IETF Hackathon

-P4 Implementation and emulation of MSR6 BE

IETF 114

July 24, 2022

Remote

Hackathon Plan

- The *P4* Implementation of MSR6 BE (Multicast Source Routing over IPv6-– Best Effort)
- Emulations of MSR6 BE based on *Intel Tofino* switches
  - MSR6 Documents:

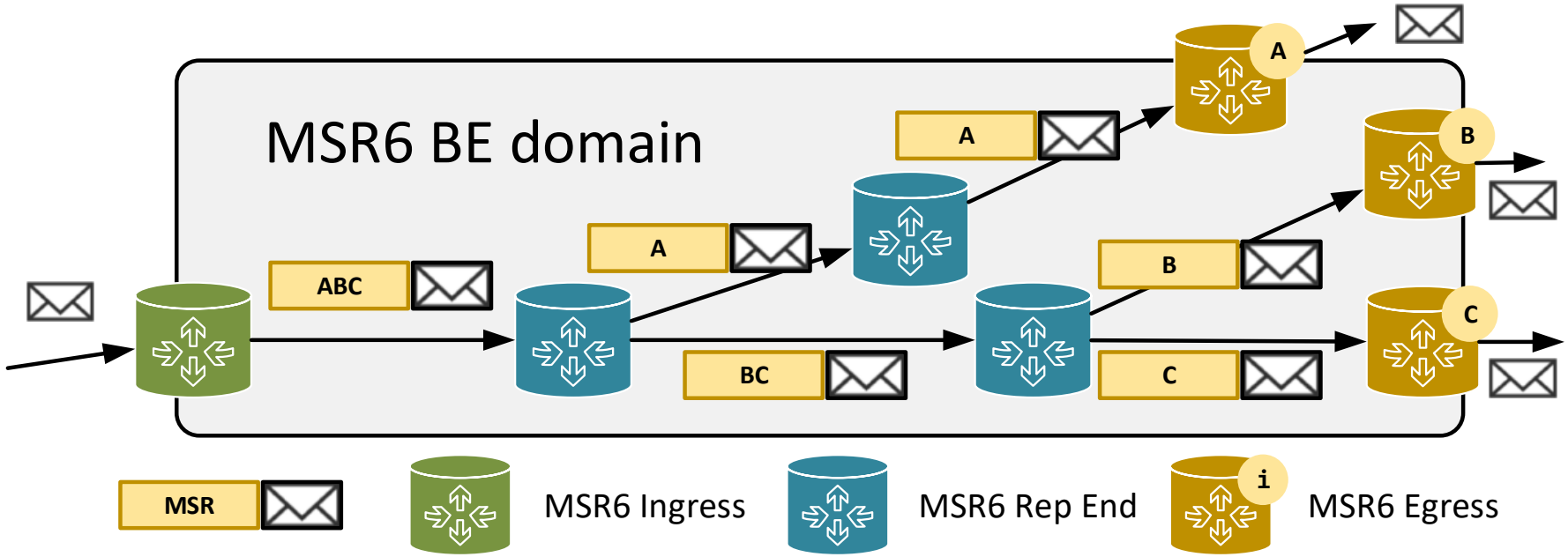
    https://datatracker.ietf.org/doc/html/draft-lx-msr6-rgb-segment
    https://datatracker.ietf.org/doc/html/draft-cheng-spring-ipv6-msr-design-consideration
    https://datatracker.ietf.org/doc/draft-cheng-msr6-design-consideration/

  - BIER Documents:

    https://datatracker.ietf.org/doc/html/rfc8279
    https://datatracker.ietf.org/doc/draft-ietf-bier-bar-ipa/
    https://datatracker.ietf.org/doc/draft-ietf-bier-bfd/

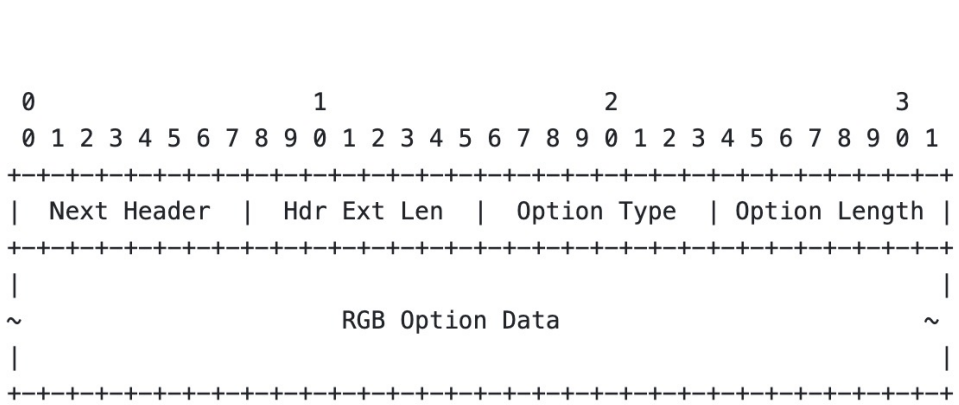
MSR6 BE

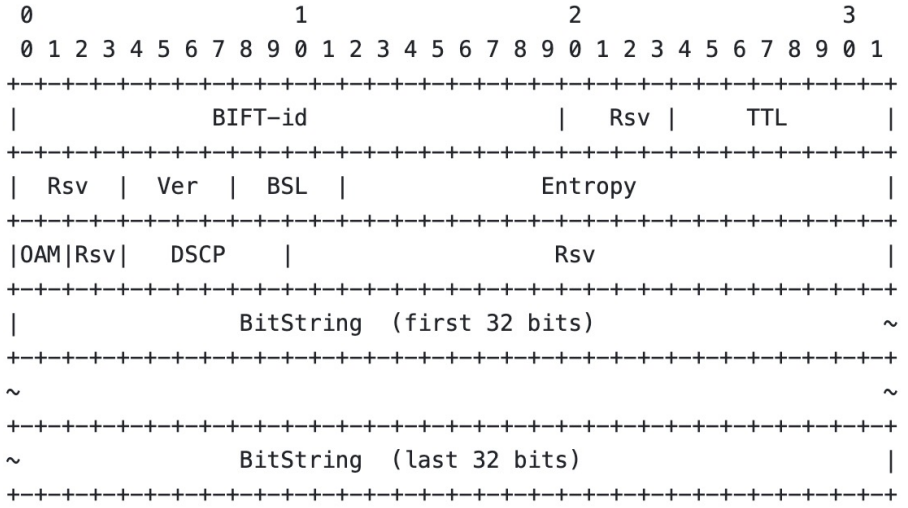
- MSR6 BE enables the source-indicated explicit replication of multicast
- MSR6 BE functionally implements BIER



RGB Segment/Option

- RGB (Replication through Global BitString) Segment is a new type of segment used to identify the Replication Endpoint
  - RGB Segment implements the function of *BIER* (Bit Index Explicit Replication.
  - RGB Segment reuses the codepoint of *Non-MPLS BIER Header* defined in RFC8296
  - RGB Option is a new type of *IPv6 Destination Options Header*





Implemented Functions

- We've implemented the demo of MSR6 BE based on *P4.*
- We've conducted some emulations based on *Hardware P4 switches (Tofino).*
- Functions in Demo
  1. The encapsulation of RGB Option according to the IPv6 Destination Address
  2. The parsing of RGB Option
  3. The functions of BIFT (Bit Index Forwarding Table)
  4. Replication and forwarding according to the BitString

```
table encap{
    actions = {
        add_bier;
        _drop;
    }
    key = {
        ig_intr_md.ingress_port:   exact;
        hdr.ipv6.dstAddr:   exact;
    }
    size = 1024;
}
```

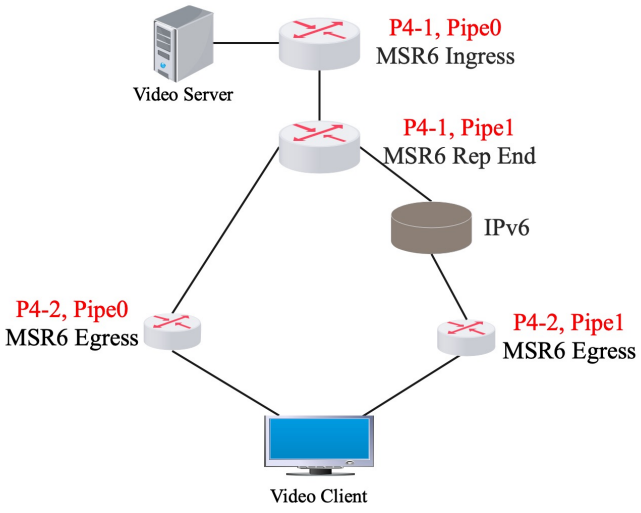
```
table decap{
    actions = {
        del_bier;

        _drop;
    }
    key = {
        hdr.ipv6.dstAddr:   exact;

    }
    size = 1024;
}
```

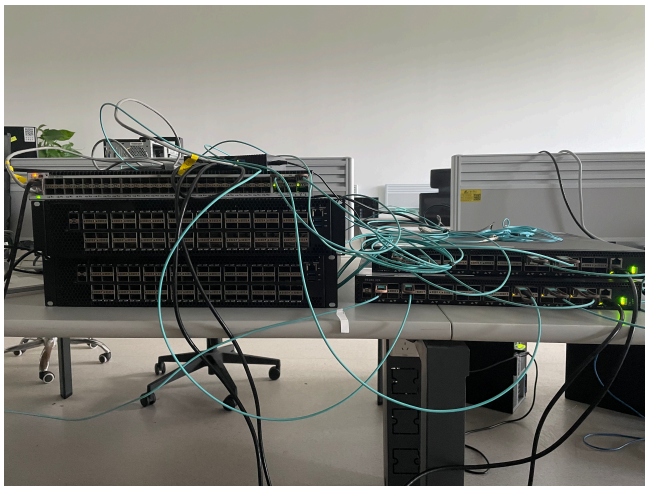
```
table bift{
    actions = {
        clone_and_forward;

        _drop;
    }
    key = {
        ig_intr_md.ingress_port:  exact;
        hdr.bs.bitstring:   ternary;

    }
    size = 1024;
}
```

```
action clone_and_forward(bit<8> fbm,bit<9> port){

    hdr.bs2.setValid();
    hdr.bs2.bitstring = hdr.bs.bitstring;
    hdr.bs.bitstring = hdr.bs.bitstring & fbm;
    ig_tm_md.ucast_egress_port = port;
    ig_dprsr_md.mirror_type = 1;
    hdr.ipv6.hoplimit = hdr.ipv6.hoplimit - 1;
    hdr.bier.ttl = hdr.bier.ttl-1;

}
```

Emulation Setup

- **2 Hosts:** *2 QSFP ports* as *1 Source and 2 Destinations*
- **2 P4 Switches:** 2 UfiSpace S9180 32X switches, whose ASIC is *Intel Tofino BFN-T10-032D.*
  - Splitting the 2 pipelines of the switch to simulate a total of 4 switches.
- **1 IPv6 Switches**: Centec E580-48X6Q





Results

- Indicates the *validity of MSR6 BE* in explicit replication and forwarding
- Indicates the *compatibility* with *IPv6* forwarding
- Encapsulation of RGB Option causes *315 nanoseconds* processing latency
- Each time replication causes *318 nanoseconds* processing latency

Future Plan

- Implement *MSR6 TE* with P4.
- Deploy the simulation on *CENI*

- CENI: An experiment infrastructure for network innovations

Characteristics:

1. For the next-generation networks, Cyberspace security, and Space Terrestrial Integrated Network
2. Contain OTN, SDN, and Programmable network
3. The NOS that support 400 cities, 1100 nodes

Wrap Up

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