An Adaptive Phased Array Beamformer for 5G

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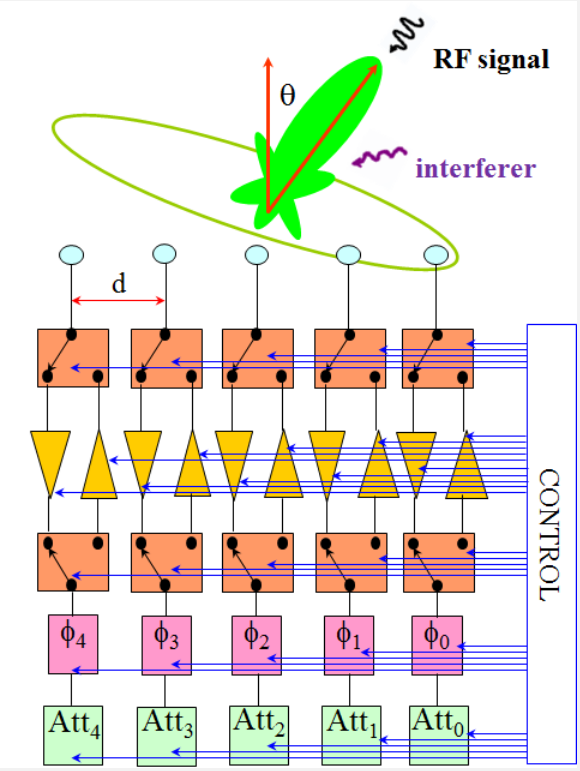

This project considers an adaptive active RF beamformer for 5G networks operating at 9.5 GHz. This project will target a frequency range of 8.5 – 10.5 GHz to comply with early work and spectrum allocations in Canada. The system level block diagram can be seen in the Figure above. Technical references and additional material will be provided once the project begins. The Tx and Rx ICs are to be driven from a single supply and DC strategy using DC/DC converters and LDOs must be examined. Control lines for phase shifters and attenuators should be compatible with I/O levels in commercial FPGAs and micro-controllers. Areas of interest include:

- Self-adaptation to exploit spatial selectivity and real-time interference mitigation.
- RF System, Package, Antenna design in commercially available Ceramics (LTCC).
- Active scalable antenna subarrays with 4x4 elements.
- RFIC/MMIC design of all component into a 65nm commercial CMOS process. Students will apply to CUSEF funding to support IC fabrication.
- Integration of the active control elements into the active 4x4 antenna subarray.
- RF/Microwave testing using connectorized as well as probed setups.

This project will ideally support 4 to 5 students with a strong background in ELEC 3509, 3909 and and who **are strongly encouraged to take ELE 4609, 4503 and 4502 in their fourth year**. The breakout for the proposed work includes:

1. Student #1: RF Tx and Rx systems design and package using EM co-simulation in ADS and SystemVue. Identify MMICs strategies for integration of a complete Tx and Rx using LTCC.
2. Student #2: Wideband phased array antenna design with Butler Matrix feed and package integration of Tx/Rx using LTCC using ADS and EMpro/HFSS.
3. Student #3: MMIC design in CMOS of Tx components: Gain stages, Drivers, HPA.
4. Student #4: MMIC design in CMOS of Rx components: balanced LNAs, LNA, gain stages.
5. Student #5: MMIC design in CMOS of control MMICS: variable attenuator, phase shifter, TTD.

All students will be involved in package integration, microwave component characterization, probed and connectorized microwave and antenna measurements. Students #1 will serve as project prime and work with others to ensure component specifications are complaint with desired 5G radio transceiver.

Reference: https://www.keysight.com/upload/cmc_upload/All/5G-Phased-Array-Transceiver-Webcast_Aug2017-final_Rev3.pdf