**Virtual Cellular Networks using Software Defined Radio Platforms**

Faculty: Prof. Subramanian, Prof. Shiv Panwar, Prof. Yaw Nyarko (NYU Economics)

Potential Students: Talal Ahmad is a first year student in the Courant PhD program. He has been very research active and has already produced one very good working paper which will be submitted to a top venue. He has experience on software defined platforms and is currently working with OpenBTS platforms.

Affiliates of Interest: Could be of interest to several Affiliates.

Overview Research Statement and Research Thrusts: Cellular networks in developing regions rely heavily on diesel for energy to provide network coverage due to the paucity of reliable grid power, which directly impacts the economic viability of the network and long-term sustainability while also leaving a massive carbon footprint. In this proposal, we aim to explore the design of virtual cellular networks using software defined picocells. This project builds upon current work on Wireless Rural Extensions (WiRE), an intermittency-aware green cellular network architecture that provides a virtual cell abstraction to extend cellular coverage to areas with unreliable power. The design of WiRE builds upon two key technological developments: (a) the use of high performance line of sight (LOS) and non-LOS mobile back-haul networks to extend connectivity across cells; (b) use of cellular software defined networks (SDNs) to move cellular services to the extreme edge. In the near future, with the rapid development of mmWave technologies, high bandwidth non-LOS mmWave backhaul links will become a reality and such networks can be powered at the edge by software-defined picocells for last hop connectivity. By moving to picocells, the WiRE system can operate at extremely low power conditions and the entire network can be solar-powered; in essence, we can roll out high bandwidth cellular connectivity in rural areas where the entire network is solar-powered. This is a massive shift from how we operate cellular networks today both from an infrastructure perspective and from the requirements of reliable power. The current design of WiRE relies on a combination of grid-solar powered software-defined cellular routers that can provide a wide range of services including calls, messaging services and mobile web using an intermittency-aware naming, addressing and routing layer that can provide high availability in the face of network failures and partitions.

In this proposal, we aim to build upon the WiRE system to experiment with the design of next generation low-power cellular networks. We aim to build a Virtual Cellular Network abstraction where a collection of software defined picocells can form a virtual network which can offer:

1. Seamless mobility across picocells
2. A unified naming, addressing, routing architecture
3. Delivering mobile services (like caching) at the extreme edge using software-defined platforms

We hope to leverage the expertise of other NYU WIRELESS faculty to extend our virtual cellular network design to support:

1. White spaces functionality in software defined picocells
2. Integration of future mmWave technologies with the platform.

Prof. Nyarko brings interesting expertise on studying the economics aspects of next generation cellular networks.

Existing support and justification for additional funding: Currently the WiRE project has been funded by an NSF Award (ending in August) and funding from the Center for Technology and Economic Development (CTED) in NYU Abu Dhabi. CTED is led by Prof. Yaw Nyarko and Prof. Subramanian. Prof. Panwar and Prof. Subramanian have started interacting on this rough problem space and have recently tried to recruit an additional student from NYU Poly on this project. The NSF grant ends by August and we are applying for an NSF grant in the September cycle. We seek additional support for this proposal for 1 year to continue the existing effort and potentially receive future funding from other sources.

Justification of the project: The areas of software defined radios, picocells and virtual cellular networks will become hop topics in the mmWave context and future cellular networks will embrace a combination of these ideas. In summary, we believe that the set of issues tackled in this proposal will be of core interest to NYU WIRELESS.