

Internet Engineering Task Force  
Internet-Draft  
Intended status: Standards Track  
Expires: 28 April 2022

S. Matsushima  
K. Horiba  
A. Khan  
Y. Kawakami  
SoftBank  
T. Murakami  
K. Patel  
Arrcus, Inc  
M. Kohno  
T. Kamata  
P. Camarillo  
Cisco Systems, Inc.  
25 October 2021

**Segment Routing IPv6 Mobile User Plane Architecture for Distributed  
Mobility Management  
draft-mhkk-dmm-srv6mup-architecture-00**

**Abstract**

This document defines the Segment Routing IPv6 Mobile User Plane (SRv6 MUP) architecture for Distributed Mobility Management. The requirements for Distributed Mobility Management described in [\[RFC7333\]](#) can be satisfied by routing fashion.

Mobile services are deployed over several parts of IP networks. A Segment Routing over IPv6 (SRv6) network can accommodate all, or part of those networks thanks to the large address space of IPv6 and the network programming capability described in [\[RFC8986\]](#).

Segment Routing IPv6 Mobile User Plane Architecture can incorporate existing session based mobile networks. By leveraging SRv6 network programmability, mobile user plane can be integrated into the SRv6 data plane. In that routing paradigm, session information between the entities of the mobile user plane is turned to routing information.

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## [1.](#) Introduction

Mobile services require IP connectivity for communication between the entities of mobile service architecture. To provide the IP connectivity, Segment Routing (SR) [[RFC8402](#)] can be a candidate solution.



In PMIPv6 [[RFC5213](#)], IP connectivity between LMA and MAG can be provided over SR networks, as well as LMA and Internet. In 3GPP 5G [[TS.23501](#)], IP connectivity for N3 interface between gNodeB(es) and UPFs can also be provided by SR, as well as for N6 interface between UPFs and DNS (Data Network).

These IP connectivities may be covered by multiple SR networks, or just one SR network, depending on the size of the deployment. In the latter case, it is expected that the address space of the SR network should be large enough to cover a vast number of nodes, such as millions of base stations. For this reason, use of IPv6 for the SR dataplane looks sufficiently suitable.

SRv6 is an instantiation of SR over IPv6 dataplane in which a single network can accommodate all entities of mobile services thanks to the huge available address space and network programming capability described in [[RFC8986](#)].

Meanwhile, SRv6 network programmability enhances SRv6 dataplane to be integrated with mobile user plane [[I-D.ietf-dmm-srv6-mobile-uplane](#)]. It will make an entire SRv6 network support the user plane in a very efficient distributed routing fashion.

On the other hand, the requirements for Distributed Mobility Management (DMM) described in [[RFC7333](#)] can be satisfied by session management based solutions. [[RFC8885](#)] defines protocol extension to PMIPv6 for the DMM requirements. 3GPP 5G defines an architecture in which multiple session anchors can be added to one mobility session by the session management.

As a reminder, the user plane related requirements in [[RFC7333](#)] are reproduced here:

REQ1: Distributed mobility management

IP mobility, network access solutions, and forwarding solutions provided by DMM MUST enable traffic to avoid traversing a single mobility anchor far from the optimal route. It is noted that the requirement on distribution applies to the data plane only.

REQ3: IPv6 deployment

DMM solutions SHOULD target IPv6 as the primary deployment environment and SHOULD NOT be tailored specifically to support IPv4, particularly in situations where private IPv4 addresses and/or NATs are used.



**REQ4: Existing mobility protocols**

A DMM solution **MUST** first consider reusing and extending IETF standard protocols before specifying new protocols.

**REQ5: Coexistence with deployed networks/hosts and operability across different networks**

A DMM solution may require loose, tight, or no integration into existing mobility protocols and host IP stacks. Regardless of the integration level, DMM implementations **MUST** be able to coexist with existing network deployments, end hosts, and routers that may or may not implement existing mobility protocols. Furthermore, a DMM solution **SHOULD** work across different networks, possibly operated as separate administrative domains, when the needed mobility management signaling, forwarding, and network access are allowed by the trust relationship between them.

This document defines the Segment Routing IPv6 Mobile User Plane (SRv6 MUP) architecture for Distributed Mobility Management. SRv6 MUP is not a mobility management system itself, but the DMM requirements are supported by leveraging SRv6 network programmability to integrate mobile user plane into the SR data plane.

In this routing paradigm, session information from a mobility management system will be transformed to routing information. It means that mobile user plane specific nodes for the anchor or intermediate points are no longer required. The user plane anchor and access agent functions can be supported by SR throughout an SR domain (REQ1), not to mention that SRv6 MUP will naturally be deployed over IPv6 networks (REQ3).

SRv6 MUP architecture is independent from the mobility management system. For the requirements (REQ4, 5), SRv6 MUP architecture is designed to be pluggable user plane part of existing mobile service architectures. Those existing architectures are for example defined in [[RFC5213](#)], [[TS.23501](#)], or if any.

The level of SRv6 MUP integration for mobile networks running based on the existing architecture will be varied and depending on the level of SRv6 awareness of the control and user plane entities.

Specifying how to modify the existing architecture to integrate SRv6 MUP is out of scope of this document. What this document provides for the existing architecture is an interface for SRv6 MUP which the existing or future architectures can easily integrate.



### **1.1. Requirements Language**

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 [RFC 2119](#) [[RFC2119](#)].

## **2. Terminology**

MUP: Mobile User Plane

MUP Segment: Representation of mobile user plane segment

MUP PE: Provider Edge node in a MUP network

MUP GW: Gateway node to interwork with another mobile user plane networks

MUP Controller: Controller node for a MUP network

UE: User Equipment, as per [[TS.23501](#)]

MN: Mobile Node, as per [[RFC5213](#)]

## **3. Architecture Overview**

SRv6 MUP architecture defined in this document introduces a new segment type of the SR called "Mobile User Plane (MUP) segment" and new routing information called "Segment Discovery route" and "Session Transformed route", then 3 new network nodes; MUP PE, MUP GW and MUP Controller. Figure 1 depicts the overview.

To carry these new routing information, this architecture requires extending the existing routing protocols. Any routing protocol can be used to carry this information but this document recommends using BGP. Thus, this document describes extensions on BGP as an example.





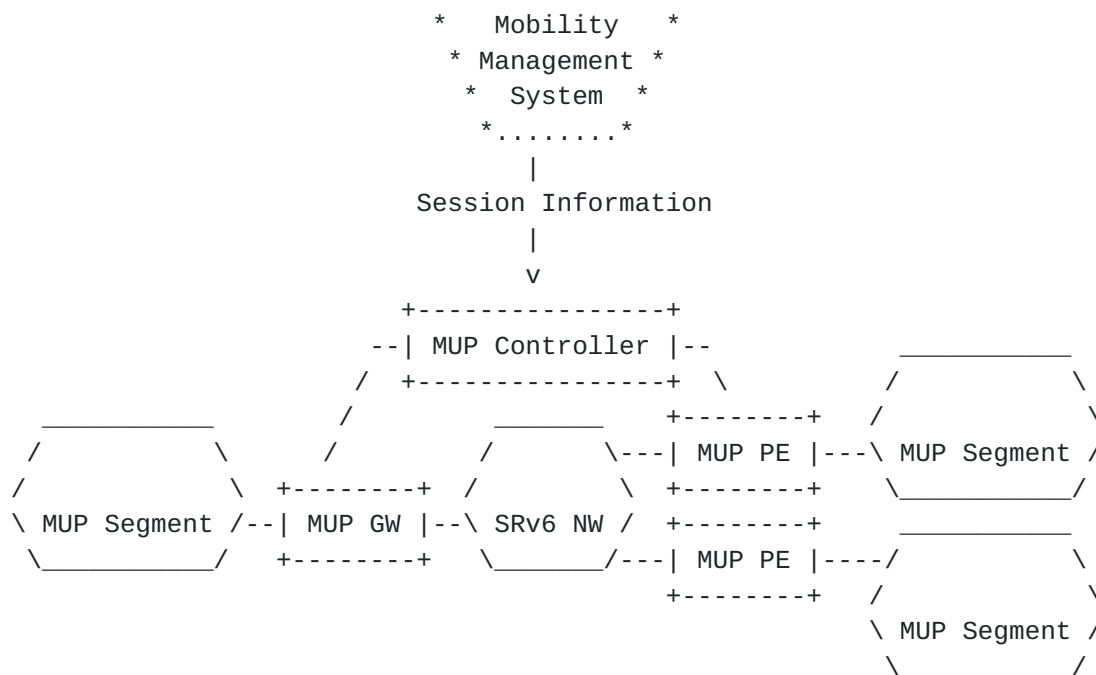


Figure 1

#### 4. Mobile User Plane Segment

This document defines one new segment type. A Mobile User Plane (MUP) segment may represent a network segment consisting of a mobile service. The MUP segment can be created by an SR node which provides connectivity for the mobile user plane. The MUP segment SID can be any behavior defined in [RFC8986], [I-D.ietf-dmm-srv6-mobile-uplane], or any other extensions for further use cases.

The behavior of the MUP segment will be chosen by the role of the representing mobile network segment. For example, in case of an SR node interfaces to 5G user plane on the access side defined as "N3" in [TS.23501], the behavior of created segment SID will be "End.M.GTP4.E", or "End.M.GTP6.E". In this case, the SR node may associate the SID to a N3 access network (N3RAN) routing instance.

Another example here is the "N6" interface on the core data network side. The behavior of the created segment SID will be "End.DT4", "End.DT6", or "End.DT2". In this case the SR node may associate the SID to a N6 data network (N6DN) routing instance.



## **5. Distribution of Mobile User Plane Segment Information**

Distribution of MUP segment information can be done by advertising routing information with the MUP segment for mobile service. This document defines two types of SR node, MUP PE and MUP GW, for distributing MUP segment information.

A MUP Segment Discovery route is routing information, of which a MUP segment is associated with network reachability. This document defines the basic network reachability types, Direct type reachability, and Interwork type reachability. Other types of network reachability may be mobile service architecture specific. Define the architecture specific network reachability is out of scope of this document and it will be specified in another document.

### **5.1. MUP PE**

A MUP PE accommodates a MUP segment to a routing instance for direct reachability. The MUP PE advertises the MUP segment discovery route for the routing instance with the direct network reachability information and the corresponding MUP segment to the SR domain.

For example in 3GPP 5G specific case, an MUP PE may connect to N6 interface on a DN side, an MUP segment discovery route for the DN will be advertised with a N6DN reachability and corresponding SID from the MUP PE.

The MUP PE keeps the received MUP segment discovery routes advertised from other MUP PEs in the RIB. The MUP PE uses those received MUP segment discovery routes to resolve the nexthop of routes for UE, MN or any other IP prefixes. If a MUP segment discovery route matches to a nexthop, the MUP PE updates the FIB entry for the route with the SID of the matched MUP segment discovery route.

### **5.2. MUP GW**

A MUP GW interfaces an MUP segment with the user plane protocol for the existing mobile service architecture. The MUP GW accommodates the MUP segment to a routing instance for the existing mobile service architecture. The MUP GW advertises the corresponding MUP segment discovery route with the interwork type reachability to the SR domain.

For example in 3GPP 5G specific case, an interwork reachability for N3 network accommodating RAN will be incorporated in an N3RAN segment discovery route associated with a RAN segment SID.



When a MUP GW receives a MUP segment discovery route with direct type reachability, the MUP GW creates an SR Policy [[I-D.ietf-spring-segment-routing-policy](#)] to the MUP segment with the associated BSID. For example in 3GPP 5G specific case, the BSID behavior for the N6DN segment discovery route will be H.M.GTP4.D or H.M.GTP6.D. The received SID in the N6DN segment discovery route will be the last SID of the created SR Policy.

The MUP GW may keep the received MUP segment discovery routes advertised from other MUP GWs in the routing instance. The IP prefixes for the received segments are imported into the routing instance table. Thereby the MUP GW can provide network connectivity between the nodes that exist in the segments.

The MUP GW may also accommodate another type of routing instance for the routes of UE, MN or any other IP prefixes. In this case, the MUP GW creates an SR policy with the BSID for the routing instance table lookup.

## 6. MUP Controller

A MUP controller provides a northbound API. A consumer of the API inputs session information for a UE or a MN from mobility management system. The MUP controller transforms the received session information to routing information and will advertise the transformed route to the SR domain.

The received session information is expected to include the UE or MN IP prefix(es), tunnel endpoint identifiers for both ends, and any other attributes for the mobile networks. For example in a 3GPP 5G specific case, the tunnel endpoint identifier will be a pair of the F-TEIDs on both the N3 access side (RAN) and core side (UPF).

SRv6 MUP architecture defines two types of session transformed route.

First type route is that IP prefix(es) for a UE or MN may be encoded in a BGP MP-NLRI attribute with associated session information of the tunnel endpoint identifier on the access side. The MUP controller advertises the UE or MN route to the SR domain.

Second type route is that the tunnel endpoint identifier of the session on the core side may also be encoded in another BGP MP-NLRI attribute. And the MUP controller also advertises this type of route with the BSID of SR Policy corresponding to the core MUP segment.



To ensure advertising the second type route, the MUP controller collects SR Policies for the segments advertised from MUP GWs in the SR domain. The MUP controller maintains the collected SR Policies and manages them for the corresponding core segment.

MUP PE and GW are expected to receive the routes advertised from the MUP controller. A MUP PE imports a route for UE or MN into the corresponding Direct type routing instance. A MUP GW imports a route for core side session tunnel endpoint identifier into the corresponding Interwork type routing instance.

## **7. Illustration**

The illustration of SRv6 MUP architecture will be filled in next revisions.

## **8. IANA Considerations**

This memo includes no request to IANA.

## **9. Security Considerations**

TBD.

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### Authors' Addresses

Satoru Matsushima  
SoftBank  
Japan

Email: satoru.matsushima@g.softbank.co.jp

Katsuhiro Horiba  
SoftBank  
Japan

Email: katsuhiro.horiba@g.softbank.co.jp



Ashiq Khan  
SoftBank  
Japan

Email: [ashiq.khan@g.softbank.co.jp](mailto:ashiq.khan@g.softbank.co.jp)

Yuya Kawakami  
SoftBank  
Japan

Email: [yuya.kawakami01@g.softbank.co.jp](mailto:yuya.kawakami01@g.softbank.co.jp)

Tetsuya Murakami  
Arrcus, Inc.  
United States of America

Email: [tetsuya@arrcus.com](mailto:tetsuya@arrcus.com)

Keyur Patel  
Arrcus, Inc.  
United States of America

Email: [keyur@arrcus.com](mailto:keyur@arrcus.com)

Miya Kohno  
Cisco Systems, Inc.  
Japan

Email: [mkohno@cisco.com](mailto:mkohno@cisco.com)

Teppei Kamata  
Cisco Systems, Inc.  
Japan

Email: [tkamata@cisco.com](mailto:tkamata@cisco.com)

Pablo Camarillo Garvia  
Cisco Systems, Inc.  
Spain

Email: [pcamaril@cisco.com](mailto:pcamaril@cisco.com)

