Project Ideas

ICSI445/660, Fall 2016 – Advanced Topics in Networking

Some specific project ideas

Evaluation of a wide area network. The exponential growth of user demand on mobile wireless networks is leading to a capacity crunch. To provide new opportunities for wireless communications, research has been focusing on a new technology based on Dynamic Spectrum Access (DSA). While this technology brings promise for improved and affordable wireless connectivity, there are still very few practical DSA deployments.

To help advance the state of current deployments, this project will evaluate traffic traces from a real DSA network. The goal of the evaluation is twofold: on one hand to understand how the local network protocols perform (particularly L2 protocols) and on another hand to determine how well is the network able to accommodate user demand.

Spectrum allocation with mobility in Dynamic Spectrum Access (DSA) networks. Dynamic Spectrum Access is a mobile wireless technology that allows clients to opportunistically utilize frequency resources that are not actively used by their primary users. A key problem in this space is deciding which frequency should a DSA client use. Spectrum sensing and spectrum databases have been explored as two viable techniques for static client scenarios. An open research problem remains that of how to assign an operating frequency to a mobile DSA client.

This project will explore current techniques for support of mobility in wireless networks. It will then design a frequency allocation scheme for mobile DSA clients.

Mining transmitter characteristics. Traditional analysis of spectrum occupancy has been limited to determining if spectrum is idle or occupied. Given the medium is occupied, such analysis does not provide more detailed information about number of occupying transmitters and their characteristics. This information, however, is critical for improved Dynamic Spectrum Access (DSA) technology and policy.

To address this problem, this project will develop a method for transmitter characterization in spectrum measurements. More specifically, the developed

methodology will make use of compressed spectrum data to analyze the nature of the transmitters that occupy the measured spectrum.

Analysis of the crowdsignals.io data. CrowdSignals.io is an initiative to collect carefully-curated crowdsourced data from users of smart devices (including smart phones and activity trackers). This data contains information about the network, personal devices, user activity and social interactions and provides a rich opportunity for location- and context-aware network and/or user behavior research. More information about the data and potential applications can be found on the project website http://crowdsignals.io/.

Some more (open-ended) project ideas

Implementation-based projects

If you choose an implementation-based project you will need to use your own laptops and phones. I might be able to provide some equipment, so come talk to me if you need hardware. Also, have in mind that whatever hardware you might need will need to be purchased, so delivery delays might slow down your project progress.

- Smartphone app development
  Here are a few suggestions of smartphone applications you can develop. Note that your app should not be something straight-forward. I am generally interested in applications targeted to developing regions, so here are a few app suggestions.
  - o An education app: maybe something that makes use of short SMS for math tutoring.
  - o A health-care app: maybe an app that supports collection of patient records, teleconferencing, guidance of inexperienced healthcare staff.
  Consider for both cases maybe making use of a combination of a smartphone and a smartpen (e.g. http://www.livescribe.com/en-us/smartpen/)
- Network analysis: build an agent that can collect data on various interfaces on your phone. This agent can perform passive or active measurements and determine network performance, usage, interference, etc. Discover what metrics you can collect on each interface. You can use your analyzer to analyze different networks (e.g. on-campus vs. residential vs. at a coffee shop).
- Network interface selection: how do we harness heterogeneous networks to improve user experience? You can think about user experience from the perspective of achieved throughput, voice call quality, battery life…

Data analysis project.

For this type of project you can either develop your own data collection tool (such as the network analysis agent suggested above) or analyze the data collected by your tool; or you can perform an in-depth analysis of an existing dataset.

- Analyzing spectrum occupancy. Make use of spectrum allocation and assignment data you can query from FCC's spectrum dashboard http://www.fcc.gov/developers/spectrum-dashboard-api. Analyze spectrum occupancy using data from Microsoft Spectrum Observatory http://observatory.microsoftspectrum.com/. Correlate the two datasets. What do you see?
- Develop an app or analysis tool that makes use of data from AidData http://aiddata.org/.
- Data analysis: you can use various datasets available on CRAWDAD (http://crawdad.cs.dartmouth.edu/) to verify a hypothesis, evaluate network performance, develop and verify a model, observe user behavior, etc.