

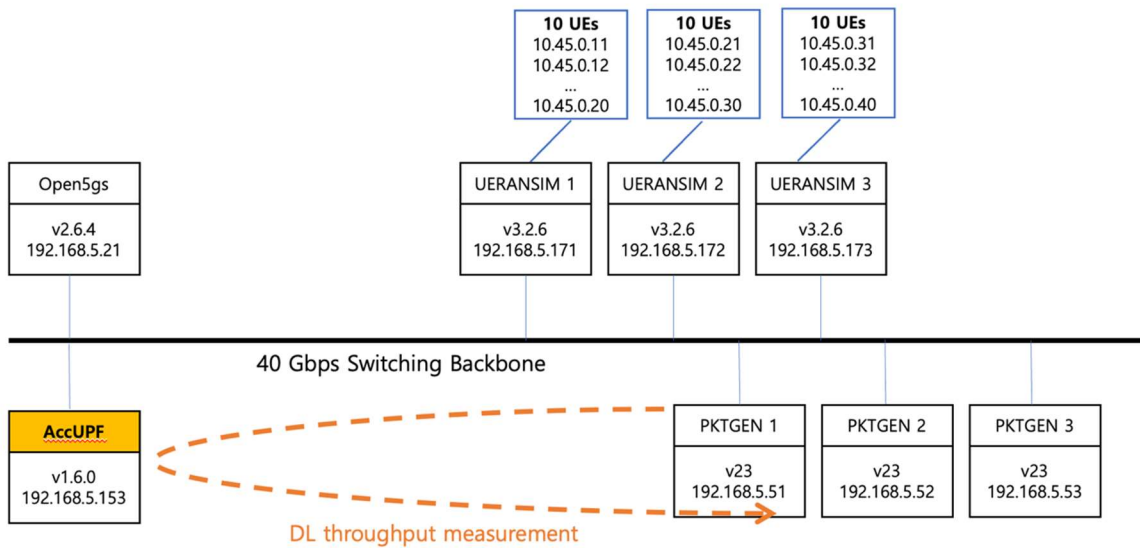
# Title: A Demonstration of 30-Gbps Load Testing for Accelerated UPF with Open5gs

## Introduction

AccUPF is an accelerated UPF supported by DPDK, NextEPC Inc. has released v1.6 on September 2023. In this document, we demonstrate how to test its performance using Open5gs, Pktgen and UERANSIM.

## Network Configuration

The 5G core is composed of Open5gs Open Source v2.6.4 and AccUPF v1.6. We install UERANSIM v3.2.6 which emulates three gNodeB with 30 active UEs. Since the UERANSIM is not suitable to send and receive a large amount of data packets, we separately install Pktgen v23 to generate a large amount of packets accelerated by DPDK.



## Hardware Specification for AccUPF

Server Model	Dell PowerEdge R450
CPU	2x Intel Xeon Gold 5315Y 3.2GHz 8 cores
Memory	32 GB
Storage	480 GB SSD
NIC	Supermicro AOC-S40G-i2Q <ul style="list-style-type: none"> <li>- 2 QSFP+ ports</li> <li>- 40 Gbps per port</li> <li>- PCI Express 3.0</li> </ul>

## Test Plan

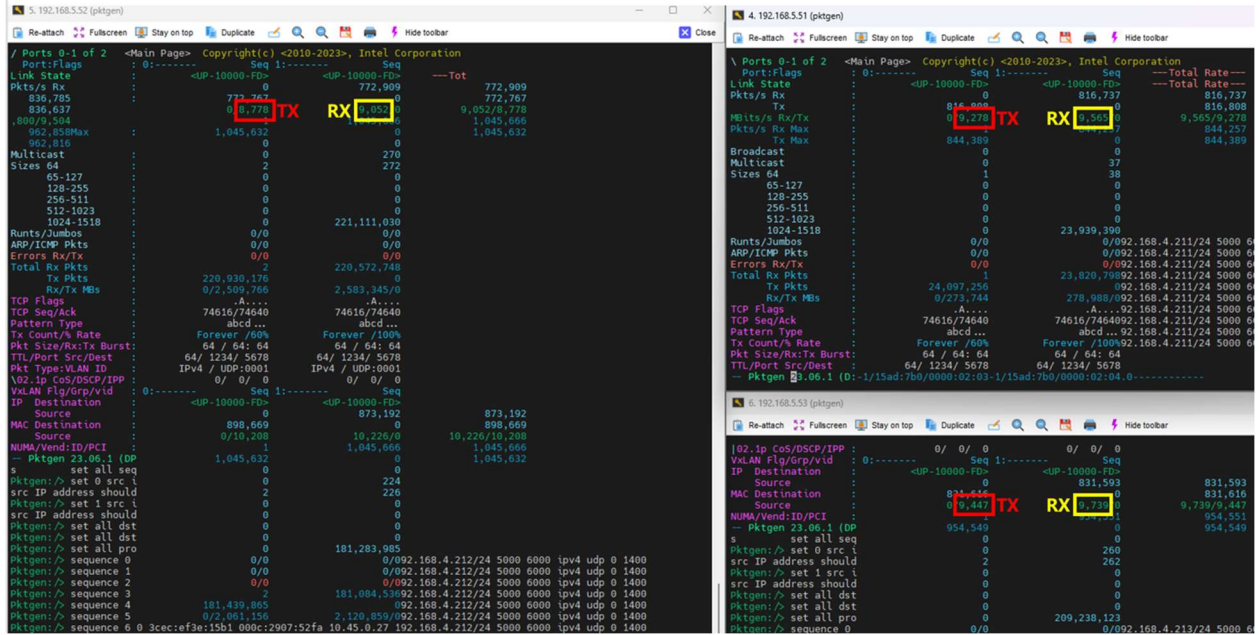
Our goal is to demonstrate the performance of AccUPF. Since each Pktgen virtual machine has a dedicated 10Gbps NIC, we could generate around 30Gbps UDP traffic at max in the 5G downlink toward UEs. We test downlink only, because the uplink requires to generate GTP traffic which is not supported by Pktgen.

## Test Procedure

1. Run Open5gs and AccUPF
  - a. Add 30 subscribers in Open5gs
  - b. Please make sure that UE AMBR is equal or greater than 1Gbps
2. Run UERANSIM to register 30 UEs.
  - a. At this point, AccUPF has all the PDU session information via N4 interface
3. Pktgen creates UDP traffic for all 30 UEs
  - a. We use three Pktgen virtual machines and sequence command is utilized to generate multiple traffic flows.
  - b. Each Pktgen generates 10 sequences toward 10 UEs at a rate of 10 Gbps.
  - c. For a single sequence,
    - i. Destination IP: UE IP
    - ii. Destination MAC: MAC address of AccUPF's N6 interface
  - d. For more information on Pktgen, Please refer to the link: [https://pktgen-dpdk.readthedocs.io/en/latest/getting\\_started.html](https://pktgen-dpdk.readthedocs.io/en/latest/getting_started.html)
4. AccUPF creates GTP encapsulated packets from the incoming data received by N6, and forward them to UERANSIM's gNodeB through N3.
5. We want to redirect the GTP packets to Pktgen because
  - a. The amount of traffic is too much to be handled by UERANSIM
  - b. We want to compare Tx/Rx results in Pktgen
6. AccUPF has a function to accept static ARP entries. We add static ARP entries for the emulated gNodeBs toward Pktgen.
7. All GTP encapsulated packets are delivered to Pktgen.

# Test Results

## Pktgen



The screenshots above are captured by three Pktgen terminals during a 30 Gbps Throughput Test run. The Rx rate is always slightly higher due to the added GTP header.

## AccUPF's stat monitor

```
Port statistics =====
Statistics for port 0 -----
Packets sent:                290603620
Packets received:            465
Packets TX pps:              2531202
Packets TX Mbps:             29159 TX
Packets TX frag:             0
Packets RX pps:              1
Packets RX Mbps:             0
Packets RX reas:             0
Packets dropped:             461
Packets drop pps:            1
DEV Stats
  DEV RX packets 465 bytes 27900
  DEV RX errors 0 missed 0 no-mbuf 0
  DEV TX packets 290603816 bytes 418469490708
  DEV TX errors 0
Packets drop detail:
  16:[461]
Statistics for port 1 -----
Packets sent:                0
Packets received:            288072564
Packets TX pps:              0
Packets TX Mbps:             0
Packets TX frag:             0
Packets RX pps:              2552816
Packets RX Mbps:             28509 RX
Packets RX reas:             0
Packets dropped:             58
Packets drop pps:            0
DEV Stats
  DEV RX packets 288073491 bytes 402150515948
  DEV RX errors 0 missed 0 no-mbuf 0
  DEV TX packets 0 bytes 0
  DEV TX errors 0
Packets drop detail:
  16:[58]
Packets RX / Lcore:
  core10:[76222040] core12:[67749580] core14:[79667216] core16:[64433728]

Aggregate statistics =====
Total packets sent:          288072418
Total packets received:      288073028
Total packets dropped:       518
=====
```

The screen shots above are captured by AccUPF's console during a 30 Gbps Throughput Test run. In the figure, Port 0 is the N3 interface while Port 1 is N6 interface.

## Conclusion

The test method we showed in this document is scalable as the number of Pktgen instances increases and it is not only for AccUPF, but applicable to any other UPF product. For any question regarding the AccUPF, please contact NextEPC.

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