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BGP Dissemination of FlowSpec for Transport Aware Mobility
draft-dmc-idr-flowspec-tn-aware-mobility-02

Abstract

   This document defines a BGP Flow Specification (flowSpec)
   extension to disseminate flows from 5G mobile networks so that
   the 5G mobile systems slices and Service Types (SSTs) can be
   mapped to optimal underlying network paths in the data network
   outside the 5G UPFs, or the N6 interface in 3GPP 5G
   Architecture [3GPP TR 23.501].

Status of this Memo

This Internet-Draft will expire on April 23, 2021.

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1. Introduction

The [TN-AWARE-MOBILITY-EXT] describes a framework for extending the mobility aware transport network characteristics through the Data Network outside the 5G UPFs.

```
      +-----------+      +------+
      |           |      |      |
  UE---| gNB-CU(UP)|------| UPF +|--------DN-------
      |           |      | C-PE |
      +-----------+      +------+

          |- N3 OR N9 -||----N6 -------------|

  |------ Mobile Network ----||-- IP Network-------|
```
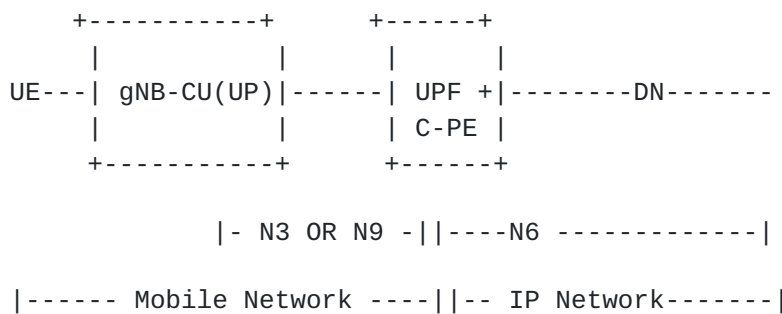
                Figure 1: Mobile and IP Data Network for UE

   The 5G UPF terminates the 5G GTP tunnels from gNB and pass the
   IP packets to the N6 data networks, which deliver the packets
   over hybrid paths, like MPLS, SR paths, Private-IP, or public
   Internet to reach the packets' destinations.

   This document focuses on using FlowSpec to disseminate rules
   that utilize the mobility aware transport network
   characteristics to forward 5G flows.

   Border Gateway Protocol (BGP) Flow Specification (FlowSpec)
   [RFC8955] and FlowSpec for IPv6 [RFC8956] leverage the BGP
   Control Plane to simplify the distribution of rules for the
   specified flows. FlowSpec filter rules can be injected to all
   BGP peers simultaneously without changing router configuration.

2. Conventions used in this document

   BSID   - Binding SID

   DC   - Data Center

   DN   - Data Network (5G)

   EMBB   - enhanced Mobile Broadband (5G)

   gNB   - 5G NodeB

    GTP-U   - GPRS Tunneling Protocol - Userplane (3GPP)

    MIOT   - Massive IOT (5G)

    PECP   - Path Computation Element (PCE) Communication
                  Protocol

    SD-WAN   - Software-Defined Wide Area Network

    SID   - Segment Identifier

    SLA   - Service Layer Agreement

    SST   - Slice and Service Types (5G)

    SR   - Segment Routing

    SR-PCE   - SR Path Computation Element

    UE   - User Equipment

    UPF   - User Plane Function (5G)

    URLLC   - Ultra reliable and low latency communications (5G)

3. TN-Aware matching conditions

   [RFC8955] defines a BGP Network Layer Reachability Information
   (NLRI) format used to distribute traffic flow specification
   rules. The NLRI for (AFI=1, SAFI=133) specifies IPv4 unicast
   filtering. The NLRI for (AFI=1, SAFI=134) specifies IPv4
   BGP/MPLS VPN filtering [RFC7432]. The Flow Specification match
   part defined in [RFC8955] includes L3/L4 information like IPv4
   source/destination prefix, protocol, ports, and the like, so
   traffic flows can be filtered based on L3/L4 information. This
   has been extended by [RFC8956] to cover IPv6 (AFI=2) L3/L4.

   The NLRI FlowSpec components described in RFC8955 and RFC8956
   are adequate for specifying the UDP Source Port Range which is

used to differentiate SLAs of flows from UPFs [EXT-TN-AWARE-Mobility].

The Ingress PE, which is either a function inside UPF or directly connected to UFP, acting as BGP FlowSpec Receiver is assumed to have a BGP FlowSpec session with the FlowSpec Controller. The Mobility traffic destination would resolve in the BGP Peer Next Hop in the data network. The BGP FlowSpec Controller would be programmed with {5G UDP Src Port Range} to map different SSTs defined in [TN-AWARE-MOBILITY] to create internal mapping Table for {5G UDP Src Port Range} < -- > {BGP FlowSpec Generalized Indirection-ID}. The Mobility IP packets coming out of the UPF, i.e., GTP header being decapsulated, carrying specific UDP Source Port can be classified based on the matching policy carried by the FlowSpec NLRI.

For example, to filter out flows with source UDP port number between [i, j], the following encoding can be used in the NLRI (SAFI=133 or SAFI 134):

Encoding

   <Type = 6, [numeric_op1, i][numberic_op2, j]>

   <Type = 2, [numeric_op3, Src-Prefix]>

   <Type = 1, [numeric_op4, Dest-prefix]>

Numberic_Op1 is:

```
   0   1   2   3   4   5   6   7
 +---+---+---+---+---+---+---+---+
 | e | a | len   | 0 |lt |gt |eq |
 | 0 | 1 | 00    | 0 | 0 | 1 | 0 |
 +---+---+---+---+---+---+---+---+
```

Numberic_Op2 is:

```
   0   1   2   3   4   5   6   7
 +---+---+---+---+---+---+---+---+
 | e | a | len   | 0 |lt |gt |eq |
 | 1 | 1 | 00    | 0 | 1 | 0 | 0 |
 +---+---+---+---+---+---+---+---+
```

Where len ==0, meaning two bytes of value [i] follows the
Numeric_op1 and two bytes of value [j] follows the
Numberic_op2.

The "numeric_op3" and "numeric_op4" are for comparing the
source and destination addresses of the UE traffic.

[4](#). Redirect a flow over an underlay tunnel

For the flows matching with the filter conditions carried by
the FlowSpec NLRI, the policy for redirect path can indicate a
set of underlay tunnels or one underlay tunnel.

As the action of taking specific underlay tunnels is performed
by the headend router, a non-transitive Extended Community for
Path Redirect [Flowspec-path-redirect] and [SRv6-flowspec-path-
redirect] should be used.

[IANA Action: need a new type:

   0x49 FlowSpec Redirect to Indirection-id Non-transitive
Extended Community.

]

For hierarchical RR deployments where the FlowSpec rules need
to be propagated, the Transitive Path Redirect Extended
Community [FlowSpec-path-redirect] can be used.

The below figure tries to capture the overall topology, showing
the mobility traffic from UPF being redirected to different
paths per the BGP FlowSpec from the Controller:

```
                          +-----------+   +----+{5G UDP Src Port Range}
                          |  FlowSpec |-->| Map|        <-->
                          | Controller|   | DB |{Generalized Indirection-ID}
                          +-----------+   +----+
                           /
                          /
                         / BGP FlowSpec NLRI with 5G
            BGP FlowSpec /   Src-Pfx, Dst-Pfx, UDP Source Port Range
              Session   /
                       / BGP FlowSpec Redirect
                      / Indirection-ID Ext Comm                /
                     /                                        /Public
                    /                                 MIOT / Cloud
                   /                               +------/
          +-------+ Ind-ID1: UDP Src Port Xx-Xy     /
          |       A1------------------------------+
          |       | Ind-ID2: UDP Src Port Yx-Yy
     UE------| UPF + A2-------------------------------------Internet
          | PE1   | Ind-ID3: UDP Src Port Zx-Zy
          |       A3-----------------------------+
          |       |                              \
          +-------+                           +-----+
{UE Src IP, UE Dst IP, UDP Src Port Num# <-->             \
 FlowSpec Ind-ID# -> Transport Hdr}                   EMBB \
                                                            \



             ---------->
       +------+----------+-------+-----+----------+
       | Data | Inner IP | GTP-U | UDP | Outer IP |
       +------+----------+-------+-----+----------+


                         ---------->
               +------+----------+-----------------+
               | Data | Inner IP | Transport Header |
               +------+----------+-----------------+
```
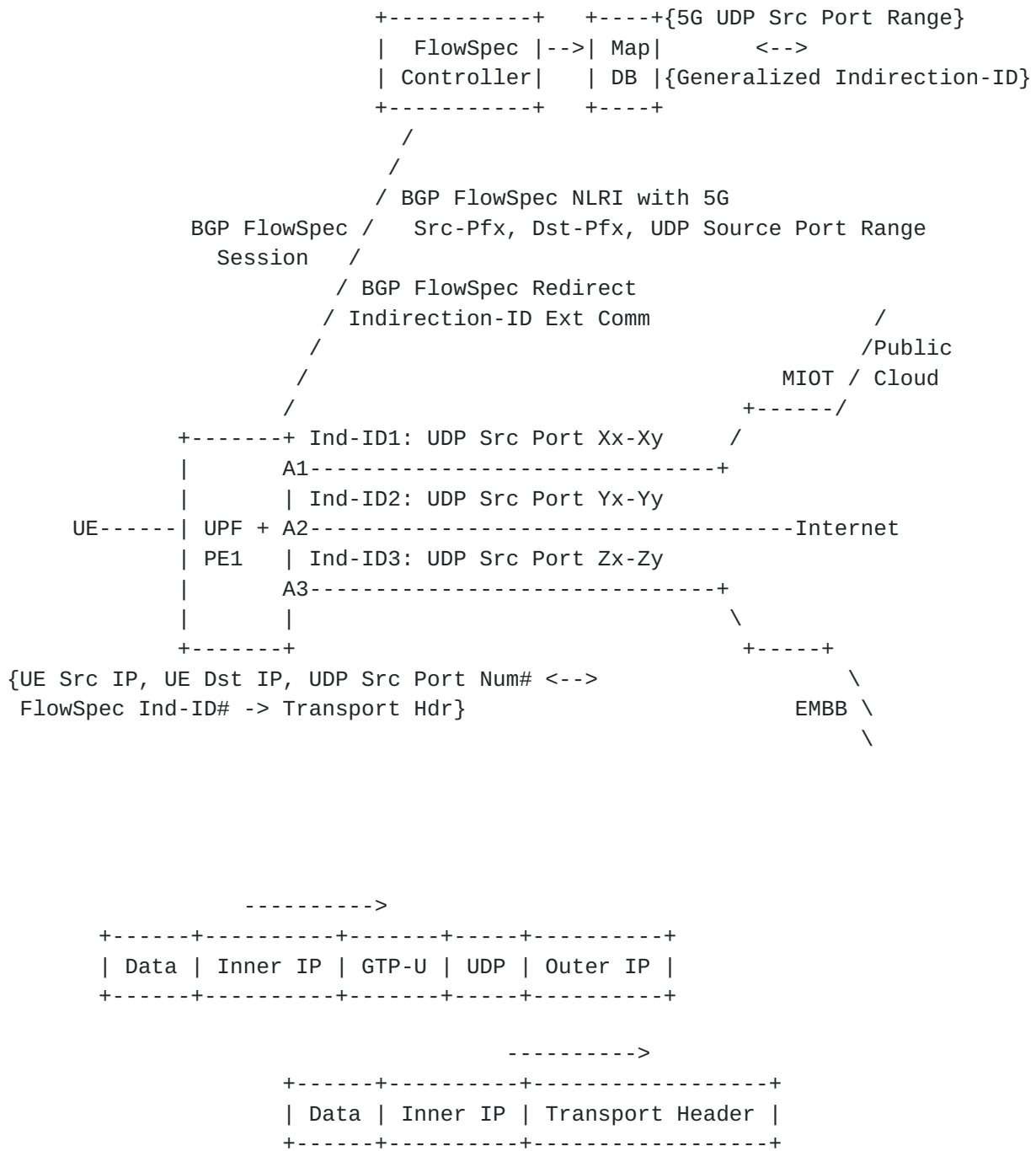
        Figure 2: TN Aware Mobility Traffic Mapping to FS Redirect Path

5. FlowSpec Redirect to Indirection-ID Non-Transitive Extended Community

This section defines "FlowSpec Redirect to Indirection-ID Non-Transitive Extended Community for IPSec Tunnel ID". The format of this extended community is shown below:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type          |IPSecSA SubType| Flags(1 octet)|IPSecSA ID-Type|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    IPsec Tunnel ID (4 octets)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
Figure 3: Redirect to Ind-ID Ext Community for IPSec Tunnel

Where

Type = 0x49 (to be assigned by IANA): Non-Transitive FlowSpec Redirect to Indirection-ID Extended Community for IPSec Tunnel ID.

[Note: Type = 0x09 for Transitive FlowSpec Redirect to Indirection-ID Extended Community can also be used for Hierarchical deployment, where the FlowSpec Update needs to be propagated]

IPSec SA Sub-Type: 1 octet, its value (TBD) will be assigned by IANA to indicate the ID carried by the Extended Community is IPsec SA ID. Assuming the IPsec SA is pre-established, its Security Association (SA) ID is within a single administrative domain a globally unique identifier. The allocation and establishment of the IPsec SA among peers is outside scope of the document.

Flags: Same as that defined in [Flowspec-path-redirect].

IPSec SA ID-Type: 1 octet value. Here are the new values needed
for IPsec IPv4 tunnel (to be assigned by IANA)

  v1 - Inner Encap type = IPSec+GRE

  v2 - Inner Encap type = IPSec+Vxlan

6. IANA Considerations

This draft needs an IANA code point allocation for the Non-
Transitive FlowSpec Redirect to Indirection-ID Extended
Community.

  Type: Non-Transitive FlowSpec Redirect to Indirection-ID
  Extended Community for IPSec Tunnel ID.

  IPsec SA Sub-Type:

  IPSec SA ID-Type:
   v1 - Inner encap type = IPSec+GRE
   v2 - Inner encap type = IPSec+Vxlan

7. Security Considerations

  TBD.

8. Contributors

The following people have contributed to this document.

9. References

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10. Acknowledgments

TBD.

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