Towards Accelerating the 5G Centralized Unit with Programmable Switches

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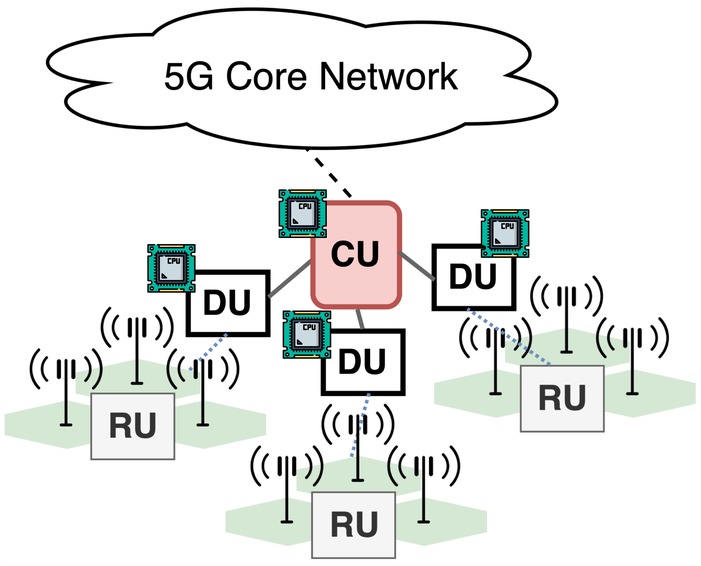
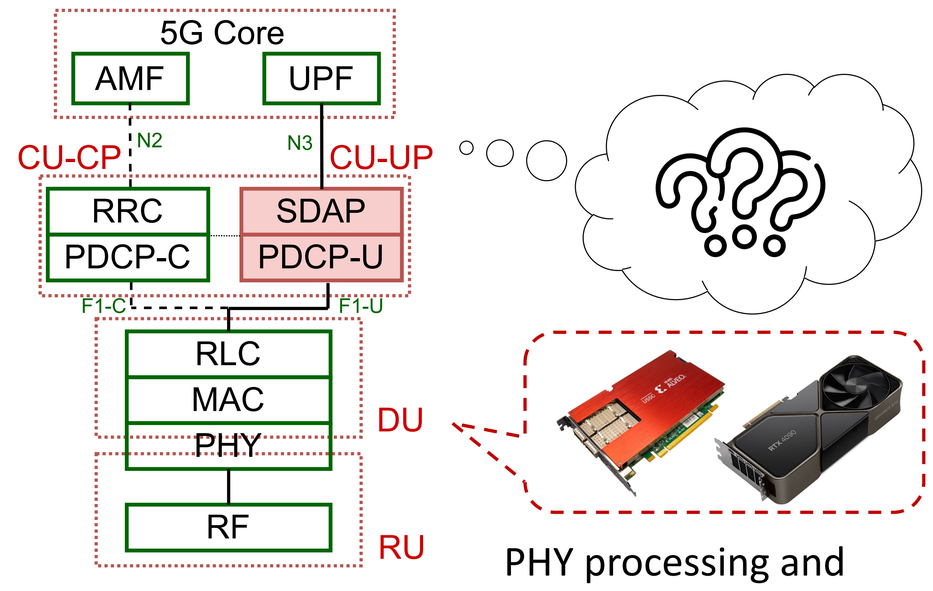
BACKGROUND AND MOTIVATION



Disaggregated and Virtualized Radio Access Networks

The Centralized Unit (CU) is the **aggregation point** for network traffic in emerging disaggregated 5G radio access networks (RAN).



5G RAN Stack

PHY processing and MAC scheduling acceleration

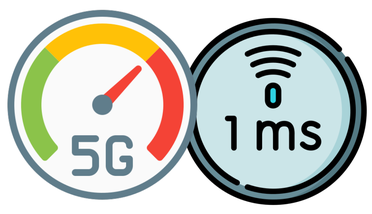
H/W accelerators have been deployed at the DU to speed-up radio processing. However, the ***acceleration of the CU has not been explored***.

CU must be scalable as the 5G RAN's aggregation node.

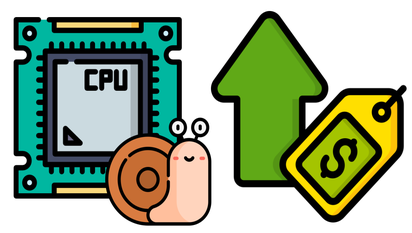
- CPU growth falls behind the demands of 5G networks.
- Under heavy load, cannot deliver bounded performance.

Objective: To design a scalable and performant CU.

Thus, we exploit the Tbps-scale line-rate forwarding performance programmable switches for CU acceleration.



Need ultra-high B/W and low latency



Slow CPU growth, scaling is costly

INSIGHT: KEY CU FUNCTIONALITIES

QoS Flow Mapping · **Sequencing** · **GTP Tunneling** · **Packet Duplication**

Observation: Many core functionalities of the CU are amenable and can be implemented on programmable switches.

CAVEATS

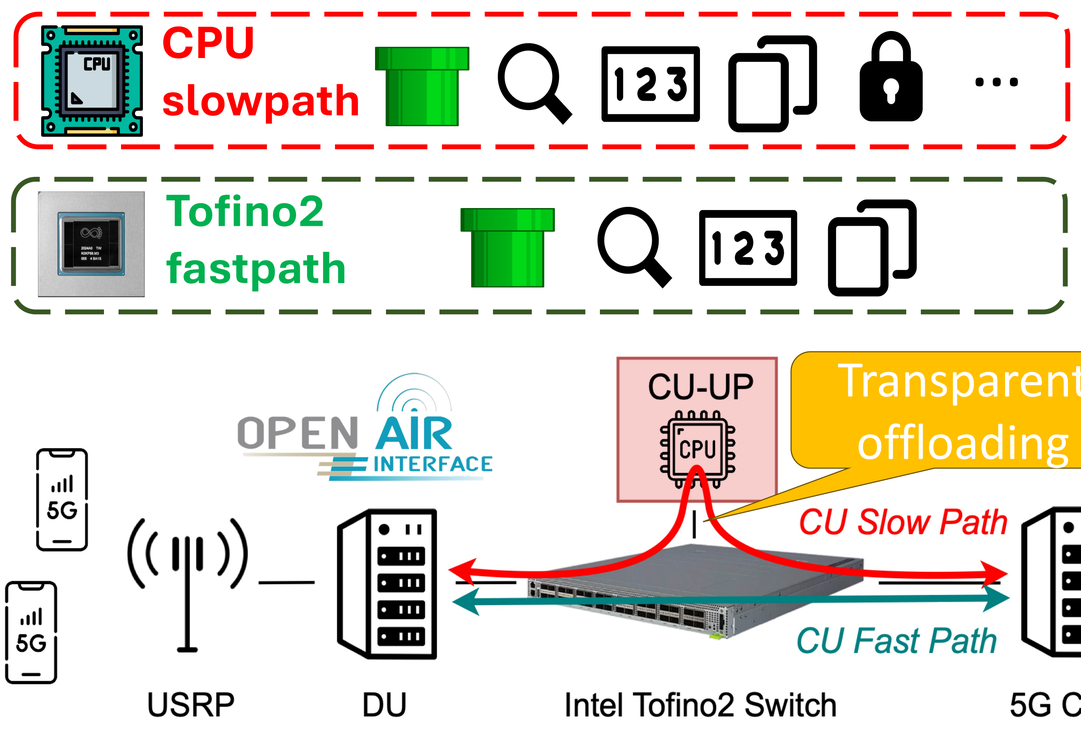
Not all functionality can be supported on the switch, like:

Ciphering/ Integrity Verification

However, not all functionality are always necessary for data traffic.

CUP4: DESIGN AND PROTOTYPE

Key idea: Hierarchical CU with a **CPU slowpath** and **Tofino2 fastpath**. Traffic is offloaded to the fastpath if the required functionalities are supported.



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PRELIMINARY RESULTS

Latency	Fastpath	Slowpath
Median	0.52 µs	40.05 µs
99th %-ile	0.60 µs	15,040.45 µs

Result: CU processing latency with the fastpath is up to **80x** (median) and **25,000x** (99%-ile) better!

FUTURE WORK

- Integrate CUP4 with OAI 5G and add support for additional CU functionalities:
  Packet Reordering · **Packet Dedup.** · **Header de-/compression**
- Evaluate CUP4 with more complex RAN topologies and explore integration with the 5G UPF to support ultra reliable low-latency (URLLC) use cases.