IETF Hackathon

Application-aware G-SRv6 networking

IETF 110

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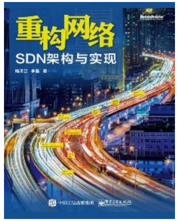
Online

Cheng Li

Huawei IP Standard Representative

- 30+ IETF drafts， 10 + WG drafts，1 RFC
- Currently focus on G-SRv6/SRv6，SFC，OAM
- Author of books
  - “ SRv6 Network Programming - Ushering in a New Era of IP Networks ”
  - “ Refactoring Network: Architecture and Implementation of SDN ”
- Paper： “ Application-aware G-SRv6 network enabling 5G services ” , INFOCOM 2021



Jianwei Mao

Huawei IP Senior Engineer for Research

- Currently focus on CFN，G-SRv6/SRv6，APN6
- Author of books
  - “ SRv6 Network Programming - Ushering in a New Era of IP Networks ”
- Paper
  - “ APN6： Application-aware IPv6 Networking ” , INFOCOM 2020
  - “ Application-aware G-SRv6 network enabling 5G services ” , INFOCOM 2021
  - “ CFN-dyncast： Load Balancing the Edges via the Network ” , IEEE WCNC 2021

Hackathon Plan

- Develop functions of Generalized SRv6 (G-SRv6), based on Linux Kernel.
- Combine G-SRv6 with APN6, to achieve Application-aware G-SRv6 networking.
  - G-SRv6 IETF drafts:

[draft-lc-6man-generalized-srh]()	Data plane extension for Generalized Segment Routing Header
[draft-cl-spring-generalized-srv6-np]()	Generalized SRv6 Network Programming
[draft-cl-spring-generalized-srv6-for-cmpr]()	Generalized SRv6 Network Programming for SRv6 Compression

  - APN6 IETF drafts:

[draft-li-6man-app-aware-ipv6-network]()	Data plane extension for Application-aware IPv6 Networking (APN6)
[draft-li-apn-framework]()	Application-aware Networking (APN) Framework
[draft-peng-apn-scope-gap-analysis]()	APN Scope and Gap Analysis

  - Open Communities:

https://github.com/G-SRv6	G-SRv6 Community
https://github.com/APN-Community	APN6 Community
https://www.ipv6plus.net	IPv6+ Community

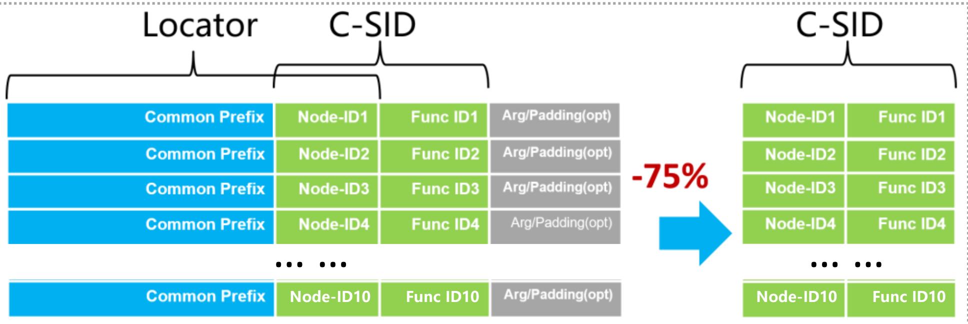
G-SRv6 Introduction

Problem Statement

- Transmission overhead of SRv6 is too high.

G-SRv6

- Reduce 75% size of SID List (transmission overhead).
- No new IPv6 address consumption, no new route creation.
- Fully compatible with SRv6, incremental deployment, deploy on demand.



SRv6 SID List
16 * 10 = **160 Bytes**

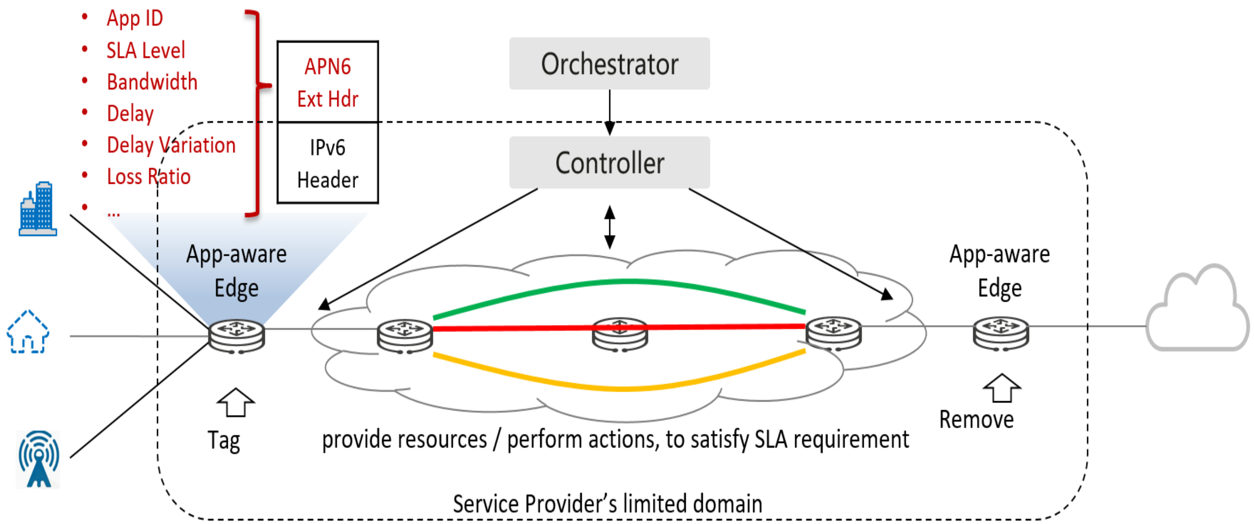
G-SRv6 SID List
4 * 10 = **40 Bytes**

12+ Vendors have PASSED Interop-test

APN6 Introduction

APN6 makes use of IPv6 Extension Headers

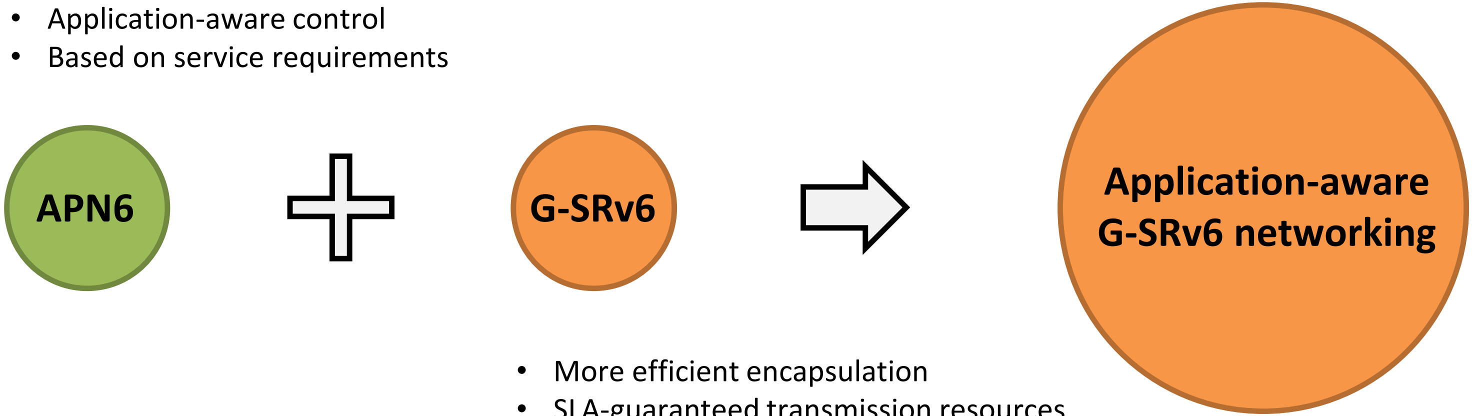
- Convey the application related information, including its SLA requirements, along with the packet to the network.
- Allows the network to quickly adapt and perform the necessary actions for SLA guarantees.



Application-aware G-SRv6 networking

- Enable application-aware fine-grained strict TE, with lower transmission overhead.

- Application-aware control
- Based on service requirements



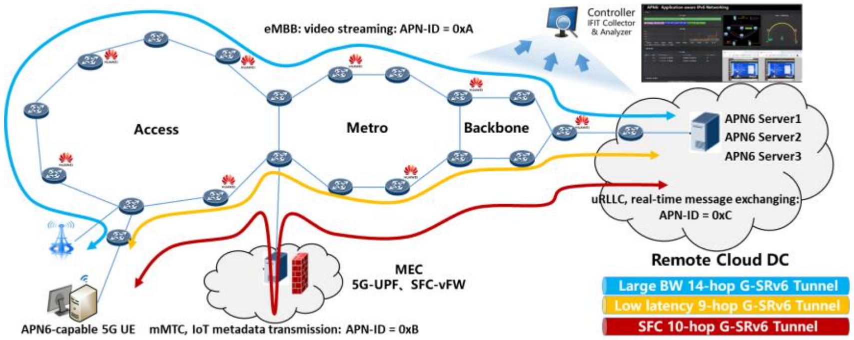
- More efficient encapsulation
- SLA-guaranteed transmission resources
- Network programmability, fully compatible with SRv6

Implemented Functions

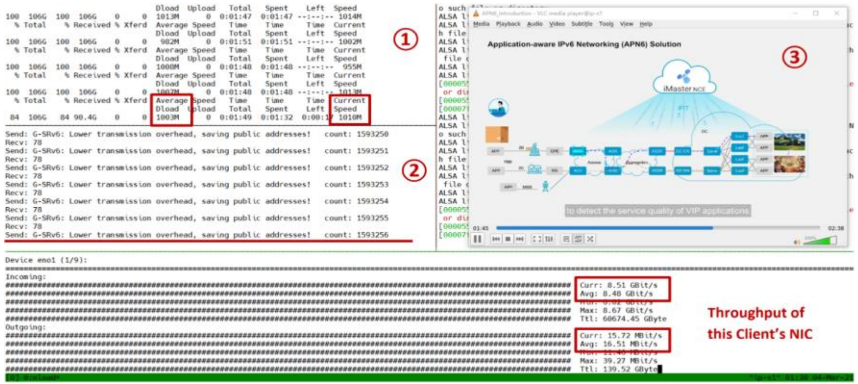
- We’ve implemented the demo based on *Linux Kernel* & *Huawei Router.*
- Functions in our demo:
  - G-SRv6:
    1. Identify APN6 info, and select the most suitable G-SRv6 TE tunnel for the specific App / flow.
    2. Encapsulate G-SRv6 Routing Header (Generalized SRH).
    3. Implement COC Flavor for End, End.X behavior.
    4. Implement End, End.X, End.DT6 as defined by SRv6 (G-SRv6 is compatible with SRv6).
    5. Implement G-SRv6 Local SID Table.
  - APN6:
    1. Encapsulate APN6 Options in IPv6 Hop-by-Hop Options Header, with application-specific info.

Demo & Result

- Topology with three layers
  - Three TE paths with 10+ hops (10+ SIDs in the SID List), for Apps with different SLA requirements.
- Apps:
  ① File Downloading (Security checking in a SFC)
  ② Interactive Control (Live & Short message)
  ③ HD Video on demand
- G-SRv6's Forwarding Rate is **55%+** higher than SRv6's.
- For 128 bytes payload, Overhead is reduced by **50%+**



Scheme	Application Throughput *	Network Throughput *	FCT *	RTT **	Forwarding Rate **	Bandwidth Utilization *
Best Effort (no APN)	0.94Gbps	0.94Gbps	923s	300.114 ms	/	10.28%
APN SRv6	7.48Gbps	9.01Gbps	114s	0.259 ms	400Mpps	83.07%
APN G-SRv6	**8.36Gbps**	**9.01Gbps**	**102s**	**0.259 ms**	**620Mpps**	**92.78%**



What we learned

Feedback to WG:

- G-SRv6 can improve utilization and value of bandwidth **significantly**.
- G-SRv6 is fully compatible with SRv6, and can apply to more scenarios.
    - e.g. Real-time control, Video on demand, HD Live streams, SFC, etc.
- Combining with APN6, flows of many kinds of Apps can be distinguished fine-grained, the SLA requirements of specific Apps can be guaranteed better.

In the future:

- We can make more proof of concept tests in wider area networks, such as CENI.
- We may share our codes of this demo openly in our Github community.
- Processing delay in our Linux prototype is higher than SRv6 now (~1ms), welcome to join us to improve it together!

CENI

China Environment for Network Innovations

China Environment of Network Innovation

Thank you :)

Team members:	• Open Communities:
• Jianwei Mao, Huawei (maojianwei@huawei.com)	https://github.com/G-SRv6
• Jiang Liu, BUPT (liujiang@bupt.edu.cn)	https://github.com/APN-Community
• Weihong Wu, BUPT (wwh_bupt@foxmail.com)	https://www.ipv6plus.net
• Lin He, Tsinghua (he-l14@mails.tsinghua.edu.cn)	• G-SRv6 Documents:
• Cheng Li, Huawei (c.l@huawei.com)	draft-lc-6man-generalized-srh
• Shuping Peng, Huawei (pengshuping@huawei.com)	draft-cl-spring-generalized-srv6-np
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	• APN6 Documents:
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