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BGP Dissemination of FlowSpec for Transport Aware Mobility
draft-dmc-idr-flowspec-tn-aware-mobility-04

Abstract

This document defines a BGP Flow Specification (FlowSpec) extension to disseminate the policies 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 which is the N6 interface in 3GPP 5G Architecture [3GPP TR 23.501].

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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.

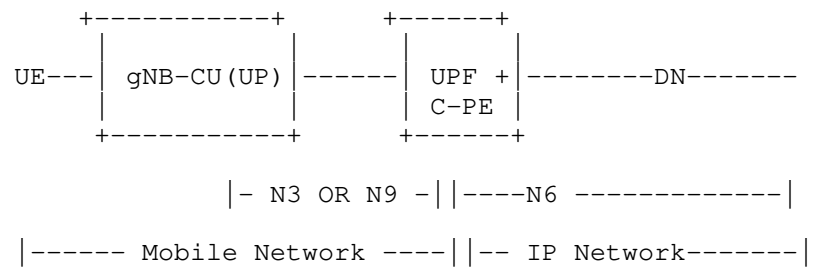


Figure 1: Mobile and IP Data Network for UE

The 5G UPF terminates the 5G GTP tunnels from gNB and passes the IP packets to the N6 Interface [3GPP] 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 specifies how to use FlowSpec to disseminate the policies 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 which is the N6 interface in 3GPP 5G Architecture [3GPP TR 23.501].

Border Gateway Protocol (BGP) Flow Specification (FlowSpec) [RFC8955] and FlowSpec for IPv6 [RFC8956] leverage the BGP Control Plane to simplify the distribution of rules & policies for the specified flows. FlowSpec filter rules can be injected into 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 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, etc., so traffic flows can be filtered based on L3/L4 information. [RFC8956] specifies the filtering 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 can be a function integrated with a UPF or an edge router directly connected to a 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 an 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., the GTP header being decapsulated, carrying a specific UDP Source Port, can be classified based on the matching policies 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):

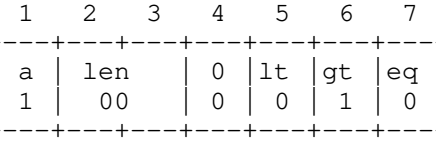
Encoding

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

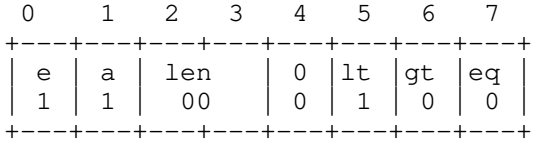
<Type = 2, [numeric_op3, Src-Prefix]>

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

Numberic_Op1 is:



Numberic_Op2 is:



Where len ==0, which indicates two bytes of value [i] follow the Numeric_op1 and two bytes of value [j] follow 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 BGP FlowSpec Receiver, i.e., the ingress PE, takes the action of redirecting traffic to specific underlay tunnels, a non-transitive Extended Community for Path Redirect [Flowspec-path-redirect] and [SRv6-flowspec-path-redirect] should be used.

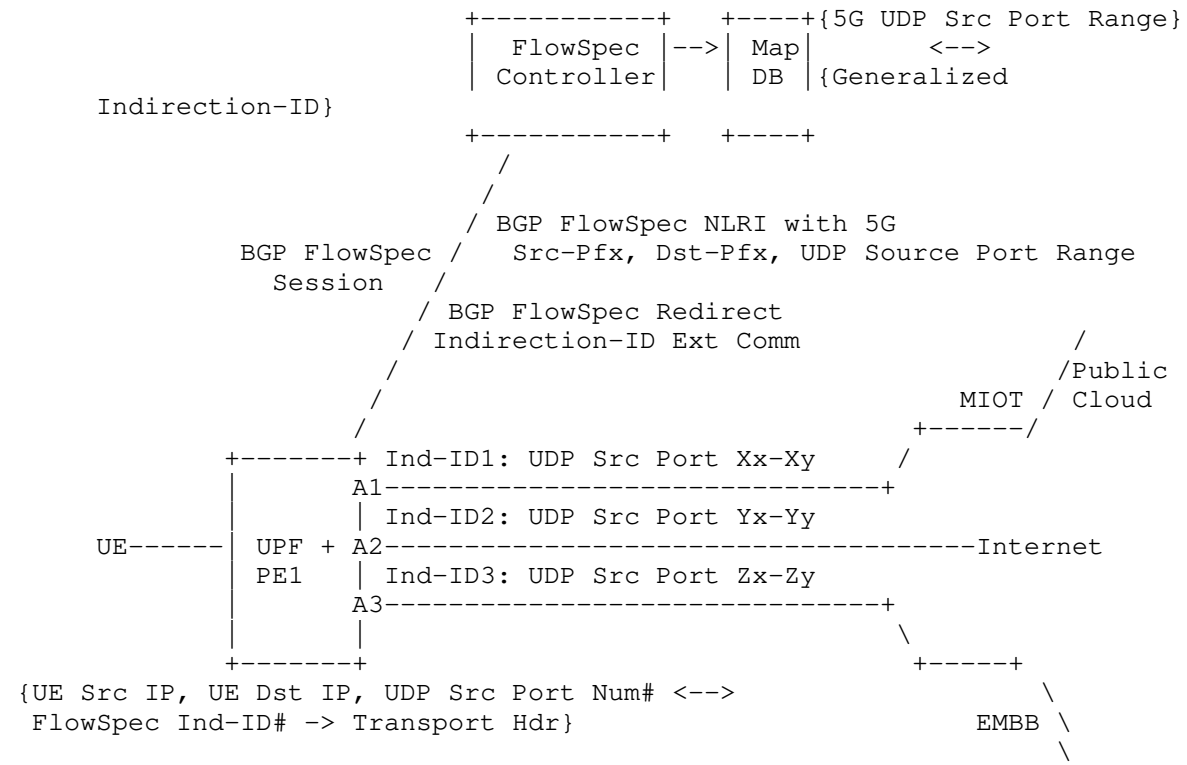
[IANA Action: need a new type:

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

]

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

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



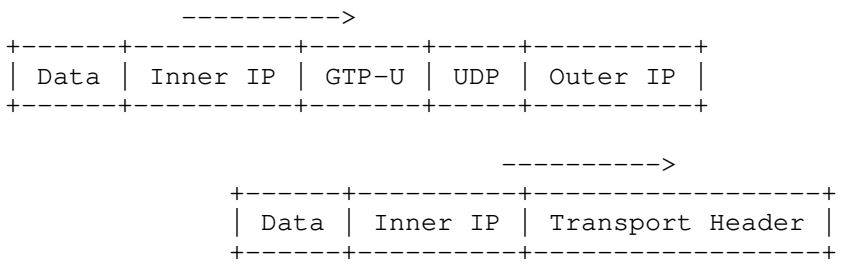


Figure 2: Mobility Traffic Mapping to Redirect Path

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:

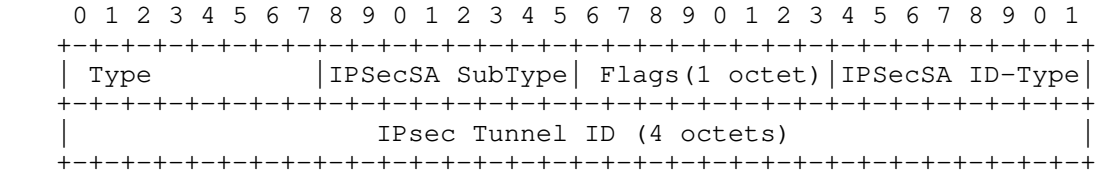


Figure 3: Redirect to Ind-ID Ext Community for IPSec Tunnel

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

9.1. Normative References

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9.2. Informative References

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10. Acknowledgments

TBD.

This document was prepared using 2-Word-v2.0.template.dot.

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