Workgroup: DMM Working Group
Internet-Draft:
draft-kohno-dmm-srv6mob-arch-06
Published: 12 March 2023
Intended Status: Informational
Expires: 13 September 2023
Authors: M. Kohno, Cisco Systems, Inc.
F. Clad, Cisco Systems, Inc.
P. Camarillo, Cisco Systems, Inc.
Z. Ali, Cisco Systems, Inc.

Architecture Discussion on SRv6 Mobile User plane

Abstract

This document discusses the solution approach and its architectural benefits of translating mobile session information into routing information, applying segment routing capabilities, and operating in a routing paradigm.

Status of This Memo

Copyright Notice

Table of Contents

1. Introduction
2. Problem Definition
3. SRv6 mobile user plane and the 5G use cases
  3.1. Network Slicing
  3.2. Edge Computing
  3.3. URLLC (Ultra-Reliable Low-Latency Communication) support
4. Co-existence and Incremental Deployability
5. Security Considerations
6. IANA Considerations
7. Acknowledgements
8. References
  8.1. Normative References
  8.2. Informative References
Authors' Addresses

1. Introduction

The current mobile user plane is defined as an overlay tunnel session to a mobile anchor point (UPF: User Plane Function in 5G context).

While this approach may be convenient from the standpoint of per-session per-usage charging, it is difficult to cost-effectively and scalably address the high traffic volumes of the 5G/Beyond 5G era and more distributed data and computing demands of the future.

In addition, the requirements for wireless systems, such as IoT and FWA (Fixed Wireless Access) applications, are becoming more diverse, and there are cases where the conventional per-session per-usage charging is not necessarily applicable.

This document discusses the solution approach and its architectural benefits of translating mobile session information into routing information, applying segment routing capabilities, and operating in a routing paradigm.

2. Problem Definition

The current tunnel session based mobile user plane has the following limitations and is getting hard to support new application requirements.

*Non-optimal for any-to-any communication
*Non-optimal for edge/distributed computing
*Non-optimal for fixed and mobile convergence (FMC)

*No control of the underlay path

In addition, the anchor point that terminates tunnel sessions becomes a scaling bottleneck.

As for FMC, there is currently a coordinated standardization effort between 3GPP WWC [TS.23316] and BBF [BBF407]. However, the idea is to anchor even wireline traffic in the mobile packet core, which compromises simplicity and scalability.

The IP routing paradigm naturally eliminates these tunnel session based shortcomings. Segment Routing enables fast protection, policy, slicing, etc. to provide reliability and SLA differentiation.

3. SRv6 mobile user plane and the 5G use cases

This section describes the advantages of applying SRv6 mobile user plane for 5G use cases.

3.1. Network Slicing

Network slicing enables network segmentation, isolation, and SLA differentiation in terms of latency and availability. End-to-end slicing will be achieved by mapping and coordinating IP network slicing, RAN and mobile packet core slicing.

But existing mobile user plane which is overlay tunnel does not have underlying IP network awareness, which could lead to the inability in meeting SLAs. Removing the tunnel and treating it with a routing paradigm simplifies the problem.

Segment Routing has a comprehensive set of slice engineering technologies. How to build network slicing using the Segment Routing based technology is described in [I-D.ali-spring-network-slicing-building-blocks].

Moreover, the stateless slice identifier encoding [I-D.filsfils-spring-srv6-stateless-slice-id] can be applicable to enable per-slice forwarding policy using the IPv6 header.

3.2. Edge Computing

Edge computing, where the computing workloads and datastores are placed closer to users, is recognized as one of the key pillars to meet 5G's demanding requirements, with regard to low latency, bandwidth efficiency, and data localty and privacy.

Edge computing is more important than ever. This is because no matter how much 5G improves access speeds, it won't improve end-to-end throughput because it's largely bound to round trip delay.

Even with existing mobile architectures, it is possible to place UPFs in a multi-tier, or to distribute UPFs, to achieve Edge Computing. However, complicated mechanisms are required to branch traffic or properly use different UPFs. Also, seamless handover needs to be compromised when UPFs are distributed.

Routing paradigm simply supports ubiquitous computing.

3.3. URLLC (Ultra-Reliable Low-Latency Communication) support

3GPP [TR.23725] investigates the key issues for meeting the URLLC requirements on latency, jitter and reliability in the 5G System. The solutions provided in the document are focused at improving the overlay protocol (GTP-U) and limits to provide a few hints into how to map such tight-SLA into the transport network. These hints are based on static configuration or static mapping for steering the overlay packet into the right transport SLA. Such solutions do not scale and hinder network economics.

Another issue that deserves special mention is the ultra-reliability issue. In order to support ultra-reliability with the tunnel session paradigm, redundant user planes paths based on dual connectivity has been proposed. The proposal has two main options.

*Dual Connectivity based end-to-end Redundant User Plane Paths
*Support of redundant transmission on N3/N9 interfaces

In the case of the former, UE and hosts have RHF(Redundancy Handling Function). In sending, RFH is to replicate the traffic onto two GTP-U tunnels, and in receiving, RHF is to merge the traffic.

In the case of the latter, traffic are to be replicated and merged with the same sequence for specific QoS flow, which requires further enhancements.

And in either cases, the bigger problem is the lack of a reliable way for the redundant sessions to get through the disjoint path: even with the redundant sessions, if it ends up using the same infrastructure at some points, the redundancy is meaningless.

These issues can be solved more simply without GTP-U tunnel.

In addition, Segment routing has some advantages for URLLC traffic. First, traffic can be mapped to a disjoint path or low latency path as needed. Second, Segment routing provides an automated reliability protection mechanism known as TI-LFA, which is a sub-50ms FRR mechanism that provides protection regardless of the topology through the optimal backup path. It can be provisioned slice-aware.

4. Co-existence and Incremental Deployability

The mobile domain is a compound domain that includes Radio Access, and it is difficult to implement a completely new architecture, so co-existence and incremental deployability is required.

[I-D.ietf-dmm-srv6-mobile-uplane] defines the data plane convergence between GTP-U and SRv6 between GTP-U and SRv6, so that it can co-exist with the current mobile architecture as needed.

Further, [I-D.mhkk-dmm-srv6mup-architecture] defines the MUP architecture for Distributed Mobility Management, which can be plugged to the existing mobile service architecture.

5. Security Considerations

The deployment of this architecture is targeted in a trusted domain.

6. IANA Considerations

NA

7. Acknowledgements

Authors would like to thank Satoru Matsushima, Shunsuke Homma,Yuji Tochio and Jeffrey Zhang, for their insights and comments.

8. References

8.1. Normative References

[I-D.hegdeppsenak-isis-sr-flex-algo] Psenak, P., Hegde, S., Filsfils, C., and A. Gulko, "ISIS Segment Routing Flexible Algorithm", Work in Progress, Internet-Draft, draft-hegdeppsenak-isis-sr-flex-algo-02, 16 February 2018, <https://datatracker.ietf.org/doc/html/draft-hegdeppsenak-isis-sr-flex-algo-02>.

[I-D.ietf-dmm-srv6-mobile-uplane] Matsushima, S., Filsfils, C., Kohno, M., Camarillo, P., and D. Voyer, "Segment Routing IPv6 for Mobile User Plane", Work in Progress, Internet-Draft, draft-ietf-dmm-srv6-mobile-uplane-24, 17 January 2023, <https://datatracker.ietf.org/doc/html/draft-ietf-dmm-srv6-mobile-uplane-24>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC8402]
Filsfils, C., Ed., Previdi, S., Ed., Ginsberg, L., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing Architecture", RFC 8402, DOI 10.17487/RFC8402, July 2018, <https://www.rfc-editor.org/info/rfc8402>.

[RFC8754] Filsfils, C., Ed., Dukes, D., Ed., Previdi, S., Leddy, J., Matsushima, S., and D. Voyer, "IPv6 Segment Routing Header (SRH)", RFC 8754, DOI 10.17487/RFC8754, March 2020, <https://www.rfc-editor.org/info/rfc8754>.

[RFC8986] Filsfils, C., Ed., Camarillo, P., Ed., Leddy, J., Voyer, D., Matsushima, S., and Z. Li, "Segment Routing over IPv6 (SRv6) Network Programming", RFC 8986, DOI 10.17487/RFC8986, February 2021, <https://www.rfc-editor.org/info/rfc8986>.

8.2. Informative References

[BBF407] BBF, "5G Wireless Wireline Convergence Architecture", BBF TR-407 Issue:1, August 2020.

[ETSI-MEC] ETSI, "MEC in 5G Networks", ETSI White Paper No.28, June 2018.

[I-D.ali-spring-network-slicing-building-blocks]
Ali, Z., Filsfils, C., Camarillo, P., and D. Voyer, "Building blocks for Slicing in Segment Routing Network", Work in Progress, Internet-Draft, draft-ali-spring-network-slicing-building-blocks-04, 21 February 2021, <https://datatracker.ietf.org/doc/html/draft-ali-spring-network-slicing-building-blocks-04>.

[I-D.auge-dmm-hicn-mobility] Auge, J., Carofiglio, G., Muscariello, L., and M. Papalini, "Anchorless mobility through hICN", Work in Progress, Internet-Draft, draft-auge-dmm-hicn-mobility-04, 7 July 2020, <https://datatracker.ietf.org/doc/html/draft-auge-dmm-hicn-mobility-04>.

[I-D.auge-dmm-hicn-mobility-deployment-options]
Auge, J., Carofiglio, G., Muscariello, L., and M. Papalini, "Anchorless mobility management through hICN (hICN-AMM): Deployment options", Work in Progress, Internet-Draft, draft-auge-dmm-hicn-mobility-deployment-options-04, 7 July 2020, <https://datatracker.ietf.org/

doc/html/draft-auge-dmm-hicn-mobility-deployment-options-04>.

[I-D.clt-dmm-tn-aware-mobility]
Chunduri, U., Li, R., Bhaskaran, S., Kaippallimalil, J., Tantsura, J., Contreras, L. M., and P. Muley, "Transport Network aware Mobility for 5G", Work in Progress, Internet-Draft, draft-clt-dmm-tn-aware-mobility-09, 12 February 2021, <https://datatracker.ietf.org/doc/html/draft-clt-dmm-tn-aware-mobility-09>.

[I-D.filsfils-spring-srv6-stateless-slice-id]
Filsfils, C., Clad, F., Camarillo, P., Raza, S., Voyer, D., and R. Rokui, "Stateless and Scalable Network Slice Identification for SRv6", Work in Progress, Internet-Draft, draft-filsfils-spring-srv6-stateless-slice-id-07, 29 January 2023, <https://datatracker.ietf.org/doc/html/draft-filsfils-spring-srv6-stateless-slice-id-07>.

[I-D.mhkk-dmm-srv6mup-architecture]
Matsushima, S., Horiba, K., Khan, A., Kawakami, Y., Murakami, T., Patel, K., Kohno, M., Kamata, T., Camarillo, P., Horn, J., Voyer, D., Zadok, S., Meilik, I., Agrawal, A., and K. Perumal, "Segment Routing IPv6 Mobile User Plane Architecture for Distributed Mobility Management", Work in Progress, Internet-Draft, draft-mhkk-dmm-srv6mup-architecture-04, 24 October 2022, <https://datatracker.ietf.org/doc/html/draft-mhkk-dmm-srv6mup-architecture-04>.

[RFC5213] Gundavelli, S., Ed., Leung, K., Devarapalli, V., Chowdhury, K., and B. Patil, "Proxy Mobile IPv6", RFC

5213, DOI 10.17487/RFC5213, August 2008, <https://www.rfc-editor.org/info/rfc5213>.

[TR.23725] 3GPP, "Study on enhancement of Ultra-Reliable Low-Latency Communication (URLLC) support in the 5G Core network (5GC)", 3GPP TR 23.725 16.2.0, June 2019.

[TR.29892] 3GPP, "Study on User Plane Protocol in 5GC", 3GPP TR 29.892 16.1.0, April 2019.

[TS.23316] 3GPP, "Wireless and wireline convergence access support for the 5G System (5GS)", 3GPP TS 23.316 16.7.0, September 2021.

[TS.23501] 3GPP, "System Architecture for the 5G System", 3GPP TS 23.501 15.0.0, November 2017.

[TS.29244] 3GPP, "Interface between the Control Plane and the User Plane Nodes", 3GPP TS 29.244 15.0.0, December 2017.

[TS.29281] 3GPP, "General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U)", 3GPP TS 29.281 15.1.0, December 2017.

Authors' Addresses

Miya Kohno
Cisco Systems, Inc.
Japan

Email: mkohno@cisco.com

Francois Clad
Cisco Systems, Inc.
France

Email: fclad@cisco.com

Pablo Camarillo Garvia
Cisco Systems, Inc.
Spain

Email: pcamaril@cisco.com

Zafar Ali
Cisco Systems, Inc.
Canada

Email: zali@cisco.com