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BGP Flow Specification Version 2 - More IP Filters
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Abstract

The BGP flow specification version 2 (FSv2) for Basic IP defines user ordering of filters along with FSv1 IP Filters and FSv1 actions. This draft defines the format for the Extended IP Filters for Flow Specification FSv2.

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1. Introduction

Version 2 of BGP flow specification (FSv2) has a series of foundational documents ([I-D.ietf-idr-fsv2-ip-basic], this document, [I-D.hares-idr-fsv2-more-ip-actions], and [draft-hares-idr-fsv2-non-ip]) plus drafts on specific filter components, actions, or groups of filter components and actions.

The remainder of this introductory section provides a introduction to FSv2.

Section 2 contains a description of the format of the FSv2 NLRI with the Extended IP Filters TLV. The Extended IP Filters TLV allows the user to specify new IP Filters components and a group of IP Filter components.

The concept of a group of filter components allows an BGP peer originating a FSv2 NLRI with the Extended IP Filter TLV to pass what components the originating BGP Peer expects will be supported by the BGP Peers receiving the FSv2 Extended Filter TLV. The group field is designed to aid upgrades to additional component by providing a simple check the FSv2 component range passed in the Extended Filters TLV. Groups can be register with IANA in either a FCFS range or IETF Consensus range. Section 2 also provides templates for defining: a) new components to be passed in the Extended IP Filter group and b) new Extended IP Filter groups.

Section 4 provides information on Validation and Error handling for the Extended Filters TLV. Section 5 contains manageability considerations for FSv2 with Extended IP Filters TLV. Section 6 contains IANA considerations and section 6 contains security considerations.

1.1. FSv2 background

FSv2 specifies new user-ordered filters that will be used with the IPv4 (AFI=1) and IPv6 (AFI=2) 2 new SAFIs (TBD1, TBD2) for FSv2 to be used with 5 AFIs (1, 2, 6, 25, and 31) to allow user-ordered lists of traffic match filters for user-ordered traffic match actions encoded in Communities (Extended or Community Path attribute). The first SAFI (TBD1) is used for IP forwarding, and the second SAFI (TBD2) will be used with VPNs. The supported AFI/SAFI combinations in FSV2 are:

- * IPV4 (AFI=1, SAFI=TBD1),
- * IPv6 (AFI=2, SAFI=TBD1),
- * L2 (AFI=6, SAFI=TBD1),
- * SFC (AFI=31, SAFI=TBD1),
- * BGP/MPLS IPv4 VPN (AFI=1, SAFI=TBD2),
- * BGP/MPLS IPV6 VPN (AFI=2, SAFI=TBD2),
- * BGP/MPLS L2VPN (AFI=25, SAFI=TBD2), and
- * SFC VPN (AFI=31, SAFI=TBD2)

A FSv2 is compliant if it implements FSv2 Basic IP forwarding functions only one AFI/SAFI pair. For example, an implementation could implement just the the FSv2 IPv4 for IP forwarding (AFI=1, SAFI=TBD1).

FSv1 and FSv2 use different AFI/SAFIs to send flow specification filters. Since BGP route selection is performed per AFI/SAFI, this approach can be termed “ships in the night” based on AFI/SAFI.

FSv2 is defined as a series of specifications. Only the FSv2 IP Basic forwarding functions are mandatory for all FSv2 implementations. Below is a list of planned specification:

FSv2 IP Basic ([I-D.ietf-idr-fsv2-ip-basic]): This specification

defines the FSv2 NLRI that allows user ordering of filters plus in a IP Basic TLV which only supports FSv1 components. FSv2 actions are implemented in Extended Communities (FSv2-EC). One or more FSv2-EC actions can be attached to a single filter component. If multiple FSv2-EC actions are attached, the implementations SHOULD support the procedures for categorization of actions and failure actions.

FSv2 IP Extended Filters (draft-hares-idr-fsv2-ip-more-filters):

This document defines the Extended IP Filters TLV to allow easy addition of FSv2 filters.

FSv2 Individual drafts for IP Extended Filters: These drafts should utilize the template given in section 2.2 Current proposals for Extended IP Filters can request component identifier(s) be included in this draft's BGP FSv2 Component registry list. Grouping of Extended IP Filter can be registered in the Extended IP Filter Groups (see section 2.3).

FSv2 IP Extended Actions ([I-D.hares-idr-fsv2-more-ip-actions]):

This document defines a FSv2 TLV for the for the BGP Community Path Attribute, and a protocols for combining FSv2 Extended Community (FSv2-EC) Actions with FSv2 Community Path Attributes.

FSv2 Individual drafts for FSv2 Actions: These drafts may define FSv2 actions in Extended Communities and/or FSv2 actions in the FSv2 TLV of the BGP Community Attribute.

Non-IP Filters (draft-hares-idr-fsv2-non-ip]: defines the template for FSv2 non-IP filters for MPLS, L2 traffic, SFC, and tunnel traffic, and FSV2 non-IP actions.

Individual drafts on Non-IP Filters: IDR drafts for non-ip functions passed in BGP FSv2 includes: MPLS ([draft-hares-idr-fsv2-mpls]), L2VPN ([I-D.ietf-idr-flowspec-l2vpn]), and NV03 ([I-D.ietf-idr-flowspec-nvo3]).

1.2. Definitions and Acronyms

AFI: Address Family Identifier

AS: Autonomous System

BGP Session ephemeral state: state which does not survive the loss of BGP peer session.

BGP Configuration state: state which persist across a reboot of

software module within a routing system or a reboot of a hardware routing device.

DDOS: Distributed Denial of Service.

Ephemeral state: state which does not survive the reboot of a software module, or a hardware reboot. Ephemeral state can be ephemeral configuration state or operational state.

FS: Flow Specification.

FSv1: Flow Specification version 1 [RFC8955] [RFC8956]

FSv2: Flow Specification version 2 [I-D.ietf-idr-fsv2-ip-basic], [this document].

FS-EC: Flow Specification Extended Community

FSv1-EC: FSv1 Extended Community that signals actions that occur after a filter match

FSv2-EC: FSv2 Extended Community that signals actions that occur after a filter match. FSv2-EC are preformed with either a default order of processing or signal the FSv2-EC are performed in implementation order.

NETCONF: The Network Configuration Protocol [RFC6241].

RESTCONF: The RESTCONF configuration Protocol [RFC8040].

RIB: Routing Information Base.

ROA: Route Origin Authentication [RFC9582]

RR: Route Reflector.

SAFI: Subsequent Address Family Identifier.

1.3. Requirements Language

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

2. Extending the IP Filters

The format of the FSv2 NLRI field for IP Filters is defined in [I-D.ietf-idr-fsv2-ip-basic]. This format includes a common header with fields for user specified order, dependency filter chain, and a TLV for filter components (type, length, value).

This section defines the use of the dependency filter chain (section 2.1) in the NLRI and the format of the Extended IP Filters TLV (section 2.2). The Extended IP Filter group provides a flexible means to define which components are supported by the Extended IP Filter TLV. Four Extended Filter Component groups are defined in section 2.3, but additional may be defined via an IANA Registry. The ordering of Filters is by user define order number, then component, then value within a component. Section 2.4 provides the rules for ordering for FSv2 NLRI with IP Basic Filters and Extended IP Filters. Section 2.5 provides a template for new Extended IP Components.

2.1. Dependency Filter Chain in FSv2 NLRI Header

FSv2 filters may be distributed in multiple BGP UPDATE packets. The format of the FSv2 NLRI is shown in Figure 2-1. In FSv2, the user can define the order of the filters by an including an order in the FSV2 NLRI prior to the filter. FSv2 also defines an optional dependency filter chain to allow the filter chains to be identified across all FSV2 Filter chains. This information may be installed from BGP data based into firewalls.

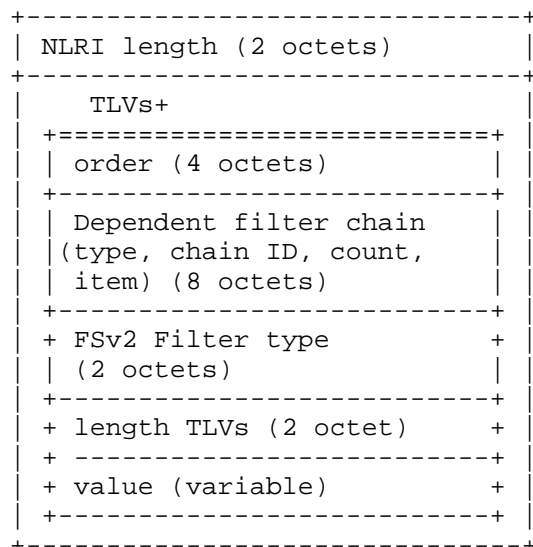


Figure 2-1 - FSv2 NLRI with Extended IP Filter type.

Where:

order: 4 octet field for the FSv21 user defined order of the filter with a value of 1-n. The value of zero is invalid

Dependent Filters Chain: 8 octets for identifying a chain of FSv2 filters that must be deployed at the same time. (See figure 2-2 for details.) If the dependency filters chain type field is zero, there is no dependency filter chain defined.

FSv2 Filter type: 2 octet field for the FSv2 filter type. The Extended IP Filter type value is 2.

length: 2 octet field for the length of the value field.

value field: variable length field defined per FSv2 filter type. The value field for the Extended IP Filter rules has the format shown in Figure 2-3.

The dependency filter chain has the following components:

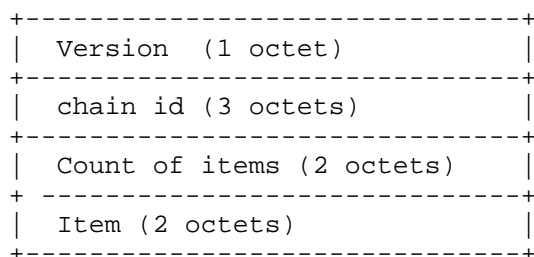


Figure 2-2 IP header SubTLV format

where:

Version: This 1 octet field defines the version of the filter chain. Valid values are 1-0xFF. Value 0 identifies that there is "No dependency filter chain". In this case the remaining 7 bytes (chain id, count of items, and item) are also zero.

Chain ID: This 3 octet field identifies the filter chain. Valid values include 0x00001 to 0xFFFFFFFF with the value zero (0x000000) being reserved.

Count of items: This 2 octet field contains the count of item on this filter dependency chains. Valid values are 0x0001 to 0xFFFF with the value of zero being reserved.

Item: This (2 octets): filter sequence number on chain Valid values are 0x0001 to 0xFFFF with the value of zero being reserved.

2.2. Extended IP Filters TLV

The Extended IP Filters TLV has a type value of TBD1 with a variable length. The Extended IP Filters value field has the form shown in Figure 2-3 where:

FSv2 Extended Filters Group: is a 2 octet field indicating the group of components supported. Three groups are defined in this document. Additional groups may be defined by registering the group in the FSv2 Extended IP Filter group registry (see IANA registry policy in section 6.2), but those groups are outside the scope of this document.

Components+: This field is a sequence of FSv2 Components with the format shown in figure 2-4.

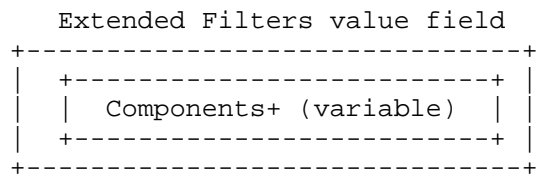


Figure 2-3 - Extended IP Filters TLV

Each Component is a sequence of TLVs with the format

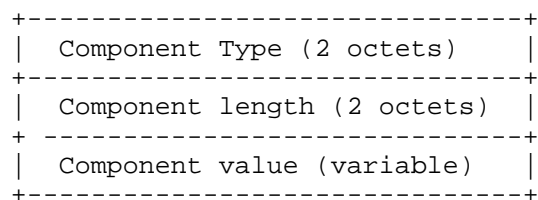


Figure 2-4 Component format

Where:

Component type: is a 1 octet specify the component type.

Component length: is a 2 octet value specifying the component length.

Component value: is a variable field defined per component.

The valid components for the Extended IP Filters defined by this specification are listed in table 2-1 below. These components include the following:

IP Basic components: Components 1-13 are defined in [I-D.ietf-idr-fsv2-ip-basic].

TTL Filter on Time to Live in IPv4 packet or maximum hop limit in IPv6 packets. This is defined in draft-hares-idr-fsv2-TTL-filter

SID function SID in segment routing header (SRH) in the IPv6 packet (per [I-D.ietf-idr-flowspec-srv6])

NRP ID NRP ID in Next Hop header in IPv6 packet (per [I-D.ietf-idr-flowspec-network-slice-ts])

Table 2-1 (ordering by frame)

Components for Extended IP Filters TLV

Component ID DEC / HEX	Extended IP Filters Components for IP Extended Filters version 2
00-15 /0x00-0x0F	Reserved for IP Basic TLV components
16-31 /0x10-0x10	Reserved for global headers
32-50 /0x20-0x32	Reserved for MPLS
51-63 /0x33-0x3F	Reserved for L2 Traffic
64-80 /0x40-0x50	Reserved for SFC Traffic
81-100/0x51-0x64	Reserved for Tunnelled (L3/L2) traffic
101-120/0x65-0x78	Reserved for srv6
101 /0x65	SRv6
102 /0x66	NRP ID in IPv6 Header
256 /0x100	TTL-Pre
270 /0x10E	IP Destination prefix
280 /0x118	IP Source prefix
290 /0x122	IPv4 Protocol or IPv6 Upper Layer Protocol
300 /0x12C	Port
310 /0x136	Destination Port
320 /0x140	Source Port
330 /0x14A	ICMPv4 type or ICMPv6 type
340 /0x154	ICMPv4 code or ICMPv6 code
350 /0x15E	TCP Flags
360 /0x168	Packet length
370 /0x172	DSCP
380 /0x17C	Fragment
390 /0x186	Flow Label
400 - /0x190	TTL-Post
410 - /0x19A	Payload

2.3. Ordering within FSv2 NLRI in Update Packet

The transmission of TLVs within a FSv2 NLRI SHOULD be sent via ascending user order (see the first 4 bytes of the FSv2 NLRI). Order is set by local configuration of the BGP Peer originating the FSv2 packet.

Within a single order value, the TLVs should be ordered by ascending FSv2 Filter type. The FSv2 Filter types which MUST be supported for the Extended IP Filter support are Filter Type IP Basic (type = 256) and Filter Type Extended IP Filters (type = 280). Other FSv2 Filter types MAY be supported, but the support of those filter types is outside the scope of this document.

Within the same order value and IP Basic Filter Type value, the components should be ordered by ascending numerical order of the component type value. If there are multiple filters with the same order value, IP Basic Filter type TLV, and component type, the order of the filters is defined by the component.

Within the same order value and Extended IP Basic Type value, the filters should be ordered by group and then by component value. If there are multiple filters with the same order value, IP Extended Filter Type TLV, group value, and component type, the order of the filters is defined by the component.

if the order of the filters is defined by the component, the value fields for components 1-13 are defined in [I-D.ietf-idr-fsv2-ip-basic], [RFC8955] and [RFC8956]. The filters MUST be stored with the value fields in ascending order.

NLRIs having TLVs which do not follow the above ordering rules MUST be considered as malformed by a BGP FSv2 propagator. This rule prevents any ambiguities that arise from the multiple copies of the same NLRI from multiple BGP FSv2 propagators. A BGP implementation SHOULD treat such malformed NLRIs as "session reset" [RFC7606].

2.4. Template for Extended IP Components

Summary: One line title summary

Component type: The numerical value for component type. If the component value has not been assigned by IANA, this value should be in the form TBDx where x is a number (1..N).

Description: Description of what component does.

What field component targets in IPv4 packet: The specific field or fields the component filters. If the field filter is in the IPv6 packet, then this field is left (n/a).

What field Filter targets in IPv6 packet: The specific field or fields the component filters. If the field filter is in the IPv4 packet, then this field is left (n/a).

Length: Describe the length or possible lengths of this field.

Encoding of Component Value field This is the encoding of the value in FSv2 NLRI. The best descriptions combine a diagram plus a description.

Ordering within component: The mechanism to order if multiple

components of the same type occur.

Conflicts with other filters: Describe what other filters this component could interfere with.

Example encoding: Provide one simple example of the encoding of a filter for the component.

references: earlier documents which defined this filter.

3. Validation and Error Handling

Validation of the FSv2 NLRI follows the rules from section 4.1 of [I-D.ietf-idr-fsv2-ip-basic]. For ease of reference to this validation procedure, the implementer might consider the following facts:

- * Extended IP filters are passed as either IPv4 (AFI=1, SAFI=TBD1), IPv6 (AFI=2, SAFI=TBD1), IPv4 VPN (AFI=1, SAFI=TBD2), IPv6 VPN (AFI=2, SAFI=TBD2). or (AFI=2) SAFI=TBD1 or SAFI=TBD2.
- * IP Extended filters sent in SAFI=TBD1 are validated against SAFI=1. To be specific, (AFI=1, SAFI=TBD1) is validated against (AFI=1, SAFI=1), and (AFI=2, SAFI=TBD1) is validated against (AFI=2, SAFI=1).
- * IP Extended filters sent in SAFI=TBD2 are validated against SAFI=128. To be specific, (AFI=1, SAFI=TBD2) is validated against (AFI=1, SAFI=128) AND (AFI=2, SAFI=TBD2) is validated against (AFI=2, SAFI=128).

Validation of the FSv2 NLRI follows the rules from section 4.2 of [I-D.ietf-idr-fsv2-ip-basic] apply to the FSV2 NLRI filters. For ease of reference to this section, implementers might consider the following facts:

FSv2 defines a Rule-0 for 0/0 with "permit-all" action.

- By default, FSv2 (and FSv1) restrict the flow from permit all. By configuration, Rule-0 could be set to 0/0 with "permit-none" and filters could have the benefit of allowing traffic. If this configuration knob is set, then it MUST be used in a Limited Domain of cooperating networks.

FSv2 rules are ordered by ascending user order number, FSv2 Filter type, FSv2 component type, and FSv2 component value.

- This ordering rules means that multiple FSv2 filter rules with the same user order number of ordered by ascending FSv2 filter types (IP Basic (0x01) and Extended IP Filters (0x02)). If the FSv2 filter has the same user order and Filter type, then the order is by ascending FSv2 component type numbers. Finally, if FSv2 filters have the same user order, Filter type, component type, then the filter is ordered by the component value.

Order is deterministic, but arbitrary. Users may use the user ordering and dependency chain to establish more complex relationships.

The following two error handling rules stated in Section 4.1.3 of [I-D.ietf-idr-fsv2-ip-basic] must be followed by all BGP speakers:

- * 1) FSv2 NLRI having TLV which do not have the correct length or syntax must be considered MALFORMED. Syntax is defined as having each field within NLRI header (order, dependent filters chain and within the FSv2 TLV (IP Basic TLV or Extended TLV) header, and each component. Any MALFORMED FSv2 NLRI is handled as "session reset" per [RFC7606].
- * 2) Any FSV2 NLRI which do not follow the ordering rules described in section 4 [I-D.ietf-idr-fsv2-ip-basic] for filters is considered MALFORMED.

Actions are transmitted on Extended Communities (EC) for FSv2 basic actions (FSv2-EC) or BGP Community path attribute (CPA) with FSv2 TLV (FSv2-CPA). The following rules MUST be followed by the FSv2 actions:

- * If BGP Community Path Attribute is not supported, then FSv2-EC MUST be ordered by FSv2 default order (see [I-D.ietf-idr-fsv2-ip-basic]) if one of the two conditions is not present:
 - Implement configuration knob that implementation specific order is set
 - Action Chain Order (ACO) FSV2-EC is attached with the Action dependency set to implementation specific
- * If a BGP Community Path Attribute with a FSv2 TLV (FSv2-CPA) is supported and attached in an invalid form, then the FSv2-CPA is ignored and not forwarded.

- * If BGP Community Path Attribute with a FSv2 TLV (FSv2-CPA) is supported and a valid FSv2-CPA is attached, then the FSv2-CPA takes precedence over FSv2-EC. The BGP Community Path attribute allows for user ordering with user order values of [1-N]. By default, the FSv2-EC follow the FSv2-CP actions (N+1) with all FSv2-EC on the same user order number. Early deployments of FSv2-CPA may want to reverse this order (first FSv2-EC, then BGP Community Path attribute). If so, FSv2-EC should be defined as [action order 0] by configuration knob.

4. Manageability

FSv1 is a key part of many existing networks. The introduction of FSv2 is expected to be a phased process. where FSv1 is replaced slowly. One potential way this might occur is the following:

FSv2 IP basic filters replaces FSv1 Filters

- A FSv2 implementation may simply configure FSv2 with the same IP Basic components as used in FSv1, and a user order of 1 for FSv2. FSv1 could be configured with a default user order of 10.

Actions in Extended Communities (EC) to done one of the following things:

- Use Existing Communities in the FSv2 order
- Send a ACO community to signal the order is implementation specific (see [I-D.ietf-idr-fsv2-ip-basic] indicating implementation specific ordering.
- Configure a Limited Domain of BGP speakers with policy that specifies the same Extended Community support (ACO does the same thing).

(editorial comments): Open issue. We need a discussion of deploying new TLVs within FSv2. Potential options are:

- a) Open capabilities on AFI/SAFI,
- b) Next-Hop capabilities within a domain or within a group,
- c) something else

5. IANA Considerations

This section complies with [RFC7153].

5.1. Flow Spec Component types

IANA is requested to indicate [this draft] as a reference on the following range assignments in the Flow Spec Component Types Registry. Designated experts will assign individual values.

Component ID	Space allocation	FSv2 Reference
-----	-----	-----
0	Reserved	[this document]
1-13	FSv1 components	[draft-ietf-idr-fsv2-ip-basic]
14-31	before L2 group filters	[this document]
50-99	L2 Traffic filters	[this document]
100-149	MPLS	[this document]
150-255	SFC	[this document]
256	TTL-Pre FSv1 filters	[this document]
257-279	FSv1 filters	[this document]
280-400	Extended Filters	[this document]
400-above	Reserved	[this document]

6. Security Considerations

The use of ROA improves on [RFC8955] by checking to see of the route origination. This check can improve the validation sequence for a multiple-AS environment.

The use of the reduced validation within an AS [RFC9117] can provide adequate validation for distribution of flow specification within a single autonomous system for prevention of DDoS.

Distribution of flow filters may provide insight into traffic being sent within an AS, but this information should be composite information that does not reveal the traffic patterns of individuals.

7. References

7.1. Normative References

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