Software Small Cell for Coverage and Services in Future Wireless Cities

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The global mobile data traffic has tripled each year since 2008, and this unprecedented trend is accelerated by the proliferation of advanced user terminals and bandwidth-greedy applications (e.g., game, mobile cloud computing). In order to support this galloping demand for data traffic and the need for ubiquitous wireless coverage in the future city, it calls for spectrum access techniques and wireless network infrastructures that can significantly increase the spectrum usage efficiency and wireless network capacity.

We consider a *soft small cell* (SoftSMCell) network architecture that concurrently exploits two orthogonal techniques to achieve the performance that is significantly superior than either: 1. enabling greater spatial re-use through the *growth* of low-power and short-range small cells, and 2. *offloading* the large amount of wireless traffic through small cells to unlicensed and opportunistic spectrum. To further increase the spectrum usage efficiency and reduce the cost, SoftSMCell will exploit the recent *software defined networking* (SDN) concept to facilitate more flexible and coordinative management of spectrum resources across different types of small cells and among multiple user flows within each cell. We expect that different types of small cells will coexist given their different roles and parallel growth. We envision small cells will support applications with the minimum communication quality over their assigned bands, while taking advantage of the opportunistic spectrum for increased data rates and rich features.

Small cell communications over whitespace promise significant capacity and coverage gains, but the unplanned deployment and the exploration of opportunistic spectrum also create substantial technical challenges. We propose to enable *cognitive* operation of small cell networks over *opportunistic spectrum*, with agile spectrum access, coordinated and uncoordinated interference control, as well as intelligent network self-organization and self-optimization with the facilitation of a SDN-based flexible control in SoftSMCell. The success of the proposed research calls for techniques and policies to efficiently detect the opportunistic spectrum, coordinatively and flexibly use available spectrum, and avoid interference to legacy systems.

The evaluation of SoftSMCell can be performed through Universal Software Radio Peripheral (USRP) testbed from GNU-Radio. Several multi-antenna USRPs can be configured to serve as the small cell base stations, and deployed with different topology relationship and interference between cells. The USRPs will serve as small cell user terminals. To realize the SoftSMCell architecture, the SoftSMCell Controller can be implemented on a Linux machine to control the base station initially. In the later phase, the SDN controller can be extended to support the control of SoftSMCell, and the SoftSMCell can be deployed for community wise experiments. To test the interaction of SoftSMCell with legacy systems, we would like to have LTE-based Femtocells around.

Bio:

Xin Wang is currently an Associate Professor in the Department of Electrical and Computer Engineering of the State University of New York at Stony Brook, Stony Brook, NY. Before joining Stony Brook, she was a Member of Technical Staff in the area of mobile and wireless networking at Bell Labs Research, Lucent Technologies, New Jersey. Her research interests include the architecture and protocol design in wireless networks, mobile and cloud computing, as well as networked sensing, measurements and services. She has served in executive committee and technical committee of numerous conferences and funding review panels, and is the referee for many technical journals.

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