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Segment Routing IPv6 for Mobile User-Plane
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Abstract

This document discusses the applicability of SRv6 (Segment Routing IPv6) to user-plane of mobile networks that SRv6 source routing capability with its programmability can fulfill the user-plane functions, such as access and anchor functions. It takes advantage of underlying layer awareness and flexibility to deploy user-plane functions that enables optimizing data-path for applications. Network slicing and an interworking way between SRv6 and existing mobile user-plane are also discussed in this document.

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1. Introduction

In mobile networks, mobility management systems provide connectivity while mobile nodes move around. While the control-plane of the system signals movements of a mobile node, user-plane establishes tunnel between the mobile node and anchor node over IP based backhaul and core networks.

This document discusses the applicability of SRv6 (Segment Routing IPv6) to those mobile networks. SRv6 provides source routing to networks where operators can explicitly indicate route for the packets from and to the mobile node. SRv6 endpoint nodes act as roles of anchor of mobile user-plane.

2. Conventions and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

All segment routing and SRv6 network programming terms are defined in [I-D.ietf-spring-segment-routing] and "[I-D.filsfils-spring-srv6-network-programming].

3. Motivations

Today's and future applications are requiring highly optimized data-path between mobile nodes and the entities of those applications in perspectives of latency, bandwidth, etc,. However current architecture of mobile management is agnostic about underlying topologies of transport layer. It rigidly fragments the user-plane in radio access, core and service networks and connects them by tunneling techniques through the user-plane functions such as access and anchor nodes. Those agnostic and rigidness make it difficult for the operator to optimize the data-path.

While the mobile network industry has been trying to solve that, applications shift to use IPv6 data-path and network operators adopt it as their IP transport as well. SRv6 integrates both application data-path and underlying transport layer in data-path optimization aspects that does not require any other techniques.

SRv6 source routing capability with programmable functions [I-D.filsfils-spring-srv6-network-programming] could fulfills the user-plane functions of mobility management. It takes advantage of underlying layer awareness and flexibility to deploy user-plane functions. Those are the motivations to adopt SRv6 for mobile user-plane.

4. Mobile User-Plane

This section describes user-plane using SRv6 for mobile networks. This clarifies mobile user-plane functions to which SRv6 endpoint applied.

Figure 1 shows mobile user-plane functions which are connected through IPv6-only networks. In the Figure 1, an mobile node (MN) connects to an SRv6 endpoint serving access point role for the MN. When the endpoint receives packets from the MN, it pushes SRH to the packets. The segment list in the SRH indicates the rest of user-plane segments which are L2 and L3 anchors respectively. Then the endpoint send the packets to the IPv6 network. In opposite direction, when an SRv6 endpoint serving L3 anchor role for the MN receives packets to it, the endpoint push SRH consist of the L2 anchor and access point segments to the packets.

```
                                User-plane
                                Function
                               <L2 Anchor>
                                O------O
                                | SRv6 |
                                | End  |
                                | Point|
                                O------O
              User-plane           ||           User-plane
    [MN]      Function        _____||_____      Function
      |     <Access Point>   /            \    <L3 Anchor>
   ___v___     O------O     /              \     O------O     ________
  /  Radio \   | SRv6 |    /                \    | SRv6 |    /        \
 /  Access  \==| End  |===/     IPv6-Only    \===| End  |===/ Service  \
 \    NW    /  | Point|   \      Network     /   | Point|   \    NW    /
  \________/   O------O    \                /    O------O    \________/
                            \              /
                             \____________/
```

Figure 1: Mobile User-plane with SRv6

An SRv6 segment represents those each function, such as Access Point, Layer-2 (L2) Anchor and Layer-3 (L3) Anchor. This makes mobile networks highly flexible to deploy any user-plane functions to which nodes in user flow basis. An SRv6 segment can represent a set of flows in any granularity of aggregation even though it is just for a single flow.

Figure 2 shows that an SRv6 endpoint connects existing IPv4 mobile user-plane, which is defined in [RFC5213] and [TS.29281]. An SRv6 segment in the endpoint represents interworking function which enables interworking between existing access point and SRv6 anchor segment, or SRv6 access point segment and existing anchor node.

Existing mobile user-plane with IPv6 underlay is expected to be widely deployed. As IPv6 network should be interoperable with SRv6 endpoints can be accommodated on it, interworking with existing IPv6 network is out of scope of this document.

```
     ________                                                 _______
    /        \    O------O                                   /       \
   / Service  \===|L2/L3 |                                  / Service \
   \    NW    /   |Anchor|         User-plane               \    NW   /
    \________/    |Node  |         Function                  \_______/
                  O------O       <Interworking>                  ||
                      \\_______     O------O     ________     O------O
                      /        \    | SRv6 |    /        \    | SRv6 |
                     / Existing \===| End  |===/ IPv6-Only\===| End  |
                     \  IPv4 NW /   | Point|   \  Network /   | Point|
       [MN]           \________/    O------O    \________/    O------O
        |             //                                         ||
     ___v____    O------O                                     ___||__
    / Radio  \   |Access|                                    / Radio  \
   /  Access  \==|Point |                            [MN]~~~/  Access  \
   \    NW    /  |Node  |                                   \    NW    /
    \________/   O------O                                    \________/
```

Figure 2: Interworking with Existing Mobile Networks

The detail of SRv6 segments representing user-plane functions are described in Section 5.

5. Supporting Mobile User-Plane Functions

This section describes mobile user-plane functions to which an SRv6 node can apply SRv6 functions and behaviors. The SRv6 node configured with those segments thereby fulfills the user-plane functions. Each function consist of two segments which are uplink (UL) from mobile node to the correspondent node, and downlink (DL) from the correspondent node to mobile node.

An SRv6 node may be configured with multiple type of user-plane functions. Each function may also be configured with multiple sets of the segments for one type of function that to purpose of separating tenants, resources and service policies, etc.

5.1. Access Point

Access Point function provides SRv6 node the role to which mobile node is connected directly. eNodeB could be referenced as an entity implementing the access point in 3GPP term.

When an SRv6 node is configured for an Access Point function, the SRv6 node allocates one DL access-point segment SID per session, or per Access Point function which represents one policy that is shared by multiple sessions.

Applicable SRv6 functions and behaviors are determined by use cases described in Section 6.

5.2. Layer-2 Anchor

Layer-2 anchor function provides SRv6 node the role to be anchor point while mobile node move around within a serving area which could be assumed as a layer-2 network. Serving Gateway (SGW) could be referenced as an entity implementing the layer-2 anchor in 3GPP term.

When an SRv6 node is configured for a Layer-2 anchor function, the SRv6 node allocates UL L2-anchor segment SID per SRv6 policy, which is bound to next L3-anchor function and specific service if needed. The SRv6 node also allocates one DL L2-anchor segment SID per SRv6 policy, which is bound to serving access point SID and specific service if needed.

Applicable SRv6 functions and behaviors are determined by use cases described in Section 6.

5.3. Layer-3 Anchor

Layer-3 anchor function provides SRv6 node the role to be anchor point across a mobile network consists of multiple serving areas. Packet data network gateway (PGW) could be referenced as an entity implementing the layer-3 anchor.

When an SRv6 node is configured for a Layer-3 Anchor function, the SRv6 node allocates one UL L3-anchor segment SID per L3-anchor function. Each L3-anchor SID represents one policy which is shared by multiple sessions, such as a routing table, or a service policy

with in the table. The routing table should maintain forwarding entries of the belonging MNs.

Applicable SRv6 functions and behaviors are determined by use cases described in Section 6.

5.4. Stateless Interworking

Stateless interworking function provides SRv6 node a role to interworking between existing mobile user-plane and SRv6 mobile user-plane. Figure 3 shows the SRv6 SID format for stateless interworking function that is encoding identifiers of corresponding tunnel in existing network as argument of the SID.

```
+----------------------+-------+-------+-------+
|    IW-IPv6-Prefix    |IPv4DA |IPv4SA |TUN-ID |
+----------------------+-------+-------+-------+
        128-a-b-c          a      b       c
```

Figure 3: Stateless Interworking SID Encoding

Stateless interworking function introduce following SRv6 end function and transit behavior.

End.TM: End point function with encapsulation for mapped tunnel
T.Tmap: Transit behavior with tunnel decapsulation and mapping an SRv6 Policy

Stateless interworking function is associated with the following mandatory parameters:

IW-IPv4-Prefix: IPv4 prefix representing network of SRv6 user-plane for legacy mobile user-plane
IW-IPv6-Prefix: IPv6 prefix representing network of legacy mobile user-plane for SRv6 user-plane
TUN-PROTO: Tunnel protocol type, such as GTP-U or GRE for PMIP

5.4.1. End.TM: End point function with encapsulation for mapped tunnel

The "End point to encapsulate for mapped tunnel" function (End.TM for short) is used to the direction from SRv6 user-plane to legacy user-plane network.

When interworking node N receives a packet destined to S and S is a local End.TM SID, N does:

```
1. IF NH=SRH & SL > 0 THEN
2.    decrement SL
3.    update the IPv6 DA with SRH[SL]
4.    push header of TUN-PROTO with tunnel ID from S            ;; Ref1
5.    push outer IPv4 header with SA, DA from S
6. ELSE
7.    Drop the packet
```

Ref1: TUN-PROTO indicates target tunnel type.

5.4.2. T.Tmap: Transit behavior with tunnel decapsulation and mapping an SRv6 Policy

The "Transit with tunnel decapsulation and map to an SRv6 policy" function (T.Tmap for short) is used to the direction from legacy user-plane to SRv6 user-plane network.

When interworking node N receives a packet destined to a IW-IPv4-Prefix, N does:

```
1.   IF P.PLOAD == TUN-PROTO & T.PLOAD == IPv6 THEN    ;; Ref1, Ref1bis
2.      pop the outer IPv4 header and tunnel headers
3.      copy IPv4 DA, SA, TUN-ID to form SID B with IW-IPv6-Prefix
4.      insert the SRH (D, B; SL=1)                    ;; Ref2, Ref2bis
5.      set the IPv6 DA = B
6.      forward along the shortest path to B
7.   ELSE
8.      Drop the packet
```

Ref1: P.PLOAD and T.PLOAD represent payload protocol of the receiving packet, and payload protocol of the tunnel respectively.

Ref1bis: First nibble of payload is used to determine payload protocol in GTP-U case due to it has no payload protocol indicator in the header.

Ref2: The received IPv6 DA is placed as last SID of the inserted SRH.

Ref2bis: The SRH is inserted before any other IPv6 Routing Extension Header.

5.5. Rate Limit

Mobile user-plane requires rate-limit feature. SID is able to encode limiting rate as an argument in SID. Multiple flows of packets should have same group identifier in SID when those flows are in an same AMBR group. This helps to keep user-plane stateless. That enables SRv6 endpoint nodes which are unaware from the mobile control-plane information. Encoding format of rate limit segment SID is following:

```
+----------------------+----------+-----------+
| Locater of rate-limit| group-id | limit-rate|
+----------------------+----------+-----------+
          128-i-j            i          j
```

Figure 4: Stateless Interworking SID Encoding

In case of j bit length is zero in SID, the node should not do rate limiting unless static configuration or control-plane sets the limit rate associated to the SID.

6. Segment Routing IPv6 Functions and Behaviors by Use Cases

This section describes SRv6 functions and behavior applied to mobile user-plane functions by use cases. Terminology of SRv6 endpoint functions refers to [I-D.filsfils-spring-srv6-network-programming].

6.1. Basic Mode

In the basic mode, we assume that mobile user-plane functions are as same as existing ones except using SRv6. This means that there is no impact to rest part of mobile system should be expected while no advanced segment routing features are introduced to it.

User-plane Function	Uplink	Downlink
Access Point	T.Insert	End.X
L2-anchor	End.B6	End.B6
L3-anchor	End.T	T.Insert

Table 1: SRv6 Functions for Basic Mode

6.1.1. Uplink

In uplink, SRv6 node applies following SRv6 end point functions and transit behavior. SIDs are allocated per L3-anchor function in the SRv6 nodes of both L2 and L3-anchor functions in basic mode.

Access Point:

When the access point node receives a packet destine to "D::1" from a mobile node "S::1", it does T.Insert process for the receiving packets to push a SRH with SID list <A2::1, D::1> with SL=1. The access point node update DA to next UL L2-anchor SID "A2::1" which the SL indicates and forward the packet.

Layer-2 Anchor:

The L2-anchor node of "A2::1" segment does End.B6 process for the receiving packet according to the SRH. The node updates DA to next UL L3-anchor SID "A3::1" bound to "A2::1" and forward the packet. In this basic use case, just one UL L3-anchor SID with SL=0 is enough to do it so that there is no need to push another SRH to the packet in that PSP (Penultimate Segment Pop) operation.

Layer-3 Anchor:

The L3-anchor node of "A3::1" segment does End.T process for the receiving packet according to the SRH. The node decrement SL to 0, updates DA to D::1 which the SL indicates and lookup IPv6 table associated with "A3::1". In this basic use case, the decremented SL is 0 so that the node does PSP operation of popped out the SRH from the packet and forward it.

6.1.2. Downlink

In downlink, SRv6 node applies following SRv6 end point functions and transit behavior. SIDs are allocated per session in the SRv6 nodes of both L2-anchor and access point functions in basic mode.

Layer-3 Anchor:

When the L3-anchor node receives a packet destine to "S::1" from a correspondent node "D::1", it does T.Insert process for the receiving packets to push a SRH with SID list <A2::2, S::1> with SL=1. The L3-anchor node update DA to next DL L2-anchor SID "A2::2" which the SL indicates and forward the packet.

Layer-2 Anchor:

The L2-anchor node of "A2::2" segment does End.B6 process for the receiving packet according to the SRH. The node updates DA to next DL access point segment "A1::1" bound to "A2::2" and forward the packet. In this basic use case, just one DL access point SID with SL=0 is enough to do it so that there is no need to push another SRH to the packet in that PSP (Penultimate Segment Pop) operation.

Access Point:

The access point node of "A1::1" segment does End.X process for the receiving packet according to the segment. The node decrement SL to 0, updates DA to S::1 which the SL indicates and forward the packet to the mobile node of "S::1" through radio channel associated with "A1::1". In this use case, the decremented SL is 0 so that the node does PSP operation of popped out the SRH from the packet and forward it.

6.2. Aggregate Mode

In the aggregate mode, user-plane function is able to steer multiple mobile sessions per service policy. This means that mobile sessions paths are aggregated into a service path which includes not only mobile user-plane functions but also other nodes, links or service functions. SIDs are allocated per service policy in the SRv6 nodes of user-plane functions in the aggregate mode.

Aggregate mode user-plane can take advantage of SRv6 that enables seamless mobile user-plane deployment with service chaining, VPNs, traffic-engineering by computed path to fulfil the policy.

User-plane Function	Uplink	Downlink
Access Point	T.Insert	End
L2-anchor	End or End.B6	End or End.B6
L3-anchor	End.T	T.Insert

Table 2: SRv6 Functions for Aggregate Mode

6.2.1. Uplink

In uplink, SRv6 node applies following SRv6 end point functions and transit behavior.

Access Point:

When the access point node receives a packet destine to "D::1" from a mobile node "S::1", it does T.Insert process for the receiving packets.

First scenario is that the service policy for "D::1" is via service function S1 and node C1 before reach to L2-anchor "A2::1" so that the node pushes a SRH with SID list <S1, C1, A2::1, D::1> with SL=3. The node updates DA to service function S1 which the SL indicates and forward the packet.

Second case is that the access point function directly indicates the path beyond the L2-anchor, service function S2 and L3-anchor "A3::1" for example, the SID list shoud be <S1, C1, A2::, S2, A3::1, D::1> with SL=5.

Layer-2 Anchor:

It is assumed that the packet successfully traversed S1 and C1 segments so that the SL was decremented 3 to 1 in the first scenario, and 5 to 3 in the second scenario before arriving the node of "A2::1" or "A2::" segment.

In the first scenario that the L2-anchor node of "A2::1" segment is bound to a service policy which indicates path via service function S2 and L3-anchor function A3::1, the node does End.B6 process for the receiving packet to push a new SRH with SID list <S2, A3::1> with SL=1. The node updates DA to next service function SID S2 which the SL indicates and forward the packet.

In the second scenario that one SRH with SIDs <S1, C1, A2::, S2, A3::1, D::1>, the L2-anchor node of "A2::" segment is bound to just End function. The node does End process for the receiving packet according to the SRH that decrements SL to 2, updates DA to next service function SID S2 which the SL indicates and forward the packet.

Layer-3 Anchor:

The L3-anchor node of "A3::1" segment does End.T process for the receiving packet according to the SRH(s).

In the first scenario that outer SRH with SIDs <S2, A3::1>, it is assumed that the SL is decremented to 0 at service function S2 so that the node pops outer SRH. Then the node processes second SRH with SIDs <S1, C1, A2::1, D::1> that decrements SL

to 0, updates DA to D::1 which the SL indicates and lookup IPv6 table associated with "A3::1". In this case, the decremented SL is 0 so that the node does PSP operation of popped out the SRH from the packet and forward it.

In the second scenario that one SRH with SIDs <S1, C1, A2::, S2, A3::1, D::1>, L3-anchor node of "A3::" segment does End.T process for the receiving packet according to the SRH. Rest part of processes are as same as previous case.

6.2.2. Downlink

In downlink, SRv6 node applies following SRv6 end point functions and transit behavior.

Layer-3 Anchor:

When the L3-anchor node receives a packet destine to "S::1" from a mobile node "D::1", it does T.Insert process for the receiving packets.

First scenario is that the service policy for "S::1" is via service function S2 before reach to L2-anchor "A2::2" so that the node pushes a SRH with SID list <S2, A2::2, S::1> with SL=2. The node updates DA to service function S2 which the SL indicates and forward the packet.

Second scenario is that the L3-anchor function directly indicates the path beyond the L2-anchor, service function S1, node C3 and access point "A1::" for example, the SID list shoud be <S2, A2::, S1, C1, A1::1, D::1> with SL=5.

Layer-2 Anchor:

It is assumed that the packet successfully traversed S2 segment so that the SL was decremented 2 to 1 in the former case, and 5 to 4 in the latter case before arriving the node of "A2::2" or "A2::" segment.

In the first scenario that the L2-anchor node of "A2::2" segment is bound to a service policy which indicates path via node C1, service function S1 and access point function A1::, the node does End.B6 process for the receiving packet to push a new SRH with SID list <C1, S1, A1::1> with SL=1. The node updates DA to next service function SID C1 which the SL indicates and forward the packet.

In the second scenario that one SRH with SIDs <S1, C1, A2::, S2, A3::1, D::1>, the L2-anchor node of "A2::" segment is bound to just End function. The node does End process for the receiving packet according to the SRH that decrements SL to 2, updates DA to next node C1 which the SL indicates and forward the packet.

Access Point:

The access point node of "A1::1" segment does End process for the receiving packet according to the SRH(s).

In the first scenario that outer SRH with SIDs <C1, S1, A1::1>, it is assumed that the SL is decremented 2 to 0 at node C1 and service function S1 so that the outer SRH is popped out by PSP at S1. Thus the node processes second SRH with SIDs <S2, A2::2, S::1> that decrements SL to 0, updates DA to S::1 which the SL indicates and forward the packet to the mobile node through radio channel associated with "S::1". In this case, the decremented SL is 0 so that the node does PSP operation of popped out the SRH from the packet and forward it.

In the second scenario that one SRH with SIDs <S2, A2::, C1, S1, A1::1, S::1>, access node of "A1::1" segment does End process for the receiving packet according to the SRH. Rest part of processes are as same as previous case.

6.3. Stateless Interworking with Legacy Access Network

This section describes an use case where user-plane functions are interworking in stateless between SRv6 and legacy access networks. Here stateless means that there's no need to be aware any states of mobility sessions in the node.

As some types of interworking scenarios could be considered, we will describe other cases in the future versions of this document.

6.3.1. Uplink: Lagacy Access to SRv6

Legacy Access Point:

When a legacy access point node receives a packet destined to "D::1" from a mobile node "S::1" through associated radio channel, it does tunnel encapsulation with the tunneling parameters, IPv4 DA, SA and tunnel header with ID, and sends out the packet to the network.

Stateless Interworking:

The stateless interworking node of corresponding to the IPv4 DA does T.Tmap process for the receiving packet to pop the tunnel headers and push a SRH to the packet. The SRH consists of SIDs <B1, D::1> with SL=1, where "B1" encodes IW-IPv6-Prefix, tunnel IPv4 DA, SA and TUN-ID in it as Figure 3 defined. The stateless interworking node updates DA to "B1" and forward the packet. SA of the packet must be kept as "S::1".

Layer-2 or Layer-3 Anchor:

The receiving node of the packet destine to B1 either be Layer-2 anchor, or Layer-3 anchor node. Which type of anchor function bound to B1 depends on operational policy.

In case of B1 to an L2-anchor node, the L2-anchor node does End.B6 process for the receiving packet as same as previous section.

In case of B1 to an L3-anchor node, the L3-anchor node does End.T process for the receiving packet as same as previous section.

6.3.2. Downlink: SRv6 to Legacy Access

Layer-2 or Layer-3 Anchor:

In case of an L3-anchor node receives a packet destine to S::1 from the correspondent node "D::1", and stateless interworking SID is bound to the next segment of S::1 , the L3-anchor node does T.Insert process for the receiving packet to push a SRH with SID list <B2::, S::1> with SL=1, where "B2" which encodes IW-IPv6-Prefix, tunnel IPv4 DA, SA and TUN-ID in it as Figure 3 defined. The L3-anchor node updates DA to "B2" and forward the packet.

In case of an L2-anchor node receives a packet destine to SID "A2::B2" and the SID is bound to "B2", the L2-anchor node does End.B6 process for the receiving packet as same as previous section. The node updates DA to B2 and forward the packet.

Stateless Interworking:

The stateless interworking node of "B2" End.TM process for the receiving packet according to the SRH. The node decrement SL to 0, updates DA to "D::1" which the SL indicates, push IPv4 and tunnel headers with IPv4 DA, SA and TUN-ID extracted from "B2", and forward the packet to the legacy network.

In this use case, decremented SL is 0 so that the node does PSP operation of popped out the SRH from the packet and forward it.

Legacy Access Point:

The legacy access point node of the IPv4 DA does tunnel termination process for the receiving packet according to the tunnel header. The node pop the IPv4 and tunnel header and forward the packet to the mobile node through radio channel associated with the tunnel.

7. Network Slicing Considerations

Mobile network may be required to create a network slicing that represent a set of network resources and isolate those resource from other slices. User-plane functions represented as SRv6 segments would be part of a slice.

To represent a set of user-plane function segments for a slice, sharing same prefix through those SIDs within the slice could be a straightforward way. SIDs in a network slice may include other type of functions in addition to the mobile user-plane functions described in this document, and underlay integration to meet SLA and quality requirements.

While network slicing has been discussed in the IETF and other standardization bodies, what functionalities are required for network slicing in mobile user-plane is further study item and to be discussed.

8. Control Plane Considerations

8.1. Existing Control Plane

A mobile control-plane entity may allocate SIDs to the node of corresponding user-plane function. In this case, the control-plane entity must signal allocated SIDs to other side of entity.

If the control-plane entity needs to employ existing mobile control-plane protocol to signal, GTP-C or PMIP for example, it must require not to impact the control-plane protocols. In this case, tunnel endpoint IPv6 address field in the control-plane message can be used to signal a SID.

The basic mode described in Section 6.1 should be adopted. In the basic mode, SID indicates unique session so that tunnel identifier is not required to SRv6 user-plane. But the mobile control-plane may be assumed that one user-plane entity has one IPv6 address and it

allocates tunnel identifier per session. In this case, SRv6 node of user-plane can form SID with the IPv6 address and the tunnel identifier.

When an IPv6 prefix "A::/64" is allocated to an user-plane, and the control-plane allocate one 32bits tunnel identifier of "0x12345678" for a mobile session, the user-plane node forms a 128bits SID "A::1234:5678".

In this way, there is no impact to the control-plane.

8.2. Aggregate Mode

To support aggregate mode described in Section 6.2 in control-plane protocol, allocated SIDs for service policies can be signaled as tunnel endpoint IPv6 address too. In this case, SRv6 policy associated to the SID should be configured in the user-plane node through other means.

Aggregate mode user-plane can take advantage of SRv6 that enables seamless mobile user-plane deployment with service chaining, VPNs, traffic-engineering by computed path to fulfil the policy.

In case of a mobile control-plane is aware those policies and is capable to advertise them, the mobile control-plane can integrate SRv6 advanced features.

8.3. User-Plane Sepalated Control Plane

In an user-plane separated control-plane system, a mobile user-plane entity may allocate SIDs to an user-plane function instead of the control-plane. In this case, the user-plane entity should inform allocated SIDs back to the control-plane entity.

If the control- and user-plane entities need to employ existing user-plane control protocol in between, such as PFCP for example, it may be required not to impact that protocol. In this case, the control-plane entity is only allowed to signal SID in a tunnel endpoint IPv6 address field.

8.4. Centralized Controller

When a centralized controller interfaces to mobile control-planes is capable to allocate SIDs to the controlling SRv6 nodes, the mobile control-planes just need to indicate nodes and their user-plane functions to the controller. In this case, the controller must allocate appropriate SIDs for the user-plane functions to the SRv6 nodes. The controller must configure allocated SIDs to the nodes.

To indicate nodes and their user-plane functions from mobile control-plane to user-plane, the centralized controller could take advantage of [I-D.ietf-dmm-fpc-cpdp]. It provides interface to the control-plane to manage the user-plane of mobile networks. To build centralized controller for mobile user-plane is out of scope of this document.

8.5. Stateless Interworking

A mobile control-plane is not required to configure statless interworking function in interworking node. This benefits operators to gradually migrate from legacy to advanced mobile user-plane with no impact to the legacy system.

SID allocating entity of SRv6 user-plane nodes needs to be aware of IW-IPv6-Prefix to form interworking SID. Legacy user-plane network allocate IPv4 address space routed to SRv6 user-plane network. The mobile control-plane of legacy user-plane also need to allocate tunnel endpoint IPv4 addresses from that address space for mobile sessions which is usual operation for it and no difference from legacy system.

9. Security Considerations

TBD

10. IANA Considerations

This document has no actions for IANA.

11. Acknowledgements

TBD

12. References

12.1. Normative References

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