EVPN Routing Policy

This chapter describes how routing protocols make decisions to advertise, aggregate, discard, distribute, export, hold, import, redistribute and modify the routes based on configured routing policy.

- EVPN Routing Policy, page 1

EVPN Routing Policy

The EVPN Routing Policy feature provides the route policy support for address-family L2VPN EVPN. This feature adds EVPN route filtering capabilities to the routing policy language (RPL). The filtering is based on various EVPN attributes.

A routing policy instructs the router to inspect routes, filter them, and potentially modify their attributes as they are accepted from a peer, advertised to a peer, or redistributed from one routing protocol to another.

This feature enables you to configure route-policies using EVPN network layer reachability information (NLRI) attributes of EVPN route type 1 to 5 in the route-policy match criteria, which provides more granular definition of route-policy. For example, you can specify a route-policy to be applied to only certain EVPN route-types or any combination of EVPN NLRI attributes. This feature provides flexibility in configuring and deploying solutions by enabling route-policy to filter on EVPN NLRI attributes.

To implement this feature, you need to understand the following concepts:

- Routing Policy Language
- Routing Policy Language Structure
- Routing Policy Language Components
- Routing Policy Language Usage
- Policy Definitions
- Parameterization
- Semantics of Policy Application
- Policy Statements
- Attach Points

For information on these concepts, see Implementing Routing Policy.
Currently, this feature is supported only on BGP neighbor "in" and "out" attach points. The route policy can be applied only on inbound or outbound on a BGP neighbor.

## EVPN Route Types

The EVPN NLRI has the following different route types:

### Route Type 1: Ethernet Auto-Discovery (AD) Route

The Ethernet (AD) routes are advertised on per EVI and per Ethernet Segment Identifier (ESI) basis. These routes are sent per Ethernet segment (ES). They carry the list of EVIs that belong to the ES. The ESI field is set to zero when a CE is single-homed.

An Ethernet A-D route type specific EVPN NLRI consists of the following fields:

```
+----------------------------------+
|Route Type (1 octet)             | *
+----------------------------------+
|Length (1 octet)                 |
+----------------------------------+
|Route Distinguisher (RD) (8 octets)| *
+----------------------------------+
|Ethernet Segment Identifier (10 octets)| *
+----------------------------------+
|Ethernet Tag ID (4 octets)        | *
+----------------------------------+
|MPLS Label (3 octets)            |
+----------------------------------+
```

**NLRI Format: Route-type 1:**

```
[Type][Len][RD][ESI][ETag][MPLS Label]
```

**Net attributes:** `[Type][RD][ESI][ETag]`

**Path attributes:** `[MPLS Label]`

### Example

```
route-policy evpn-policy
  if rd in (1.1.1.1:0) [and/or evpn-route-type is 1] [and/or esi in (0a1.a2a3.a4a5.a6a7.a8a9)]
  [and/or etag is 4294967295] then
    set ..
  endif
end-policy

route-policy evpn-policy
  if rd in (1.1.1.2:0) [and/or evpn-route-type is 1] [and/or esi in
  (00a1.a2a3.a4a5.a6a7.a8a9)] [and/or etag is 4294967295] then
    set ..
  endif
end-policy
```
Route Type 2: MAC/IP Advertisement Route

The host's IP and MAC addresses are advertised to the peers within NLRI. The control plane learning of MAC addresses reduces unknown unicast flooding.

A MAC/IP Advertisement Route type specific EVPN NLRI consists of the following fields:

```
+---------------------------------------------+ |Route Type (1 octet) (*       |
|_________________________________________+ |Length (1 octet)                      |
|_________________________________________+ |RD (8 octets) (*                      |
|_________________________________________+ |Ethernet Segment Identifier (10 octets)|
|_________________________________________+ |Ethernet Tag ID (4 octets) (*)        |
|_________________________________________+ |MAC Address Length (1 octet) (*)      |
|_________________________________________+ |MAC Address (6 octets) (*)            |
|_________________________________________+ |IP Address Length (1 octet) (*)       |
|_________________________________________+ |IP Address (0, 4, or 16 octets) (*)   |
|_________________________________________+ |MPLS Label1 (3 octets)               |
|_________________________________________+ |MPLS Label2 (0 or 3 octets)           |
```

NLRI Format: Route-type 2:

```
[Type][Len][RD][ESI][ETag][MAC Addr Len][MAC Addr][IP Addr Len][IP Addr][MPLS Label1][MPLS Label2]
```

Net attributes:

```
[Type][RD][ETag][MAC Addr Len][MAC Addr][IP Addr Len][IP Addr]
```

Path attributes:

```
[ESI], [MPLS Label1], [MPLS Label2]
```
**Example**

```plaintext
route-policy evpn-policy
  if rd in (1.1.1.2:0) [and/or evpn-route-type is 2] [and/or esi in (0000.0000.0000.0000.0000) [and/or etag is 0] [and/or macaddress in (0013.aabb.ccdd)] [and/or destination in (1.2.3.4/32)] then
    set ..
  endif
end-policy
```

**Route Type 3: Inclusive Multicast Ethernet Tag Route**

This route establishes the connection for broadcast, unknown unicast, and multicast (BUM) traffic from a source PE to a remote PE. This route is advertised on per VLAN and per ESI basis.

An Inclusive Multicast Ethernet Tag route type specific EVPN NLRI consists of the following fields:

```
+----------------------------------+-
| Route Type (1 octet)          | *
+----------------------------------+-
| Length (1 octet)               | *
+----------------------------------+-
| RD (8 octets)                  | *
+----------------------------------+-
| Ethernet Tag ID (4 octets)     | *
+----------------------------------+-
| IP Address Length (1 octet)    | *
+----------------------------------+-
| Originating Router's IP Address| *
| (4 or 16 octets)               | *
+----------------------------------+-
```

**NLRI Format: Route-type 3:**

```
[Type][Len][RD][ETag][IP Addr Len][Originating Router's IP Addr]
```

**Net attributes:** `[Type][RD][ETag][IP Addr Len][Originating Router's IP Addr]`

**Example**

```plaintext
route-policy evpn-policy
  if rd in (1.1.1.1:300) [and/or evpn-route-type is 3] [and/or etag is 0] [and/or evpn-originator in (1.1.1)] then
    set ..
  endif
end-policy
```
Route Type 4: Ethernet Segment Route

Ethernet segment routes enable to connect a CE device to two or PE devices. ES route enables the discovery of connected PE devices that are connected to the same Ethernet segment.

An Ethernet Segment route type specific EVPN NLRI consists of the following fields:

```
+----------------------------------------+ *
| Route Type (1 octet)                  |
+----------------------------------------+ *
| Length (1 octet)                      |
+----------------------------------------+ *
| RD (8 octets)                         |
+----------------------------------------+ *
| Ethernet Segment Identifier (10 octets)| *
+----------------------------------------+ *
| IP Address Length (1 octet)           |
+----------------------------------------+ *
| Originating Router's IP Address       |
| (4 or 16 octets)                      |
+----------------------------------------+ *
```

NLRI Format: Route-type 4:

```
[Type][Len][RD][ESI][IP Addr Len][Originating Router's IP Addr]
```

Net attributes: [Type][RD][ESI][IP Addr Len][Originating Router's IP Addr]

Example

```
route-policy evpn-policy
  if rd in (1.1.1.1:0) [and/or evpn-route-type is 4] [and/or esi in (00a1.a2a3.a4a5.a6a7.a8a9)] [and/or evpn-originator in (1.1.1.1)] then set ..
  endif
end-policy
```

Route Type 5: IP Prefix Route

An IP Prefix Route type specific EVPN NLRI consists of the following fields:
EVPN RPL Attribute

Route Distinguisher

A Route Distinguisher (rd) attribute consists of eight octets. An rd can be specified for each of the EVPN route types. This attribute is not mandatory in route-policy.

Example

```
rd in (1.2.3.4:0)
```
**EVPN Route Type**

EVPN route type attribute consists of one octet. This specifies the EVPN route type. The EVPN route type attribute is used to identify a specific EVPN NLRI prefix format. It is a net attribute in all EVPN route types.

**Example**

```
evpn-route-type is 3
```

The following are the various EVPN route types that can be used:

1 - ethernet-ad
2 - mac-advertisement
3 - inclusive-multicast
4 - ethernet-segment
5 - ip-advertisement

**IP Prefix**

An IP prefix attribute holds IPv4 or IPv6 prefix match specification, each of which has four parts: an address, a mask length, a minimum matching length, and a maximum matching length. The address is required, but the other three parts are optional. When IP prefix is specified in EVPN route type 2, it represents either a IPv4 or IPv6 host IP Address (/32 or /128). When IP prefix is specified in EVPN route type 5, it represents either IPv4 or IPv6 subnet. It is a net attribute in EVPN route type 2 and 5.

**Example**

```
destination in (128.47.10.2/32)
destination in (128.47.0.0/16)
destination in (128:47::1/128)
destination in (128:47::0/112)
```

**esi**

An Ethernet Segment Identifier (ESI) attribute consists of 10 octets. It is a net attribute in EVPN route type 1 and 4, and a path attribute in EVPN route type 2 and 5.

**Example**

```
esi in (ffff.ffff.ffff.ffff.fff0)
```

**etag**

An Ethernet tag attribute consists of four octets. An Ethernet tag identifies a particular broadcast domain, for example, a VLAN. An EVPN instance consists of one or more broadcast domains. It is a net attribute in EVPN route type 1, 2, 3 and 5.

**Example**

```
etag in (10000)
```

**mac**

The mac attribute consists of six octets. This attribute is a net attribute in EVPN route type 2.
Example

mac in (0206.acb1.e806)

evpn-originator

The evpn-originator attribute specifies the originating router's IP address (4 or 16 octets). This is a net attribute in EVPN route type 3 and 4.

Example

evpn-originator in (1.2.3.4)

evpn-gateway

The evpn-gateway attribute specifies the gateway IP address. The gateway IP address is a 32-bit or 128-bit field (IPv4 or IPv6), and encodes an overlay next-hop for the IP prefixes. The gateway IP address field can be zero if it is not used as an overlay next-hop. This is a path attribute in EVPN route type 5.

Example

evpn-gateway in (1.2.3.4)

EVPN RPL Attribute Set

In this context, the term set is used in its mathematical sense to mean an unordered collection of unique elements. The policy language provides sets as a container for groups of values for matching purposes. Sets are used in conditional expressions. The elements of the set are separated by commas. Null (empty) sets are allowed.

prefix-set

A prefix-set holds IPv4 or IPv6 prefix match specifications, each of which has four parts: an address, a mask length, a minimum matching length, and a maximum matching length. The address is required, but the other three parts are optional. The prefix-set specifies one or more IP prefixes.

Example

prefix-set ip_prefix_set
14.2.0.0/16,
54.0.0.0/16,
12.12.12.0/24,
50:50::1:0/112
end-set

mac-set

The mac-set specifies one or more MAC addresses.

Example

mac-set mac_address_set
1234.2345.6789,
Configure EVPN RPL Feature

The following section describe how to configure mac-set, esi-set, evpn-gateway, and evpn-originator.

/* Configuring a mac-set and refering it in a route-policy (Attach point - neighbor-in) */
/* Configuring a esi-set and refering it in a route-policy (Attach point - neighbor-in) */

2345.3456.7890
end-set

esi-set
The esi-set specifies one or more ESI's.

Example
esi-set evpn esi_set
1234.2345.3456.4567.5678,
1234.2345.3456.4567.5670
end-set

etag-set
The etag-set specifies one or more Ethernet tags.

Example
etag-set evpn etag_set
10000,
20000
end-set

2345.3456.7890
end-set

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Router(config-rpl-if)# set local-preference 100
Router(config-rpl-if)# else
Router(config-rpl-else)# set local-preference 300
Router(config-rpl-else)# endif
Router(config-rpl)# end-policy
Router(config)# commit

/* Configuring evpn-gateway/evpn-originator in a route-policy (Attach point - neighbor-in and out) */
Router# configure
Router(config)# route-policy gateway_demo
Router(config-rpl)# if evpn-gateway in (10.0.0.0/32) then
Router(config-rpl-if)# pass
Router(config-rpl-if)# endif
Router(config-rpl)# end-policy
Router(config)# commit
Router(config)# route-policy originator_demo
Router(config-rpl)# if evpn-originator in (10.0.0.1/32) then
Router(config-rpl-if)# set local-preference 100
Router(config-rpl-if)# else
Router(config-rpl-else)# set med 200
Router(config-rpl-else)# endif
Router(config-rpl)# end-policy
Router(config)# commit
Router(config)# router bgp 100
Router(config-bgp)# address-family ipv4 unicast
Router(config-bgp-af)# !
Router(config-bgp-af)# neighbor 10.0.0.10
Neighbor(config-bgp-nbr)# remote-as 8
Router(config-bgp-nbr)# address-family ipv4 unicast
Router(config-bgp-nbr-af)# route-policy gateway_demo in
Router(config-bgp-nbr-af)# route-policy originator_demo out
Router(config-bgp-nbr-af)# commit

Running Configuration

/* Configuring a mac-set and refering it in a route-policy (Attach point - neighbor-in) */
mac-set demo_mac_set
  1234.ffff.aaa3,
  2323.4444.ffff
end-set

route-policy policy_use_pass_mac_set
  if mac in demo_mac_set then
    set med 200
  else
    set med 1000
  endif
end-policy
!
router bgp 100
  address-family ipv4 unicast
    !
    neighbor 10.0.0.10
    remote-as 8
    address-family ipv4 unicast
    route-policy policy_use_pass_mac_set in
    !
    !
end

/* Configuring a esi-set and refering it in a route-policy (Attach point - neighbor-in) */
Wed Oct 26 11:52:23.720 IST
esi-set demo_esi
  ad34.1233.1222.ffff.44ff,
  ad34.1233.1222.ffff.6666
end-set

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route-policy use_esi
   if esi in demo_esi then
      set local-preference 100
   else
      set local-preference 300
   endif
end-policy

EVPN Route Policy Examples

route-policy ex_2
   if rd in (2.2.18.2:1004) and evpn-route-type is 1 then
      drop
   elseif rd in (2.2.18.2:1009) and evpn-route-type is 1 then
      drop
   else
      pass
   endif
end-policy
!
route-policy ex_3
   if evpn-route-type is 5 then
      set extcommunity bandwidth (100:9999)
   else
      pass
   endif
end-policy
!
route-policy samp
end-policy
!
route-policy samp1
   if rd in (30.0.101.2:0) then
      pass
   endif
end-policy
!
route-policy samp2
   if rd in (30.0.101.2:0, 1:1) then
      pass
   endif
end-policy
!
route-policy samp3
   if rd in (*:**) then
      pass
   endif
end-policy
!
route-policy samp4
   if rd in (30.0.101.2:*) then
      pass
   endif
end-policy
!
route-policy samp5
   if evpn-route-type is 1 then
      pass
   endif
end-policy
!
route-policy samp6
   if evpn-route-type is 2 or evpn-route-type is 5 then
      pass
   endif
end-policy
!
route-policy samp7
   if evpn-route-type is 4 or evpn-route-type is 3 then
      pass
   endif
route-policy samp8
  if evpn-route-type is 1 or evpn-route-type is 2 or evpn-route-type is 3 then
    pass
  endif
end-policy

route-policy samp9
  if evpn-route-type is 1 or evpn-route-type is 2 or evpn-route-type is 3 or evpn-route-type is 4 then
    pass
  endif
end-policy

route-policy test1
  if evpn-route-type is 2 then
    set next-hop 10.2.3.4
  else
    pass
  endif
end-policy

route-policy test2
  if evpn-route-type is 2 then
    set next-hop 10.10.10.10
  else
    drop
  endif
end-policy

route-policy test3
  if evpn-route-type is 1 then
    set tag 9988
  else
    pass
  endif
end-policy

route-policy samp21
  if mac in (6000.6000.6000) then
    pass
  endif
end-policy

route-policy samp22
  if extcommunity rt matches-any (100:1001) then
    pass
  else
    drop
  endif
end-policy

route-policy samp23
  if evpn-route-type is 1 and esi in (aaaa.bbbb.cccc.dddd.eeee) then
    pass
  else
    drop
  endif
end-policy

route-policy samp24
  if evpn-route-type is 5 and extcommunity rt matches-any (100:1001) then
    pass
  else
    drop
  endif
end-policy

route-policy samp25
  if evpn-route-type is 2 and esi in (1234.1234.1234.1234.1236) then
    pass
  else

route-policy samp26
  if etag in (20000) then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp27
  if destination in (99.99.99.1) and etag in (20000) then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp31
  if evpn-route-type is 1 or evpn-route-type is 2 or evpn-route-type is 3 or evpn-route-type
  is 4 or evpn-route-type is 5 then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp33
  if esi in evpn_esi_set1 then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp34
  if destination in (90:1:1::9/128) then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp35
  if destination in evpn_prefix_set1 then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp36
  if evpn-route-type is 3 and evpn-originator in (80:1:1::3) then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp37
  if evpn-gateway in (10:10::10) then
    pass
  else
    drop
  endif
end-policy
!
route-policy samp38
  if mac in evpn_mac_set1 then
    pass
  else

route-policy samp39
  if mac in (6000.6000.6002) then
    pass
  else
    drop
  endif
end-policy

route-policy samp41
  if evpn-gateway in (10.10.10.10, 10:10::10) then
    pass
  else
    drop
  endif
end-policy

route-policy samp42
  if evpn-originator in (24.162.160.1/32, 70:1:1::1/128) then
    pass
  else
    drop
  endif
end-policy

route-policy example
  if rd in (62300:1903) and evpn-route-type is 1 then
    drop
  elseif rd in (62300:19032) and evpn-route-type is 1 then
    drop
  else
    pass
  endif
end-policy

route-policy samp100
  if evpn-route-type is 4 or evpn-route-type is 5 then
    drop
  else
    pass
  endif
end-policy

route-policy samp101
  if evpn-route-type is 4 then
    drop
  else
    pass
  endif
end-policy

route-policy samp102
  if evpn-route-type is 4 then
    drop
  elseif evpn-route-type is 5 then
    drop
  else
    pass
  endif
end-policy

route-policy samp103
  if evpn-route-type is 2 and destination in evpn_prefix_set1 then
    drop
  else
    pass
  endif
end-policy

route-policy samp104
if evpn-route-type is 1 and etag in evpn_etag_set1 then
drop
elseif evpn-route-type is 2 and mac in evpn_mac_set1 then
drop
elseif evpn-route-type is 5 and esi in evpn esi_set1 then
drop
else
pass
endif
end-policy
!

EVPN Routing Policy
Configure EVPN RPL Feature

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