PRAVEGA: Scaling Private 5G RAN via eBPF/XDP

Udhaya Kumar Dayalan, Ziyan Wu, Gaurav Gautam, Feng Tian, Zhi-li Zhang
Agenda

● Introduction
● Design & Workflow
● Offloading Ciphering/Deciphering
● Preliminary Results
● Conclusion & Future Work
5G Architecture

CU- Central Unit;  DU- Distributed Unit;  RU- Radio Unit;  UPF- User Plane Function
UE- User Equipment
PRAVEGA - Introduction

- Central Unit User Plane (CU-UP) is likely the bottleneck for user plane data path.
- Exploit eBPF+XDP to scale and accelerate software packet processing
- CU mainly processes SDAP and PDCP layer.
- Additional options for further improvements
PRAVEGA - Design

- Kernel Based CU-UP

- Data Path Layer are configured by the Management Layer using eBPF Maps

- Kernel space key components
  - Parser
  - Classifier
  - Forwarder
PRAVEGA - Flow

● Parser
  ○ Filters and send GTP-U user plane packets to 'Classifier'

● Classifier
  ○ Processes the SDAP layer

● Forwarder
  ○ Processes the PDCP layer
Offloading Ciphering/Deciphering

- Challenge - Ciphering/Deciphering are optional CPU-intensive operations
- Example: Voice-traffic in the mobile network
  - Ciphering algorithms such as SNOW 3G and ZUC are CPU-intensive
  - Bottleneck if not designed carefully
- Bluefield 2 (BF2) to offload expensive ciphering/deciphering operations
- Two key components
  - Mellanox ConnectX6-based switching data plane
  - 8 Arm A72 cores
Preliminary Results on Ciphering/Deciphering

- Without Offloading Scheme
  - Throughput goes down as $PE$ increases

- With Offloading Scheme
  - Performance greatly increased
Conclusion & Future Work

**Conclusion**

- Designed PRAVEGA, an eBPF/XDP based fast processing CU-UP.
- Discussed other potential design options for optimization on offloading to the SmartNICs.

**Future Work**

- Explore techniques using dedicated cryptographic hardware.
- Incorporation on other O-RAN components.