

5G UPF

project proposal

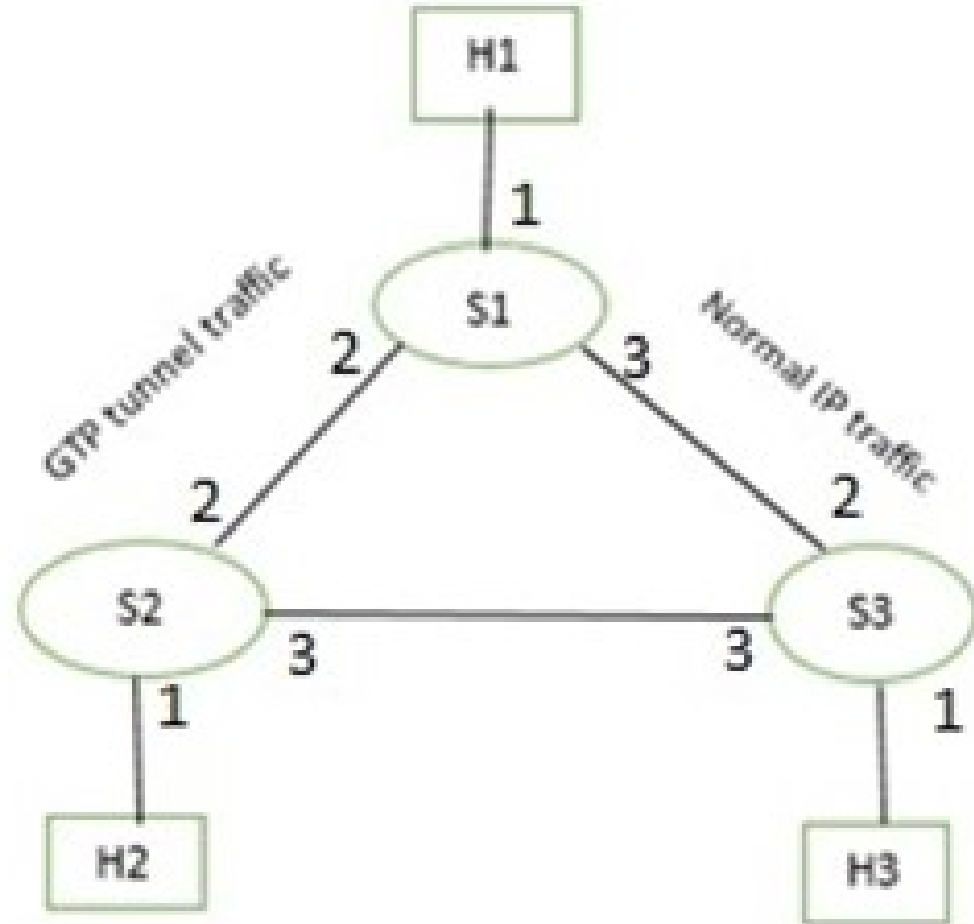
2019.03.18

Introduction

- 5G UPF – User Plan Function functionality
- mobile gateway w. GTP tunneling and rate limitation
- 1 team of 2
- Based on p4Runtime example
- Modification on `advanced_tunnel.p4` and `mycontroller.py`
- Topology is not changed.

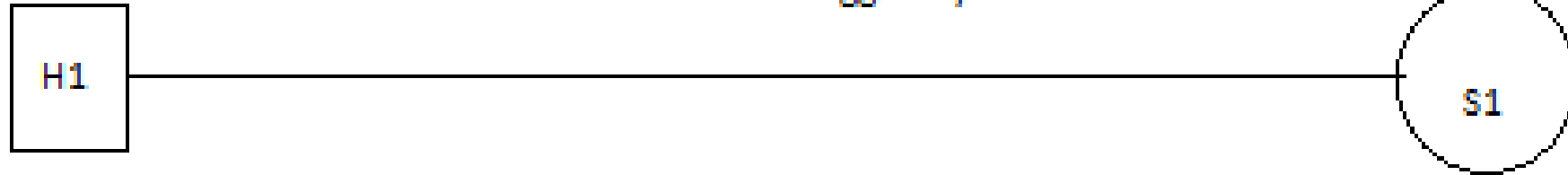
TODO 1

GTP tunnel
implementation



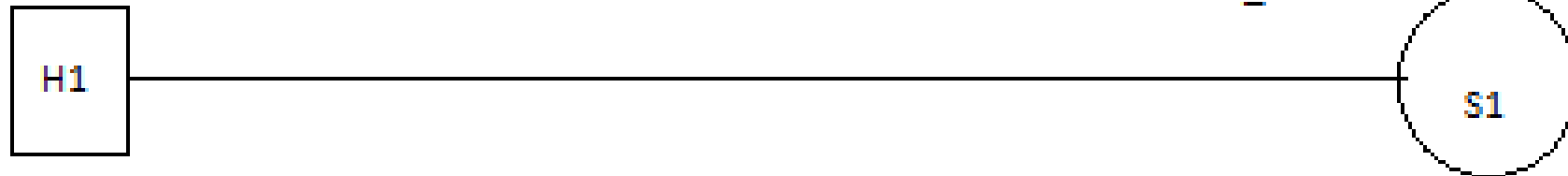
TODO 2

Process packet based on how the packet
was tagged by the meter—Rate limit



TODO 3

ARP to S1(GW)
Answer: own_mac

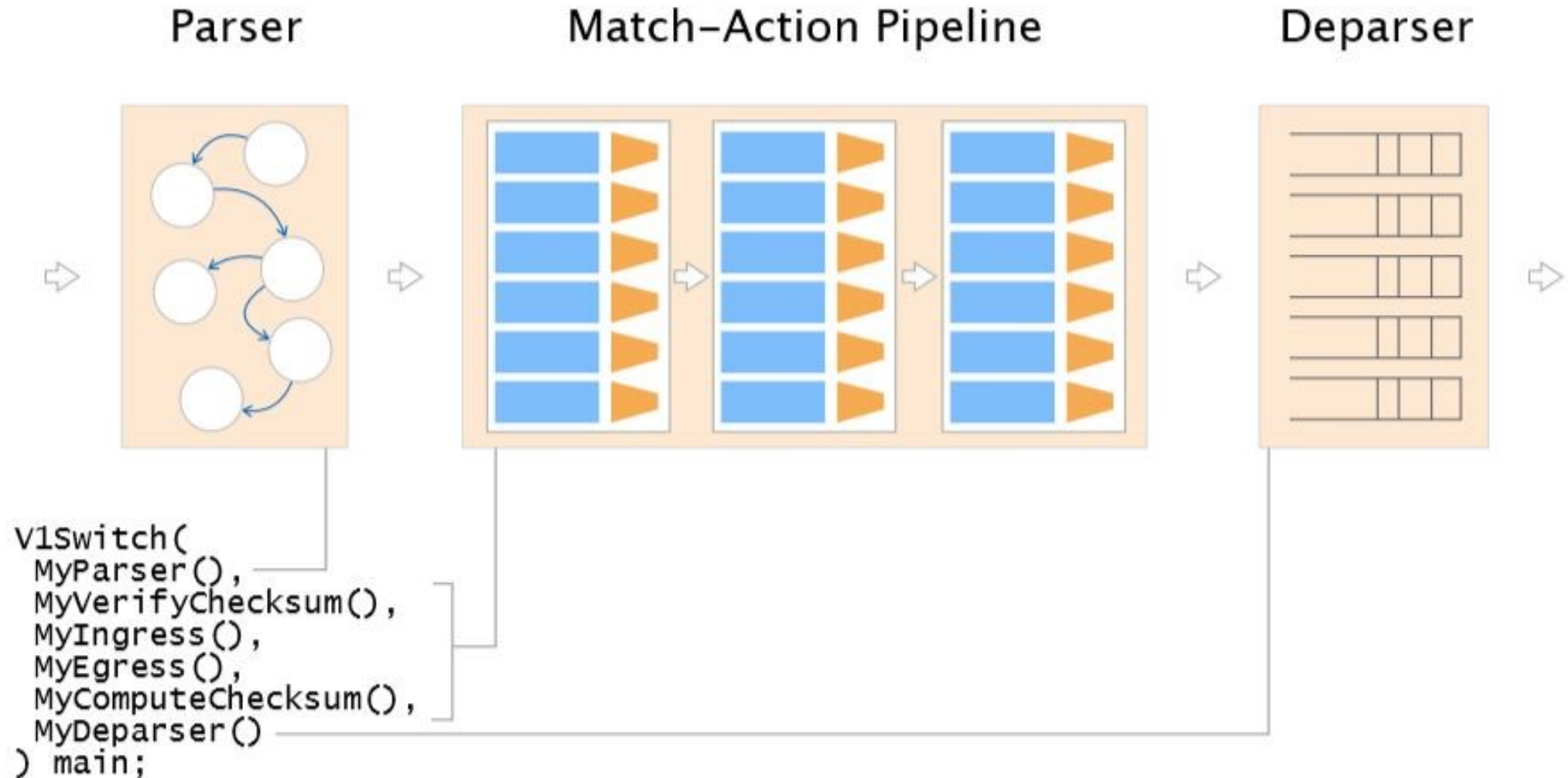


ICMP request and reply between H1
and S1

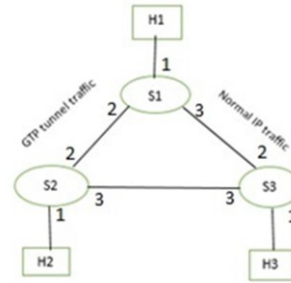
TODOs

- Define GTPv1, GTPv2, UDP , ICMP, ARP
- Meter –rate limiting extern in V1model
- Use counter extern to count in(out) packets(bytes) on certain interface
- ARP
- ICMP
- Create corresponding table, match, and actions (log file)
- All of the table entries are added by the controller

A P4 program consists of three basic parts



Parsing



```
[13:14:23.983] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Processing packet received on port 1
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Parser 'parser': start
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Parser 'parser' entering state 'start'
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Extracting header 'ethernet'
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Parser state 'start': key is 0800
[13:14:23.984] [bmv2] [T] [thread 10729] [23.0] [cxt 0] Bytes parsed: 14
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Parser 'parser' entering state
'parse_ipv4'
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Extracting header 'ipv4'
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Parser state 'parse_ipv4': key is 01
[13:14:23.984] [bmv2] [T] [thread 10729] [23.0] [cxt 0] Bytes parsed: 34
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Verifying checksum 'cksum': true
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Parser 'parser': end
```

```
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Pipeline 'ingress': start
[13:14:23.984] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(240)
Condition "hdr.ipv4.isValid() &&! hdr.udp.isValid()" (node_2) is true
[13:14:23.984] [bmv2] [T] [thread 10729] [23.0] [cxt 0] Applying table
'MyIngress.ipv4_lpm'
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Looking up key:
* hdr.ipv4.dstAddr   : 0a000202

[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Table
'MyIngress.ipv4_lpm': hit with handle 0
[13:14:23.984] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Dumping entry 0
Match key:
* hdr.ipv4.dstAddr   : LPM      0a000202/32
Action entry: MyIngress.gtp_encapsulate - a,a000003,
```


[13:14:23.985] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Action entry is MyIngress.gtp_encapsulate - a,a000003,
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] Action MyIngress.gtp_encapsulate
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(173) Primitive hdr.inner_ipv4.setValid()
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(174) Primitive hdr.inner_ipv4 = hdr.ipv4
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(175) Primitive hdr.udp.setValid()
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(176) Primitive hdr.gtp_common.setValid()
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(177) Primitive hdr.gtp_teid.setValid()
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(7) Primitive 2152; ...
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(7) Primitive 2152; ...
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(180) Primitive hdr.udp.checksum = 0
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(181) Primitive hdr.udp.plength = hdr.ipv4.totalLen + 8
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(182) Primitive hdr.gtp_teid.teid = teid
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(183) Primitive hdr.gtp_common.version = 1
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(184) Primitive hdr.gtp_common.pFlag = 1
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(185) Primitive hdr.gtp_common.messageType = 255
[13:14:23.985] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(186) Primitive hdr.gtp_common.messageLength =
hdr.ipv4.totalLen + 8
[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(9) Primitive 0x0A000001; // 10.0.0.1 ...
[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(188) Primitive hdr.ipv4.dstAddr = ip
[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(6) Primitive 0x11; ...
[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(190) Primitive hdr.ipv4.ttl = 255
[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(191) Primitive hdr.ipv4.totalLen = hdr.udp.plength + 8
[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(192) Primitive meta.gtp_metadata.teid = teid

[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(246) Condition "hdr.udp.isValid()" (node_4) is true

[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] Applying table 'MyIngress.myTunnel_exact'

[13:14:23.986] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Looking up key:

* hdr.gtp_teid.teid : 0000000a

[13:14:23.986] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Table 'MyIngress.myTunnel_exact': hit with handle 0

[13:14:23.986] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Dumping entry 0

Match key:

* hdr.gtp_teid.teid : EXACT 0000000a

Action entry: MyIngress.forward - 2,

[13:14:23.986] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Action entry is MyIngress.forward - 2,

[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] Action MyIngress.forward

[13:14:23.986] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(196) Primitive standard_metadata.egress_spec = port

[13:14:23.987] [bmv2] [T] [thread 10729] [23.0] [cxt 0] advanced_tunnel.p4(8) Primitive 0x001122334455; ...

[13:14:23.987] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Pipeline 'ingress': end

[13:14:23.987] [bmv2] [D] [thread 10729] [23.0] [cxt 0] Egress port is 2

[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Pipeline 'egress': start
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Pipeline 'egress': end
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparser 'deparser': start
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Updating checksum 'cksum'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparsing header 'ethernet'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparsing header 'ipv4'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparsing header 'udp'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparsing header
'gtp_common'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparsing header 'gtp_teid'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparsing header
'inner_ipv4'
[13:14:23.987] [bmv2] [D] [thread 10732] [23.0] [cxt 0] Deparser 'deparser': end

Reference

<https://github.com/P4ELTE/t4p4s/blob/master/examples/smgw.p4>

<https://p4.org/>

Log files