IETF Hackathon

-Comprehensive Hardware Evaluation of Multicast Source Routing over IPv6(MSR6) on Experimental Network

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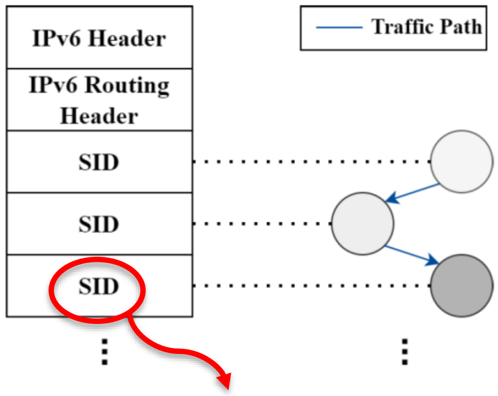
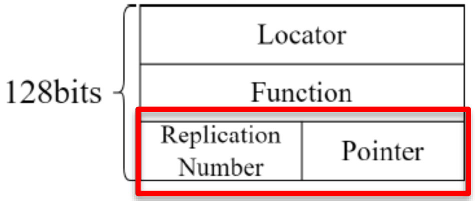
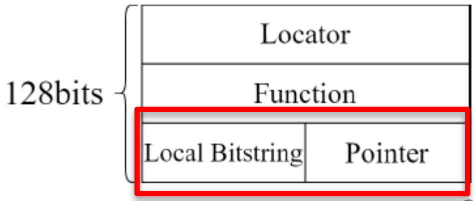
Hackathon Plan

- Implement MSR6 TE and MSR6 TE with RLB on hardware using the *P4* language.
- Conduct comprehensive *hardware emulations* based on a testbed with *5 hardware P4 switches* on *CENI*(China Environment for Network Innovations).
- Documents
  - https://datatracker.ietf.org/doc/draft-geng-msr6-traffic-engineering/02
  - https://datatracker.ietf.org/doc/draft-geng-msr6-rlb-segment/01
  - https://datatracker.ietf.org/doc/draft-chen-pim-srv6-p2mp-path/





SID Structure of ***MSR6 TE***



SID Structure of ***MSR6 TE with RLB***

Experimental Topology

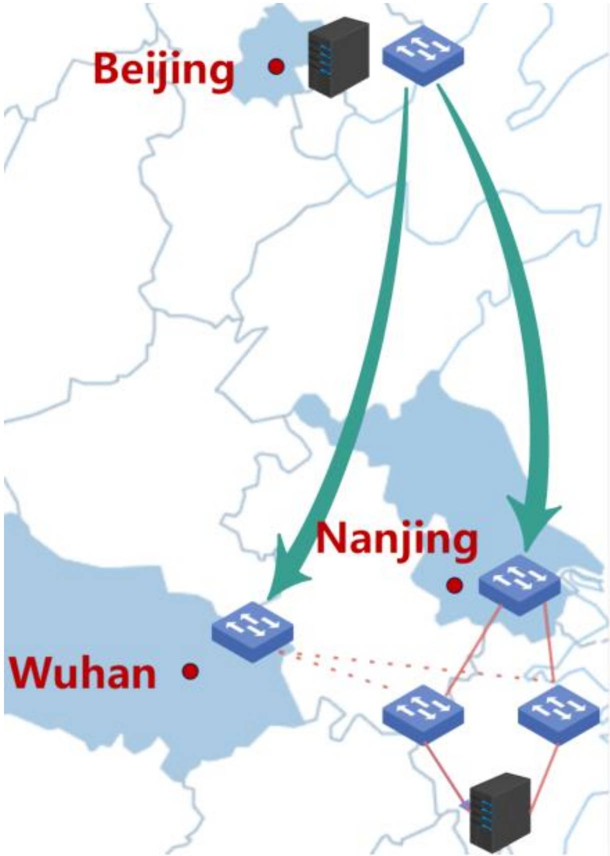


Figure 1. Experimental Topology

- ***Ingress Node***: Beijing, encapsulate to form MSR6 packets ***[deploy a video server to run real video traffic]***
- ***Transit Node***: Wuhan and Nanjing, receive the MSR6 packets and copy them into 2 copies based on specific fields in the MRH ***[deploy monitoring devices at each forwarding node]***
- ***Egress Node***: Nanjing, decapsulate the MSR6 packets ***[deploy a server to capture packets to verify the correctness of the packet after processing]***

Hardware Resource Usage

	Average	0	1	2	3
Action Data Bus Bytes	6.1%	3.1%	0.0%	1.6%	68.8%
Exact Match Input Xbar	2.5%	14.8%	0.8%	1.6%	12.5%
Gateway	1.0%	6.3%	0.0%	6.3%	0.0%
Hash Bit	2.0%	12.0%	2.4%	0.0%	9.6%
Logical Table ID	4.2%	25.0%	6.3%	12.5%	6.3%
SRAM	3.8%	7.5%	1.3%	1.3%	35.0%
Stash	2.1%	12.5%	6.3%	0.0%	6.3%
TCAM	2.1%	0.0%	0.0%	25.0%	0.0%
Ternary Match Input Xbar	2.0%	0.0%	0.0%	24.2%	0.0%
VLIW Instruction	2.1%	6.3%	6.3%	6.3%	6.3%
Exact Match Search Bus	2.1%	12.5%	6.3%	6.3%	6.3%
Exact Match Result Bus	2.1%	12.5%	6.3%	0.0%	6.3%
Ternary Result Bus	2.1%	12.5%	0.0%	12.5%	0.0%

Table 1. Resource Occupancy of MSR6 TE

1. The P4 program used in this project only uses 4 of the 12 stages, with most stages being idle and the resource occupancy rate in the used stages is not high.
2. It can be considered that this program will not bring a bottleneck on hardware resources.

Delay Measurement

- ***Encapsulation Delay***

Type	Average	Variance	MIN	MAX
MSR6 TE	286.59ns	$0.9619 ns^2$	284ns	289ns
RLB	318.53ns	$1.2704 ns^2$	316ns	321ns
IPv6	274.96ns	$1.7062 ns^2$	273ns	279ns

①MSR TE and RLB cause delays of about 287ns and 319ns respectively.

②The encapsulation delay of the MSR6 TE scheme is 3.5% higher than the IPv6 forwarding delay, and the encapsulation delay of the RLB scheme is 15% higher than the IPv6 forwarding delay.

- ***Clone and Forward Delay***

Action	1stClone	2ndClone
Average	296.92ns	378.97ns
Variance	$0.3336 ns^2$	$5.6691 ns^2$

Table 2. MSR6 TE's delay of clone and forward

Action	1stClone	2ndClone
Average	328.08ns	402.87ns
Variance	$0.2692 ns^2$	$9.7433 ns^2$

Table 3. MSR6 TE with RLB's delay of clone and forward

Action	1stClone	2ndClone
Average	270.70ns	285.14ns
Variance	$2.3508 ns^2$	$0.1254 ns^2$

Table 4. IPv6's delay of clone and forward

Stability

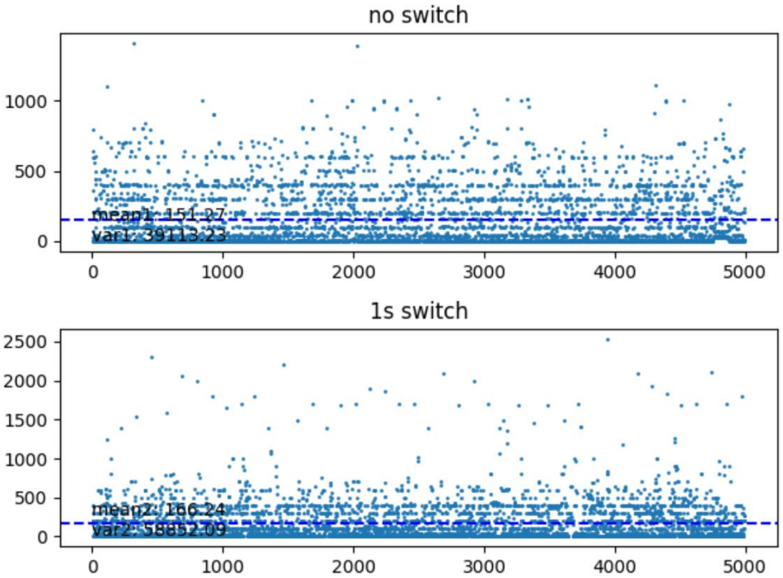
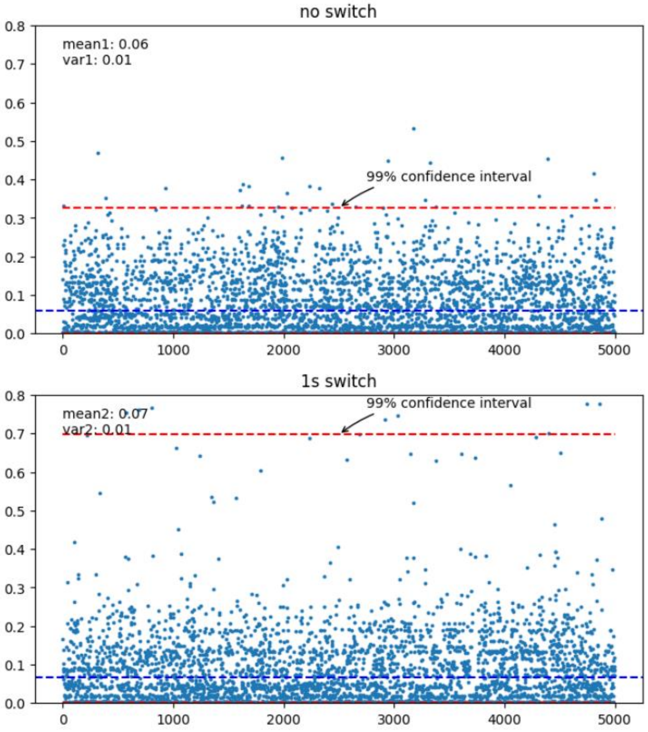


Figure 2. The difference between the sending interval and the receiving interval



The packet sending time at the sending end is t1, t2,. . . , and the packet receiving time at the receiving end is T1, T2,. . . . We have set a value to further measure stability

Figure 3. Distribution of |(T2 – T1) –(t2 – t1)|/ ((t2 – t1))

It can be seen that when the long delay link is involved, the turbulence of the interval between sending time and receiving time rises, but the rate of increase is acceptable. Therefore, this system is considered to a good stability.

Wrap Up

Team members:

- Weihong Wu (wuweihong@bupt.edu.cn)
- Yunyi Tang (tangyunyi0708@bupt.edu.cn)
- Yuxin Jiang (jyxin@bupt.edu.cn)
- Yutong Zhao(zhaoyutong@bupt.edu.cn)
- Jiang Liu (liujiang@bupt.edu.cn)
- Pei Anbang(anbangpei@bupt.edu.cn)