Extension of Transport Network Aware Mobility in the Data Network
draft-mcd-rtgwg-extension-tn-aware-mobility-02

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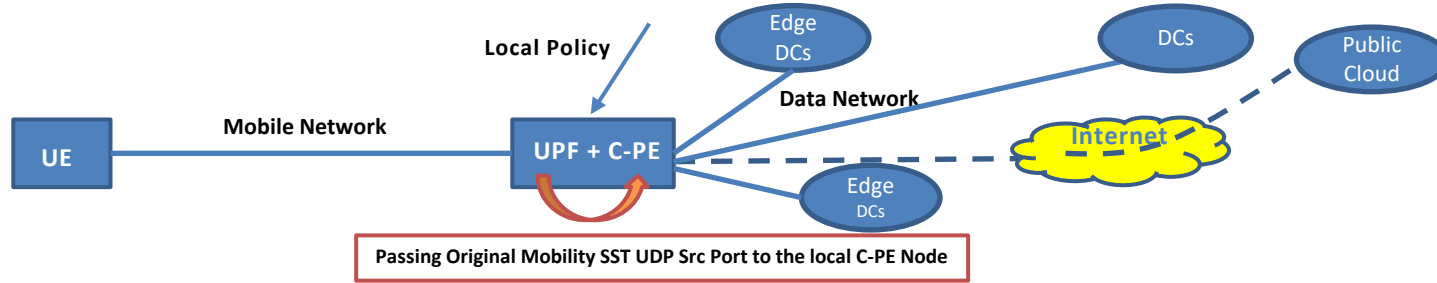IETF 111 July 2021, San Francisco (virtual)

IETF 109 Recap: Background

- This draft was originally presented in the IETF 109 in virtual Bangkok.

- The existing Transport Network Aware Mobility for 5G [*draft-ietf-dmm-tn-aware-mobility*] draft defines a framework for mapping the 5G mobile systems Slice and Service Types (SSTs) to corresponding underlying network paths. The focus of that work is limited to the mobility domain.

- To maintain E2E transport network characteristics the framework needs to be extended beyond UPF.

- This proposed draft describes a framework for extending the mobility aware transport network characteristics from the UPF through the Data Network.
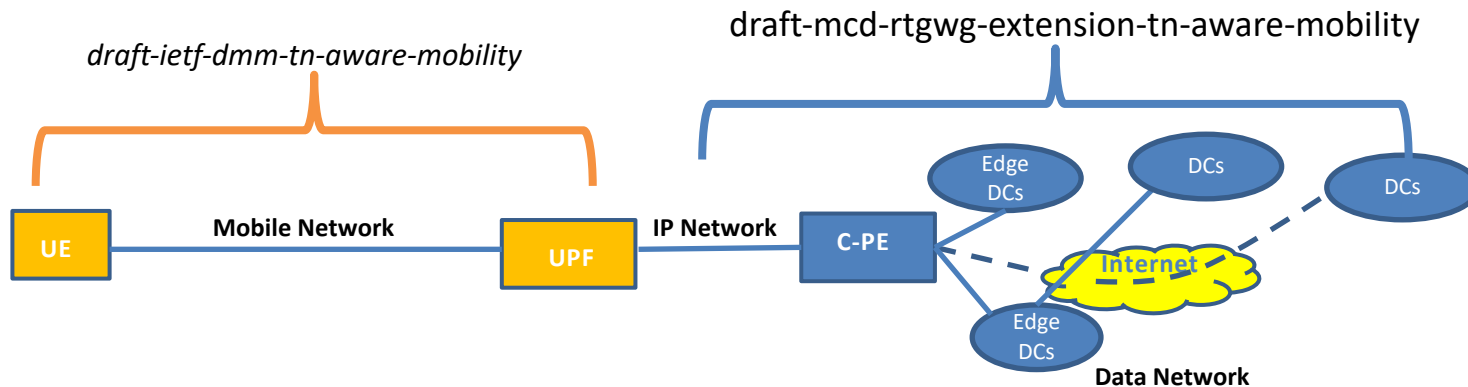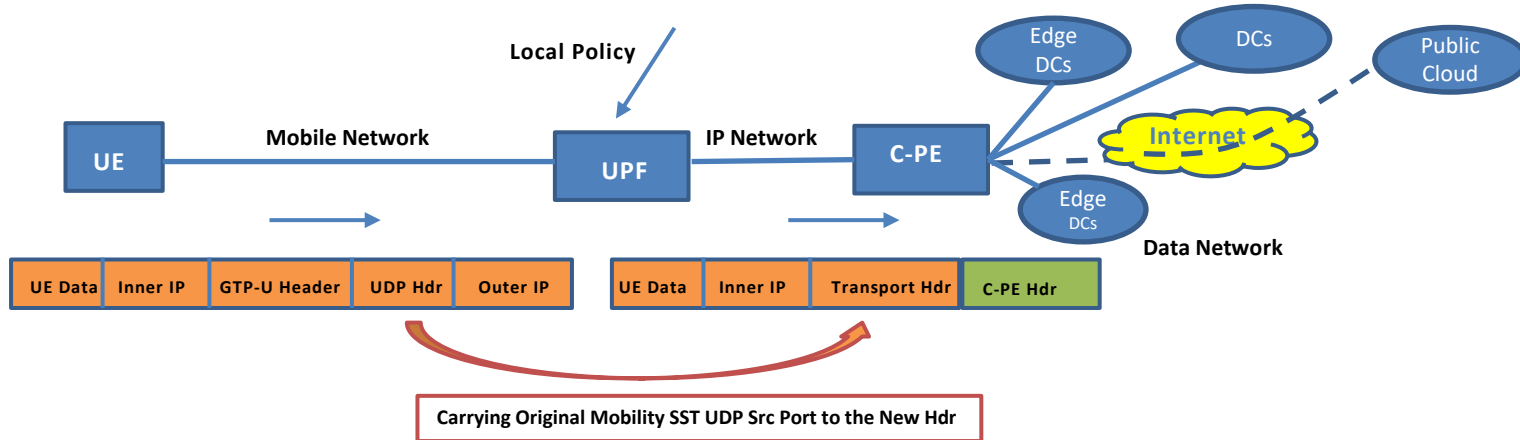
Packet Transition from the Mobile to the Data Network

Scenario A: The UPF runs part of Edge C-PE Node

Local Policy

Edge DCs

DCs

Public Cloud

Data Network

UE

Mobile Network

UPF + C-PE

Internet

Edge DCs

Passing Original Mobility SST UDP Src Port to the local C-PE Node

Scenario B: The UPF and Edge C-PE Node are connected through IP Network

Local Policy

Edge DCs

DCs

Public Cloud

UE

Mobile Network

UPF

IP Network

C-PE

Internet

Edge DCs

Data Network

UE Data	Inner IP	GTP-U Header	UDP Hdr	Outer IP

UE Data	Inner IP	Transport Hdr	C-PE Hdr

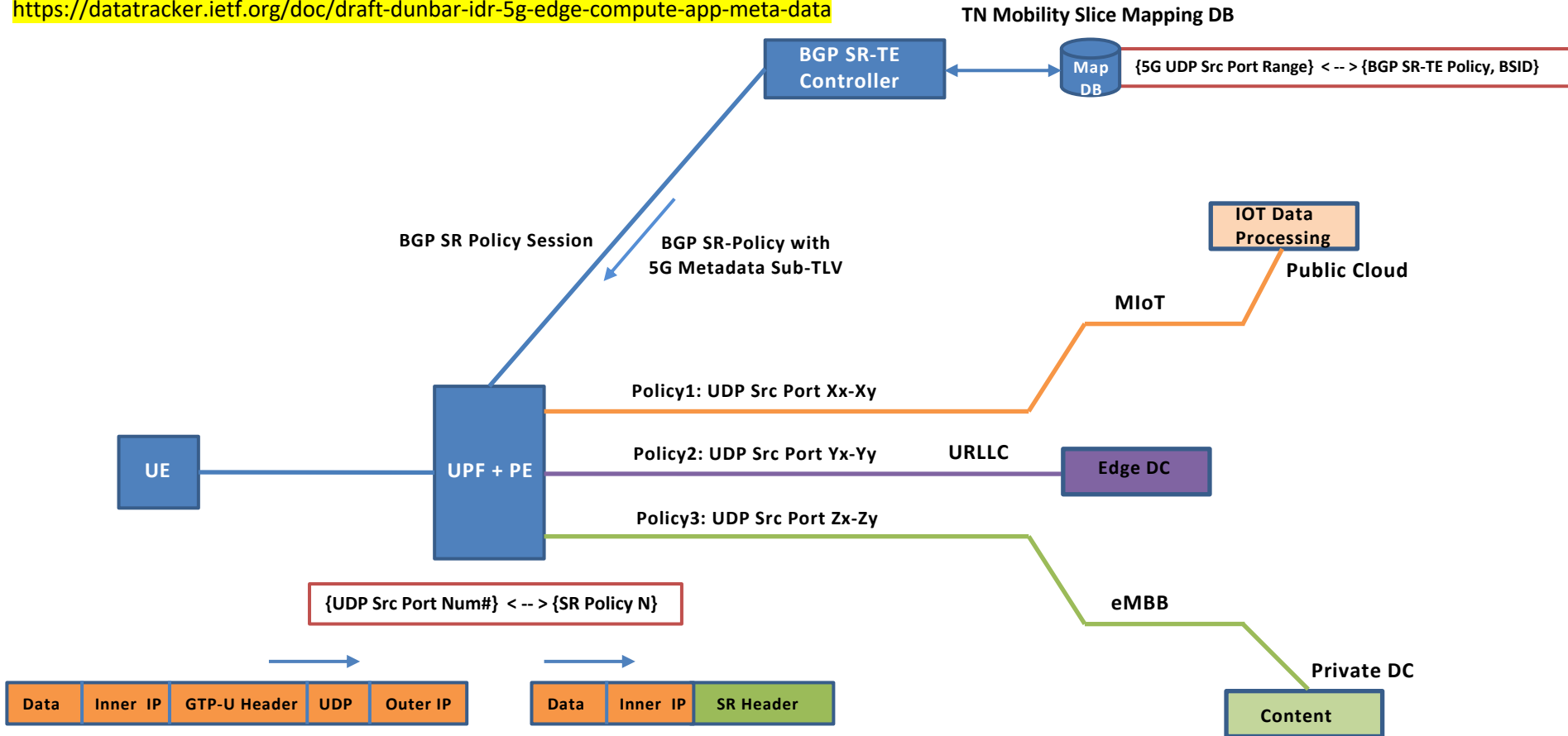Carrying Original Mobility SST UDP Src Port to the New Hdr

TN Characteristics Mapping to the SR-TE Paths in Data Network

- The UPF would be terminating the 5G mobility connectivity from the UE. It can be co-located with the PE on the same device, or it can be connected to the PE node over IP Network.

- On a PE node, based on the mobility transport characteristics, the current draft proposes of different methods of applying SR-TE path segments or applying FlowSpec Traffic Re-direct mechanism:

  - **Scenario 1:** The Ingress PE node is connected to the BGP SR-TE Controller through the BGP SR-TE Policy SAFI Session.

  - **Scenario 2:** The Ingress PE node is connected to the SR-PCE (Path Compute Element) Controller through the PCEP Session.

  - **Scenario 3:** The Ingress PE node is connected to the SR-TE Controller over Restconf/ Netconf or gRPC Session.

  - **Scenario 4:** The Ingress PE is connected to the FlowSpec Controller over BGP FlowSpec Session.

Extend BGP SR-TE Policy for TN Aware Mobility

TN Mobility Slice Mapping DB

BGP SR-TE Controller

Map DB

{5G UDP Src Port Range} < -- > {BGP SR-TE Policy, BSID}

IOT Data Processing

Public Cloud

BGP SR Policy Session

BGP SR-Policy with 5G Metadata Sub-TLV

MIoT

UE

UPF + PE

Policy1: UDP Src Port Xx-Xy

Policy2: UDP Src Port Yx-Yy

URLLC

Edge DC

Policy3: UDP Src Port Zx-Zy

eMBB

{UDP Src Port Num#} < -- > {SR Policy N}

Private DC

| Data | Inner IP | GTP-U Header | UDP | Outer IP |

| Data | Inner IP | SR Header |

Content

SR-TE Based Data Network

Extend BGP FlowSpec Traffic Redirect for TN Aware Mobility

https://datatracker.ietf.org/doc/draft-dmc-idr-flowspec-tn-aware-mobility/

TN Mobility Slice Mapping DB

BGP FlowSpec Controller

Map DB

{5G UDP Src Port Range} < -- > {Generalized Indirection_ID}

BGP FlowSpec Session

BGP FlowSpec NLRI with 5G UDP Source Port Range

BGP FlowSpec Indirection_ID Extended Community

IOT Data Processing

Public Cloud

MIoT

Policy1: UDP Src Port Xx-Xy

UE

UPF + PE

Policy2: UDP Src Port Yx-Yy

URLLC

Edge DC

Policy3: UDP Src Port Zx-Zy

eMBB

{UDP Src Port Num#} < -- > {FS Indirection_ID} → Transport Header

Private DC

| Data | Inner IP | GTP-U Header | UDP | Outer IP |

| Data | Inner IP | Transport Header |

Content

SR-TE Based Data Network

Extend Transport Network Aware Mobility for SD-WAN Traffic
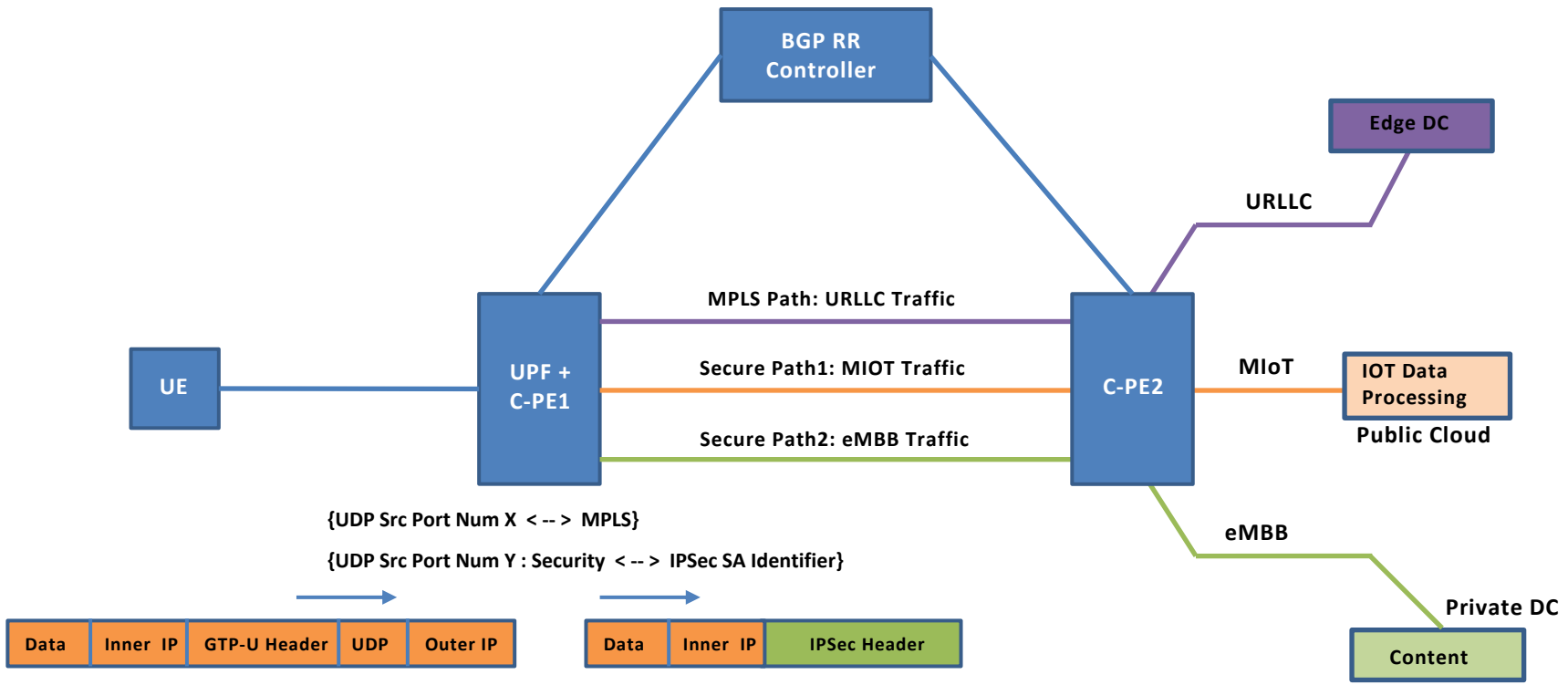
SD-WAN Data Network

Next Steps

- Get the IANA Code Allocation for 5G Metadata Sub-TLV Type filed.

- Comments are addressed from IETF 109.

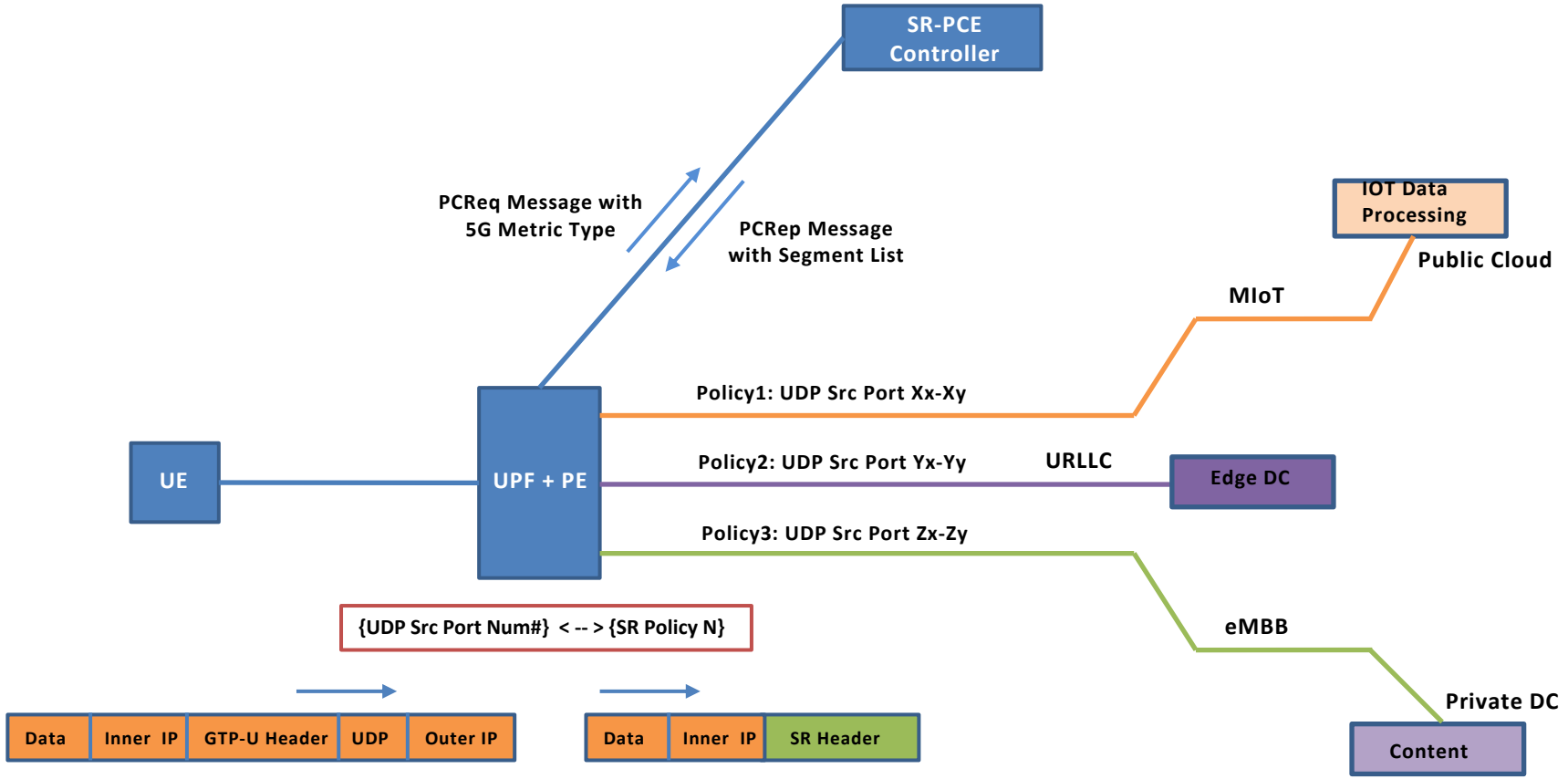- Request for the WG adoption (will continue to update based on the feedback).

Appendix/Backup Slides

Architecture

The proposed Extension of Transport Aware Mobility in the Data Network solution focuses on the following areas:

- The Mobility packet transition in and out from the UPF to the C-PE Node maintaining the Transport Path Characteristics.

- On a PE node, based on the transport characteristics, use different methods of fetching SR-TE path segments from the SR-TE Controller and map the SR-TE segments with the mobility aware transport packets.

- On a SD-WAN CE Node, based on the transport characteristics, mapping of mobility aware transport packets to the secure and un-secure tunnel paths.

BGP SR Policy 5G Metadata Sub-TLV

- To support the Transport Network Mobility Traffic Mapping to BGP SR-TE Policy Path in the Ingress PE, a new 5G Metadata Sub-TLV needs to be supported.

- There is no change in the existing encoding that is defined in the *draft-ietf-idr-segment-routing-te-policy* draft

```
SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
Attributes:
    Tunnel Encaps Attribute (23)
        Tunnel Type: SR Policy
            Existing Policy Sub-TLV
            5G Metadata Sub-TLV    ←———————    New Sub-TLV
```

The format of the new SR-TE 5G Metadata Sub-TLV is captured below:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Type       |    Sub-Type   |    Length     |    Flags      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   UDP Src Port Start Value     |    UDP Src Port End Value     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    5G Metadata Sub-TLV
```

Extend On-demand SR-PCE Policy for TN Aware Mobility

SR-PCE Controller

PCReq Message with 5G Metric Type

PCRep Message with Segment List

IOT Data Processing

Public Cloud

MIoT

Policy1: UDP Src Port Xx-Xy

UE

UPF + PE

Policy2: UDP Src Port Yx-Yy

URLLC

Edge DC

Policy3: UDP Src Port Zx-Zy

{UDP Src Port Num#} < -- > {SR Policy N}

eMBB

| Data | Inner IP | GTP-U Header | UDP | Outer IP |

| Data | Inner IP | SR Header |

Private DC

Content

SR-TE Based Data Network

TN Aware Mobility Integration with SR-PCE

1. Define Class-map for Mobility SST

Class-map type traffic match MIOT
match UDP Source Port Range Xx – Xy

Class-map type traffic match URLLC
match UDP Source Port Range Yx – Yy

Class-map type traffic match EMBB
match UDP Source Port Range Zx – Zy

2. Define Policy-map to Map SST to SR-TE Color

Policy-map type Transport-Network-Aware-Mobility
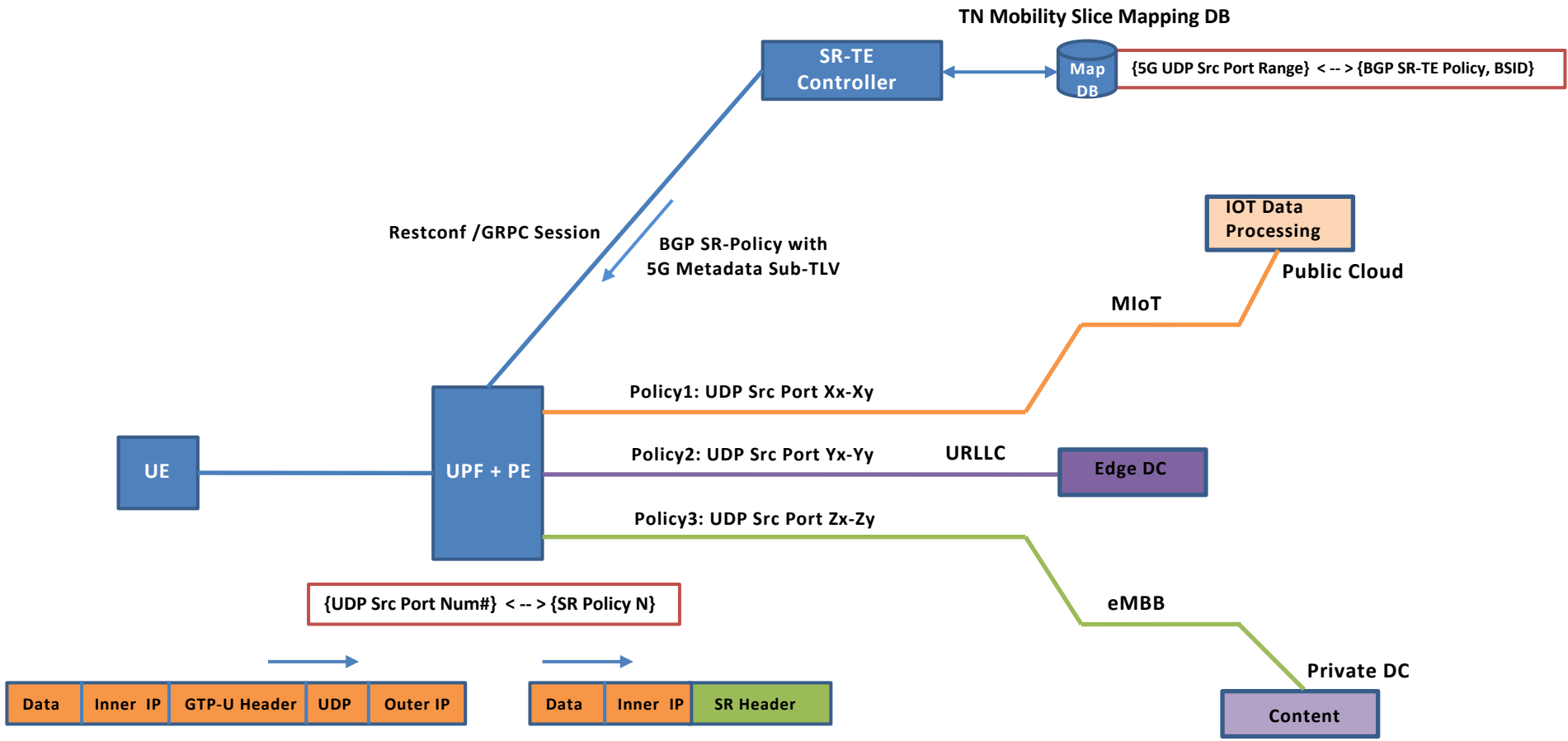class type traffic MIOT
set color <MIOT-10>

class type traffic URLLC
set color <URLLC-20>

class type traffic EMBB
set color <EMBB-30>

3. Define SR-TE Color Dynamic for 5G Metric Type

Segment-routing traffic-eng
on-demand color <MIOT-10> dynamic
metric
type <MIOT>
on-demand color <URLLC-20> dynamic
metric
type <URLLC>
on-demand <EMBB-30> dynamic
metric
type <EMBB>

Extend SR-TE Policy Using Restconf/GRPC for TN Aware Mobility

SR-TE Controller

TN Mobility Slice Mapping DB

Map DB

{5G UDP Src Port Range} < -- > {BGP SR-TE Policy, BSID}

IOT Data Processing

Public Cloud

Restconf /GRPC Session

BGP SR-Policy with 5G Metadata Sub-TLV

MIoT

Policy1: UDP Src Port Xx-Xy

UE

UPF + PE

Policy2: UDP Src Port Yx-Yy

URLLC

Edge DC

Policy3: UDP Src Port Zx-Zy

eMBB

{UDP Src Port Num#} < -- > {SR Policy N}

| Data | Inner IP | GTP-U Header | UDP | Outer IP |

| Data | Inner IP | SR Header |

Private DC

Content

SR-TE Based Data Network

Flowspec Indirection ID with 5G Metadata Extended Community

- The existing IDR draft *flowspec-path-redirect* defines a new transitive BGP Extended Community known as "FlowSpec Redirect to indirection-id Extended Community".

- The current proposal tries to integrate FlowSpec Redirect to Indirection ID [FLOWSPEC-PATH-REDIRECT] based traffic rules with the TN aware mobility traffic based on the UDP Source Port range at the FlowSpec Client Router/Ingress PE.

- Based on the BGP FlowSpec RFC 8955 the BGP FlowSpec NLRI can carry out the UDP Source Port range. The 5G SST specific UDP Source Port range values can be pushed over a BGP FlowSpec session between the FlowSpec Controller and the Ingress PE node.

- There are no additional changes required on the BGP FlowSpec side other than provisioning 5G SST specific UDP Source Port range at the FlowSpec Controller along with the corresponding FlowSpec Redirect to indirection-id.

- The BGP FlowSpec NLRI carrying 5G UDP Source Port Range along with the corresponding Redirect to indirection-id Extended Community can be pushed to the Ingress PE node.

- The Mobility traffic coming from the UPF to the Ingress PE in the Data Network carrying specific UDP Source Port from UE can be classified based on the local Policy and apply the BGP FlowSpec based re-direction rule based on the matching FlowSpec policy.

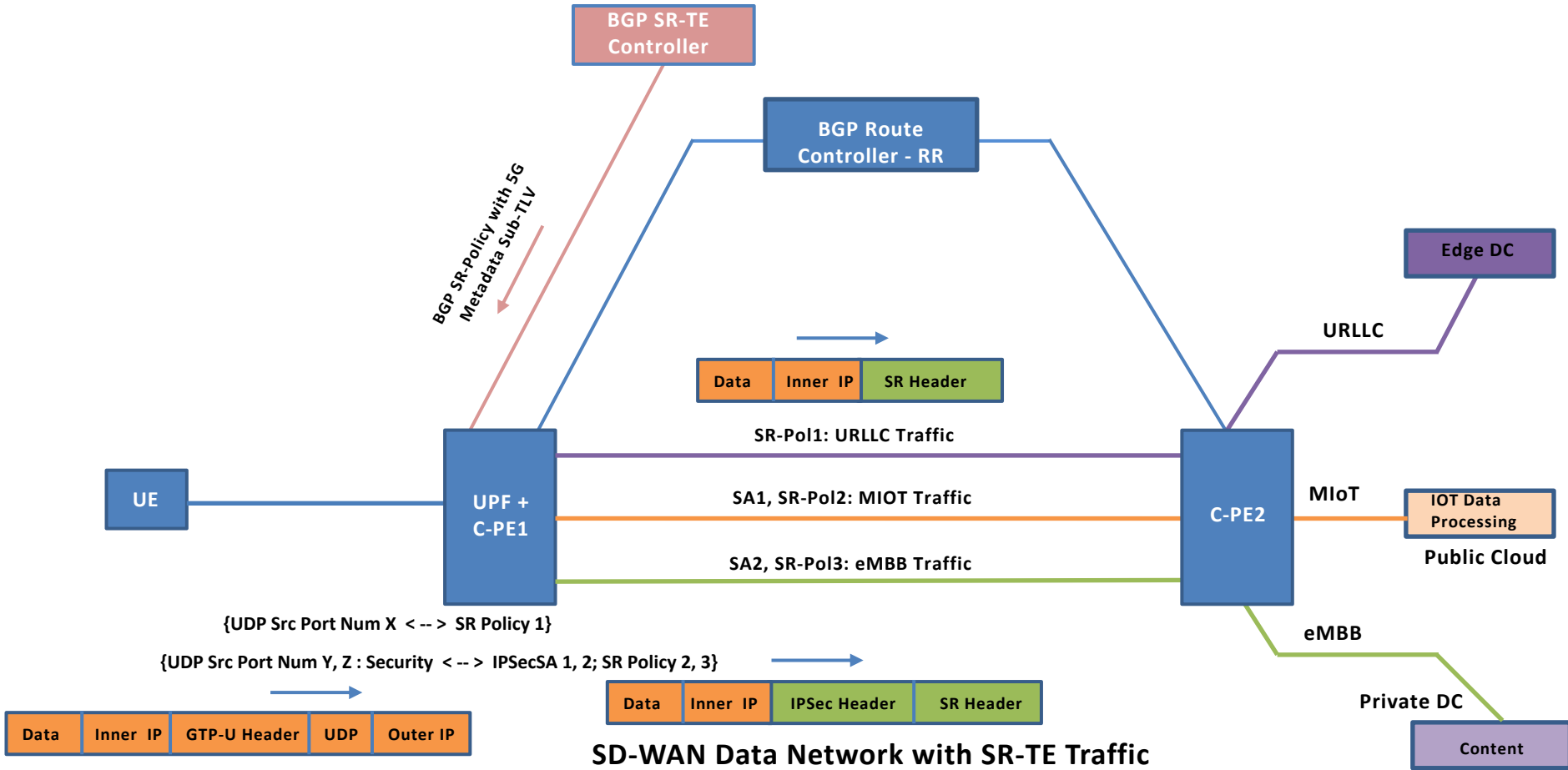# Mapping of TN Characteristics on SD-WAN Edge Node

- In SD-WAN hybrid use cases [*draft-ietf-bess-bgp-sdwan-usage*], UPF can run part of SD-WAN edge node, or it could be connected to it over IP network. This would be use case scenario for Enterprise 5G.

- In that scenario, the Transport Path Characteristic for the 5G mobile traffic need to be mapped to Secure (IPSec Tunnel) or Un-secure path (could be MPLS or VxLAN tunnel).

- The existing [*draft-ietf-dmm-tn-aware-mobility*] draft has been expanded with a new Transport Path Characteristics "Security" for the mobile traffic where security is an important characteristics for certain mobile traffic.

- Based on the UDP Src Port characteristics coming from the mobile network, the SD-WAN edge node would be able to map the 5G TN aware mobility traffic to a secure tunnel vs. un-secure tunnel.

Mapping of TN Characteristics on SD-WAN Edge Node with SR-TE

SD-WAN Hybrid Use Case with SR-TE Integration:

- In the case of SD-WAN hybrid use cases, UPF can run part of SD-WAN edge node, or it could be connected to it over IP network. This would be use case scenario for Enterprise 5G.

- The SD-WAN edge node can act as a SR-TE Headend PE in some scenarios and connected with SR-TE Policy Controller over BGP SR-Policy SAFI session, or SR-PCE Controller over PCEP session, or SR-TE Controller over Netconf/ Restconf, or GRPC session, or even SR FlowSpec Controller over BGP FlowSpec session.

- The SD-WAN edge node can map the "Un-secure" mobility traffic to the SR-TE path same way as described under PE acting as ingress SR-TE headend.

- Though the mapping for "Secure" mobility traffic to the SR-TE path would be slightly different than "Un-secure" mobility traffic.

- The mobility 5G UE client traffic with the Transport Path Characteristics "Security" would be encapsulated with Tunnel mode IPSec header between the two SD-WAN SAFI underlay endpoints (belong to same BGP AS domain). This encapsulated secure traffic will become the new overlay for the SR-TE traffic.

- The rest of the mechanism for the secure mobility traffic with SR-TE traffic forwarding is same as un-secure SR-TE based traffic forwarding.

Extend TN Aware Mobility for SD-WAN Traffic with BGP SR-TE Policy

SD-WAN Data Network with SR-TE Traffic

Thank You!