## Data-Intensive Cellular Network Monitoring

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## Project Description

Cellular networks are using increasingly sophisticated procedures for coordinating session state and communication across multiple base stations. The last few releases of 3GPP LTE, for example, have included methods for dynamic load balancing, inter-cellular interference coordination, carrier aggregation, and coordinate multipoint (CoMP) to name a few. Evolution to 5G will only further this trend toward complex and high-speed multi-base station coordination as multiple base stations and relays will be needed to sustain robust links.

While many of these algorithms can be tested in simulation, monitoring the actual performance of these algorithms in real deployments is challenging. The key problem is sheer volume of data potentially generated by cellular networks: Networks involve very large numbers of cells, with scheduling and link decisions are made on the millisecond timescale. This data volume will only increase with 5G evolution.

The broad goal of this project is to develop a scalable database architecture that can capture massive amounts of data in modern cellular networks and to develop a “learning server” that can process the data to monitor network performance and adapt various algorithm parameters.

In the absence of real data, we will use network simulator in conjunction with the ProMan component of the WinProp software suite to simulate a small network of base stations and mobiles. The database and learning server will be developed on this synthetic data and its feasibility for large-scale networks can be estimated via extrapolation. For the adaptation component, as an initial demonstration problem, we will focus on handover optimization in mmWave, since this is likely to be an extremely complex and environmental dependent algorithm tuning problem. We will explore a class of algorithms with various tunable parameters and then adapt the parameters using machine learning methods. The parameters may be base station dependent to enable location-based or site-specific tuning.

Team Dennis Shasha is world-leading expert in database, machine learning and big data and Rangan is an expert in cellular networks with extensive field experience. The student George Wong is one of the star undergrads at Courant who has just finished, triple majoring in math, physics, and computer science. He was one of the leads in the mmWave measurement campaigns at NYU WIRELESS.

Interest to Affiliates: We believe the ideas in the proposal can have interest to several affiliates particularly carriers and vendors for carrier monitoring software. We have been careful not to require real data, since we know this is sensitive. For NYU WIRELESS, the project can nicely extend and build on our concentration in lower level communications work.

Funding: This line of work is not being pursued in any academic setting, and we believe that we can leverage preliminary results from this project toward an NSF grant.