Developing an Energy Model for 5G Virtualized RANs Using OpenAirInterface

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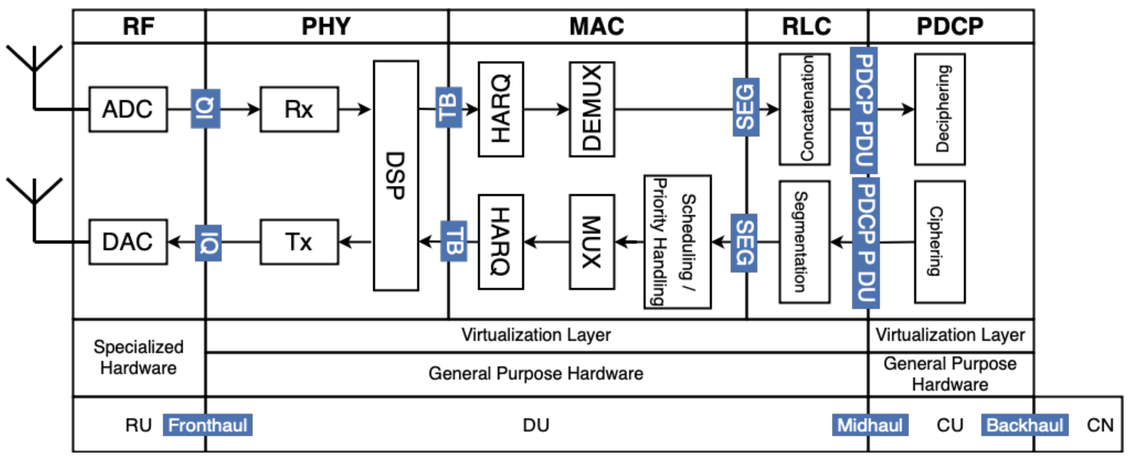
Introduction



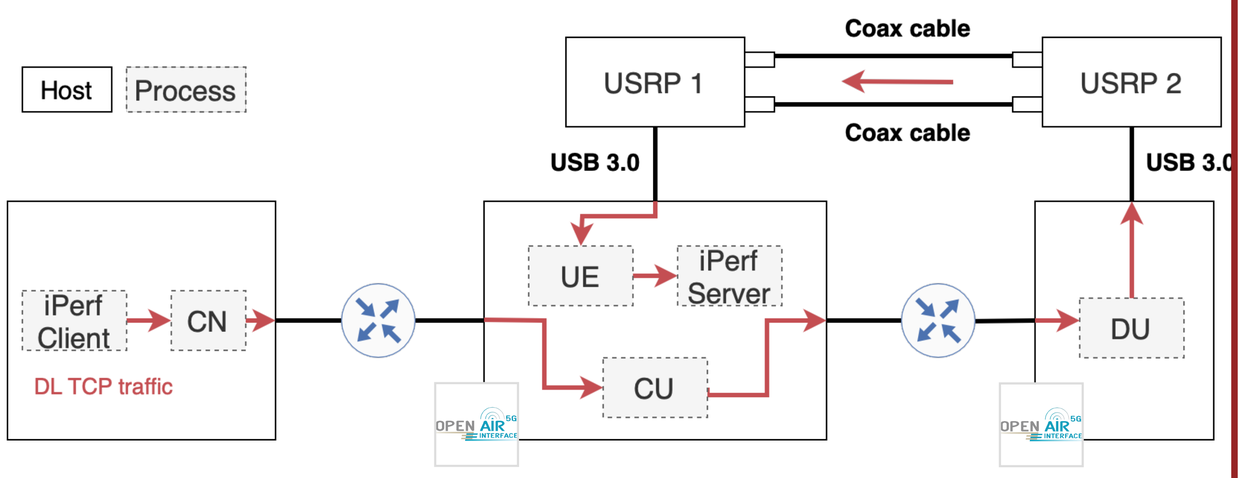
- **Virtualized Radio Access Networks (vRANs)** enable agile software and hardware updates through the centralization of signal processing of multiple **Base Stations (BSs)**. However, they raise these questions:
  - Do energy savings resulting from centralization counterbalance the increased energy consumption resulting from the use of virtualization technologies and **general purpose processors (GPPs)**?
  - How does the energy consumption of vRANs vary with different radio configurations and traffic loads?
- We propose a methodology and an **OpenAirInterface (OAI)**-based testbed to develop an energy model for 5G vRANs that answers these questions.

Methodology

- Monitor:
  - Number of useful bits transmitted
  - Performance monitoring counters (PMCs) indexed by function using *perf:*
    - Number of CPU cycles
    - Number of **last-level cache (LLCs)** misses
  - Energy consumption before+during application execution
- 10 experiments (each 5 minutes)

OpenAirInterface-based Testbed

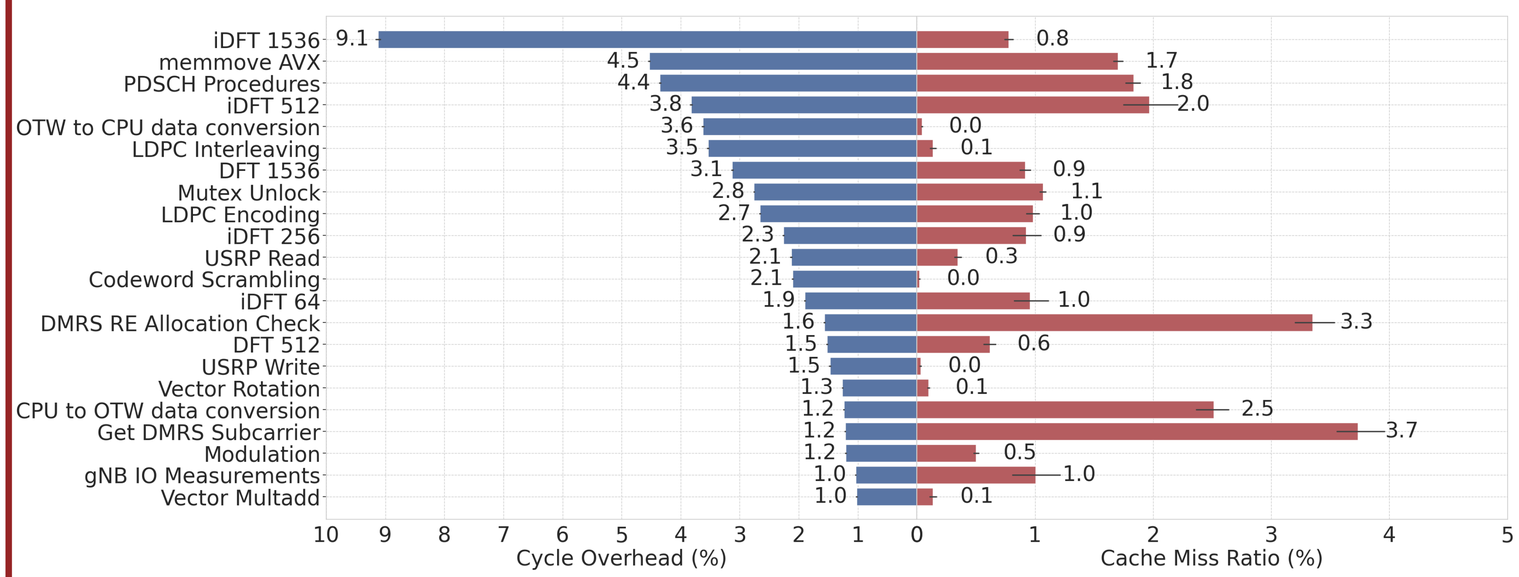
- GPPs and software-defined radios (USRP B210)
- Frequency Band 78 (TDD, 3300-3800 MHz), Subcarrier Spacing of 30 kHz, 106 physical resource blocks (PRBs), and Effective Bandwidth of 38.15 MHz



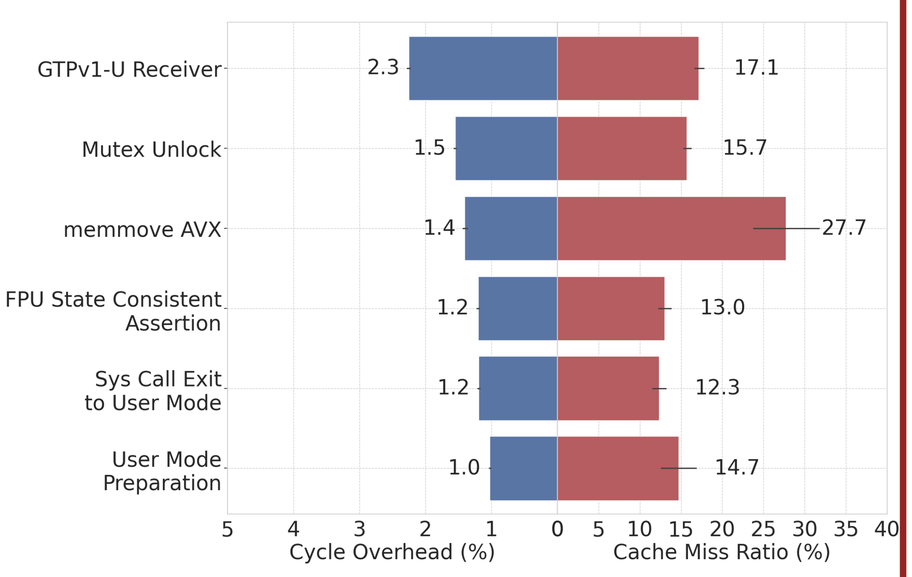
CU: Centralized Unit | DU: Distributed Unit | UE: User Equipment

Results

Distributed Unit



Centralized Unit



Process	Cycle Count (%)	Cache Miss Count (%)
CU	1.24%	3.93%
DU	20.39%	6.94%
UE	**78.38%**	**89.13%**

- UE: most computationally intensive component
- iDFT functions: greatest contributors to the energy consumption of virtualized BSs (with downlink traffic)
- Physical layer functions: most computationally intensive
- ≈ 3% of the CPU overhead from kernel to user space switching (*perf* in the CU)
- 1 UE → CU's energy consumption is limited → Take results with a grain of salt

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