possible in the IPFIX message. The collector which receives an IPFIX message with maximum length and BGP communities contained in its data set SHOULD be aware that the BGP communities may be truncated due to limited message space. In this case, it is RECOMMENDED to configure export policy of BGP communities on the exporter to limit the BGP communities to be exported, so as to only export some specific communities, or not to export some specific communities.

If needed, we may consider to extend the message length of IPFIX [[RFC7011](#)] from 16 bits to 32 bits to solve this problem completely. The detailed mechanism is out of the scope of this document.

[7.](#) Security Considerations

This document only defines three new IEs for IPFIX. This document itself does not directly introduce security issues. The same security considerations as for the IPFIX Protocol Specification [[RFC7011](#)] and Information Model [[RFC7012](#)] apply.

As the BGP community information is deducible by other means, there are no increased privacy concerns, neither.

[8.](#) IANA Considerations

This draft specifies the following IPFIX IEs to export BGP community information along with other flow information.

The Element IDs for these IEs are solicited to be assigned by IANA. The following table is for IANA's reference to put in each field in the registry.

ElementID	Name	Data Type	Data Type Semantics
TBA1	bgpCommunity	unsigned32	identifier

TBA2	bgpSourceCommunityList	basicList	list
TBA3	bgpDestinationCommunityList	basicList	list
TBA4	bgpExtendedCommunity	octetArray	default
TBA5	bgpSourceExtendedCommunityList	basicList	list
TBA6	bgpDestinationExtendedCommunityList	basicList	list
TBA7	bgpLargeCommunity	octetArray	default
TBA8	bgpSourceLargeCommunityList	basicList	list
TBA9	bgpDestinationLargeCommunityList	basicList	list

ElementID	Description	Units
TBA1	BGP community as defined in [RFC1997]	
TBA2	zero or more BGP communities corresponding with source IP address of a specific flow	
TBA3	zero or more BGP communities corresponding with destination IP address of a specific flow	

TBA4	BGP Extended Community as defined in [RFC4360] The size of this IE is 8 octets
TBA5	zero or more BGP Extended Communities corresponding with source IP address of a specific flow
TBA6	zero or more BGP Extended communities corresponding with destination IP address of a specific flow
TBA7	BGP Large Community as defined in [RFC8092] The size of this IE is 12 octets.
TBA8	zero or more BGP Large Communities corresponding with source IP address

	of a specific flow
TBA9	zero or more BGP Large communities corresponding with destination IP address of a specific flow

ElementID	Range	References	Requester	Revision	date
TBA1		RFC1997	this draft	0	
TBA2		RFC6313 , RFC1997	this draft	0	
TBA3		RFC6313 , RFC1997	this draft	0	
TBA4		RFC4360	this draft	0	
TBA5		RFC6313 , RFC4360	this draft	0	
TBA6		RFC6313 , RFC4360	this draft	0	
TBA7		RFC8092	this draft	0	
TBA8		RFC6313 , RFC8092	this draft	0	

TBA9		RFC6313 , RFC8092	this draft		0	
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Figure 10: IANA Considerations

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[Appendix A](#). Application Example

In this section, we give an example to show the encoding format for the three new introduced IEs.

Flow information including BGP communities is shown in the below table. Suppose we want all the fields to be reported by IPFIX.

Source ip	Destination ip	Source BGP community	Destination BGP community
1.1.1.1	2.2.2.2	1:1001,1:1002,8:1001	2:1002,8:1001
3.3.3.3	4.4.4.4	3:1001,3:1002,8:1001	4:1001,8:1001

Figure 11: Flow information including BGP communities

[A.1](#). Template Record

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```

0           1           2           3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|           SET ID = 2           |           Length = 24           |
```



```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      Template ID = 256      |      Field Count = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|0|      SourceIPv4Address = 8  |      Field length = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|0| DestinationIPv4Address = 12 |      Field length = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|0| bgpSourceCommunityList = 459|      Field length = 0xFFFF |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|0| bgpDestinationCommunityList |      Field length = 0xFFFF |
| |      = 460                  |                               |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

Figure 12: Template Record Encoding Format

In this example, the Template ID is 256, which will be used in the data record. The field length for `bgpSourceCommunityList` and `bgpDestinationCommunityList` is `0xFFFF`, which means the length of this IE is variable, the actual length of this IE is indicated by the list length field in the basic list format as per [\[RFC6313\]](#).

A.2. Data Set

The data set is represented as follows:

```

      0              1              2              3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      SET ID = 256      |      Length = 92      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      SourceIPv4Address = 1.1.1.1      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      DestinationIPv4Address = 2.2.2.2      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      255      |      List length = 17      |semantic=allof |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      bgpCommunity = 458      |      Field Len = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Source Community Value 1 = 1:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Source Community Value 2 = 1:1002      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Source Community Value 3 = 8:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

```

|      255      |      List length = 13      |semantic =allof|
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      bgpCommunity = 458      |      Field Len = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Destination Community Value 1 = 2:1002      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Destination Community Value 2 = 8:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      SourceIPv4Address = 3.3.3.3      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      DestinationIPv4Address = 4.4.4.4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      255      |      List length = 17      |semantic =allof|
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      bgpCommunity = 458      |      Field Len = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Source Community Value 1 = 3:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Source Community Value 2 = 3:1002      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Source Community Value 3 = 8:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      255      |      List length = 13      |semantic =allof|
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      bgpCommunity = 458      |      Field Len = 4      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Destination Community Value 1 = 4:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
|      BGP Destination Community Value 2 = 8:1001      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

Figure 13: Data Set Encoding Format

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