A Tutorial Introduction to GENI WiMAX

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Part 1: GENI WiMAX Overview

- Why GENI WiMAX?
- WiMAX Testbed Tour
- GENI WiMAX Base Station
- Other tools
- GENI WiMAX Testbeds Open to Experimenters
- Resources and Support

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Why GENI WiMAX?

Wireless is an essential part of the next-generation Internet.

By 2015, global mobile data usage is predicted to reach **6.3 exabytes/ month** over **7.1 billion** mobile devices

We need research to:

- Address issues specific to mobile and multi-homed devices
- Develop new ideas for maximizing the performance of IP-based broadband wireless access networks
- Evaluate existing and proposed networking protocols over new and old wireless networks

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WiMAX Testbed Tour

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WiMAX Testbed Tour

Hardware Components:

- Each testbed node is a PC equipped with
  - VIA Esther processor 1GHz
  - 40GB Hard disk
  - Atheros 802.11 a/b/g Wireless Network Adapter
  - Intel Centrino Advanced-N + WiMAX 6250 Wireless Network Adapter
  - 100BaseT Ethernet port for experiment control
  - Chassis Manager card for resetting node
- Servers to support various experimenter services

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WiMAX Testbed Tour

Software Components:

- Web-based interface for reserving resources
- Experiment Control using OMF
  - OMF is a platform to support rigorous and repeatable experimentation
  - Provides an unambiguous way to describe and instrument an experiment, enabling repeatability
  - One OMF experiment can run on any GENI WiMAX testbed with minimal modification
- Instrumentation and Measurement using OML
  - Measurements are saved in a standard database format for easy manipulation and analysis
  - Store measurements and metadata in one place

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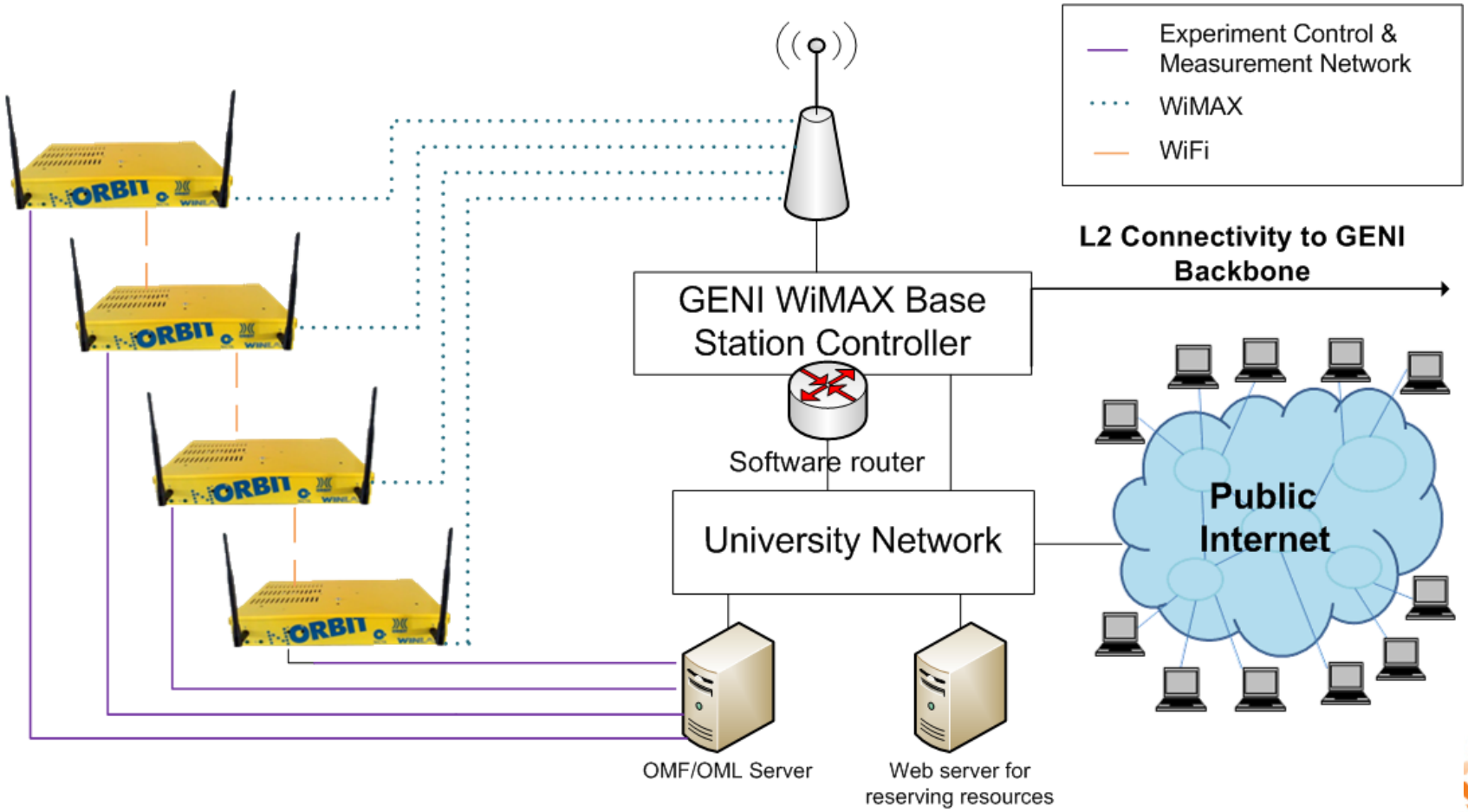
WiMAX Testbed Tour



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GENI WiMAX Base Station

- Open/programmable base station node
- Experimenters can reserve the base station for their experiments
  - Eliminate the uncertainty associated with competing traffic, carrier policies, and other problems that come with using a commercial network for wireless research

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GENI WiMAX Base Station

- The WiMAX base station uses an external PC controller that runs Linux.
- We use the ORBIT Management Framework (OMF) software to interface the base station to other parts of the GENI network.

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Other tools we provide

- Common applications instrumented with OML for use in OMF/OML experiments, e.g.
  - VLC media player
  - Iperf
  - HTTP server
- Tools for recording experiment state and metadata
  - Script for saving base station configuration to OML database – keep configuration and experimental measurements in one place

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GENI WiMAX Sites Open to Experimenters

- Two GENI WiMAX sites currently operate open-access testbeds, with more coming soon:
  - WINLAB: http://orbit-lab.org
  - NYU-Poly: http://witestlab.poly.edu

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Resources and Support

- Documentation, tutorials, software tools
  - http://witestlab.poly.edu (NYU-Poly Testbed)
  - http://wimax.orbit-lab.org (GENI WiMAX)
  - http://mytestbed.net (OMF)

- Support
  - witestlab@poly.edu (NYU-Poly Testbed)
  - orbit-user@orbit-lab.org (WINLAB Testbed)
  - omf-user@lists.nicta.com.au (OMF)

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Next

- Guided hands-on tutorial
  - (Registration: http://witestlab.poly.edu/index.php/tutorials/26-registration.html)
  - (Reservation: http://witestlab.poly.edu/index.php/tutorials/25-reservations.html)
  - Start an experiment: http://witestlab.poly.edu/index.php/tutorials/27-starting-an-experiment.html
  - Basic WIMAX RSSI experiment: http://witestlab.poly.edu/index.php/tutorials/28-4-basic-wimax-rssi-experiment.html
  - Iperf broadcast receiver experiment: http://witestlab.poly.edu/index.php/tutorials/29-5-iperf-udp-broadcast-receiver-experiment.html
  - Saving BS configuration to OML http://witestlab.poly.edu/index.php/tutorials/31-6-saving-bs-config-to-oml.html
  - Varying modulation and coding experiment http://witestlab.poly.edu/index.php/tutorials/30-7-varying-modulation-and-coding-experiment.html

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Wrap up

- What did we learn today:
  - Remote access to the GENI WiMAX tesbted (registration)
  - Reserve the testbed for experimentation (scheduler)
  - Configure the parameters of the BS / Initiate an experiment
  - Build and execute an experiment (using OMF)
  - Define measurement points (using OML)
  - Conduct experiments measuring signal strength
  - Conduct experiments, generating traffic and measuring throughput, packet loss
  - Collect measurements and observe them though the OML visualization service
  - Saving BS configuration with the measurements of the experiment
  - Varying modulation and coding schemes during the experiment

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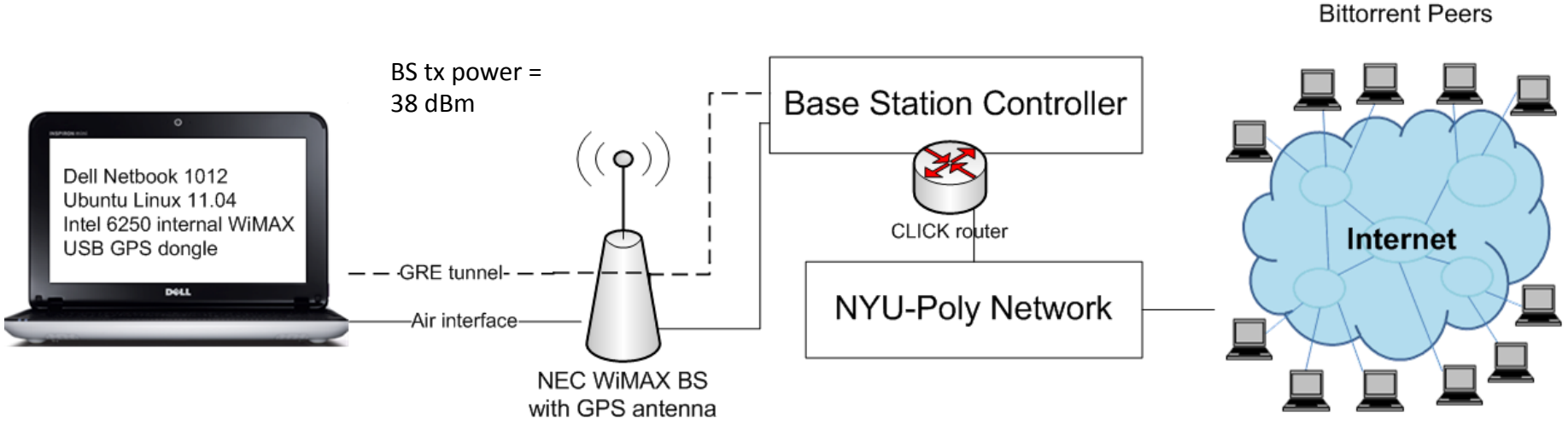
Range and Throughput Experiments



- To gather throughput statistics, we used Bittorrent rather than traditional network testing tools (e.g. *iperf*)
  - Behavior of a TCP flow, as measured by *iperf*, gives pessimistic picture of network performance: link under-utilization, poor recovery from loss, highly variable results between *iperf* trials, and overall degraded end-to-end performance. Each measurement point takes some time to collect, so this tool is not suitable for taking hundreds of measurement points over a wide area.
  - Bittorrent uses multiple parallel connections to maximize link utilization, and DL and UL speeds stabilize quickly as link quality changes while we move throughout the coverage area.

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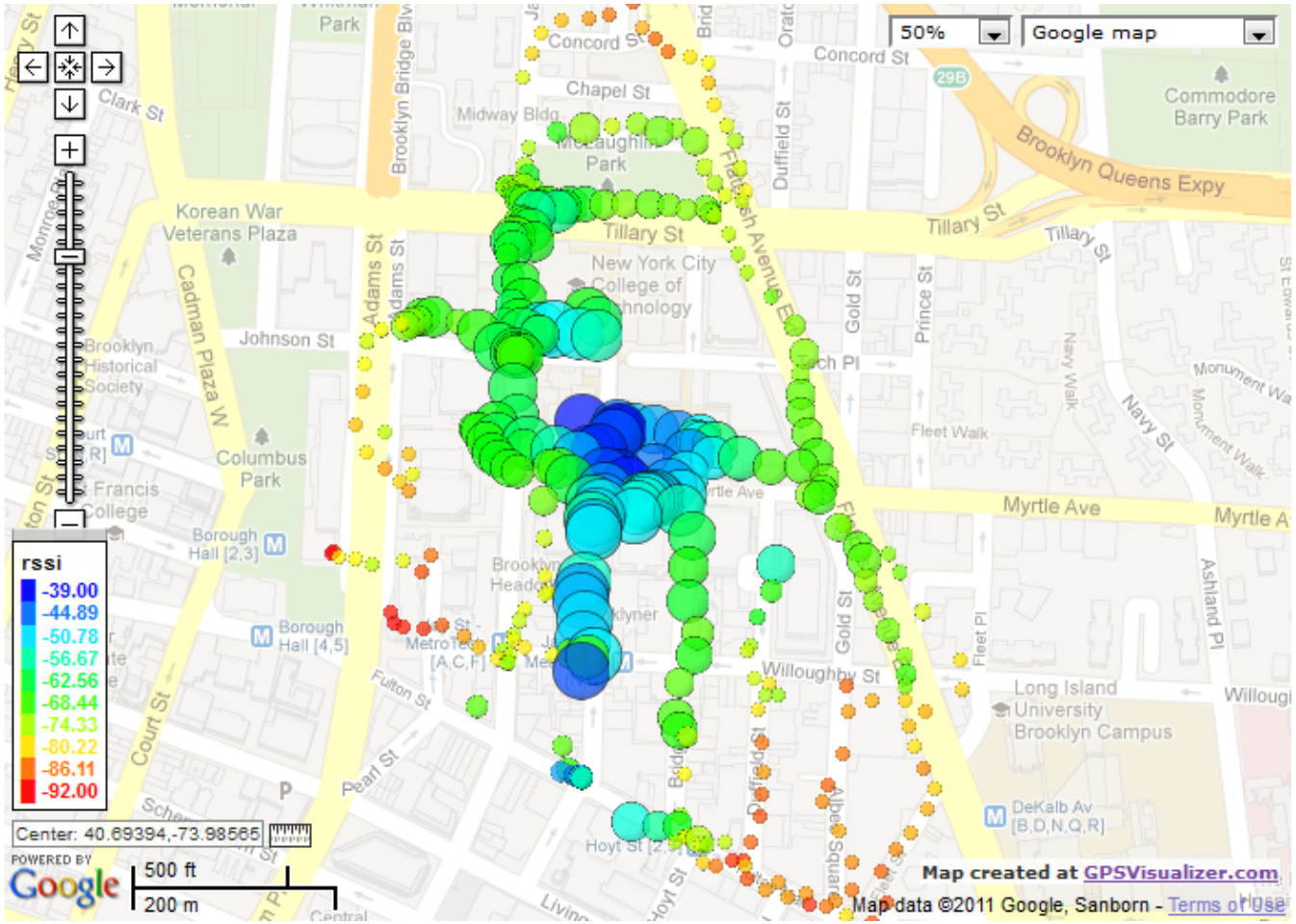
Range and Throughput Experiments



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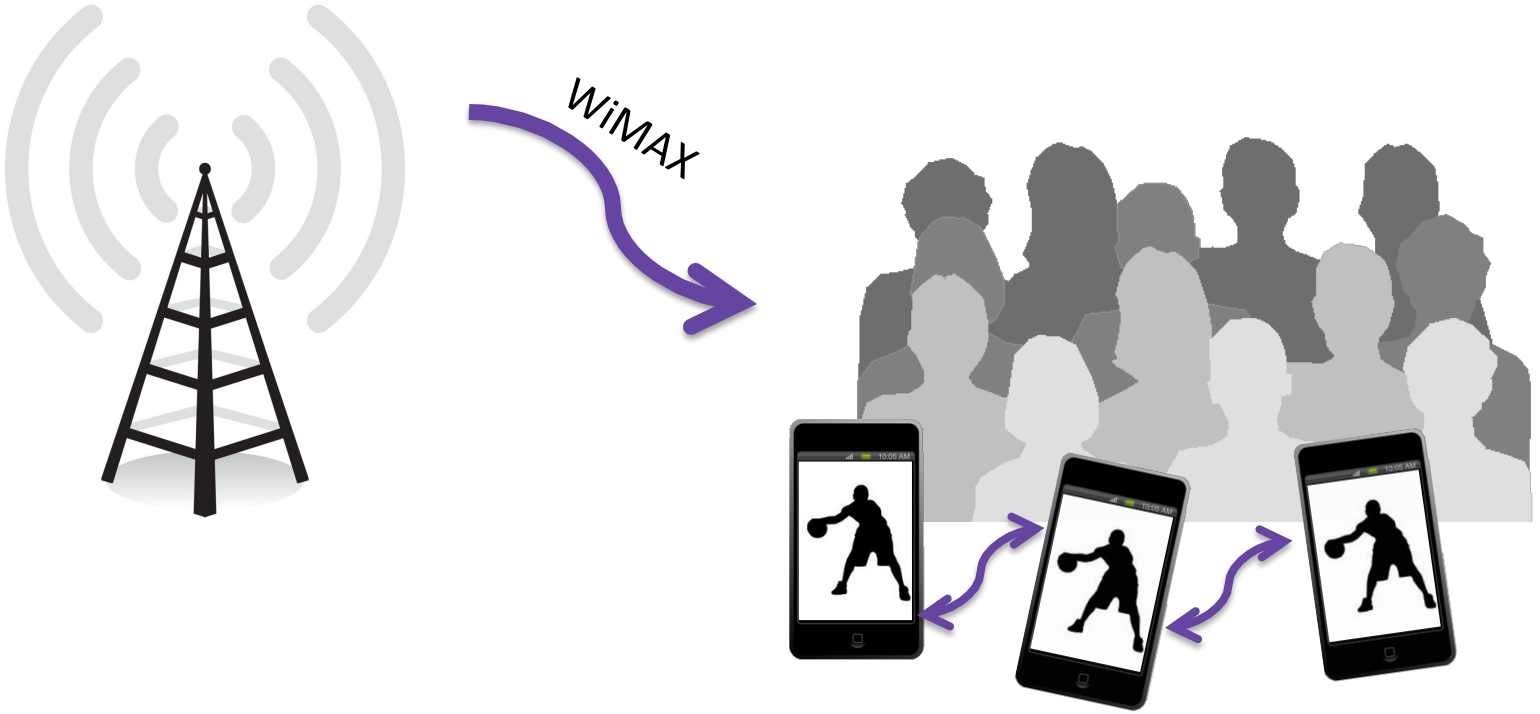
Develop WiFi/WiMAX schemes

- Cooperative recovery though heterogeneous networks



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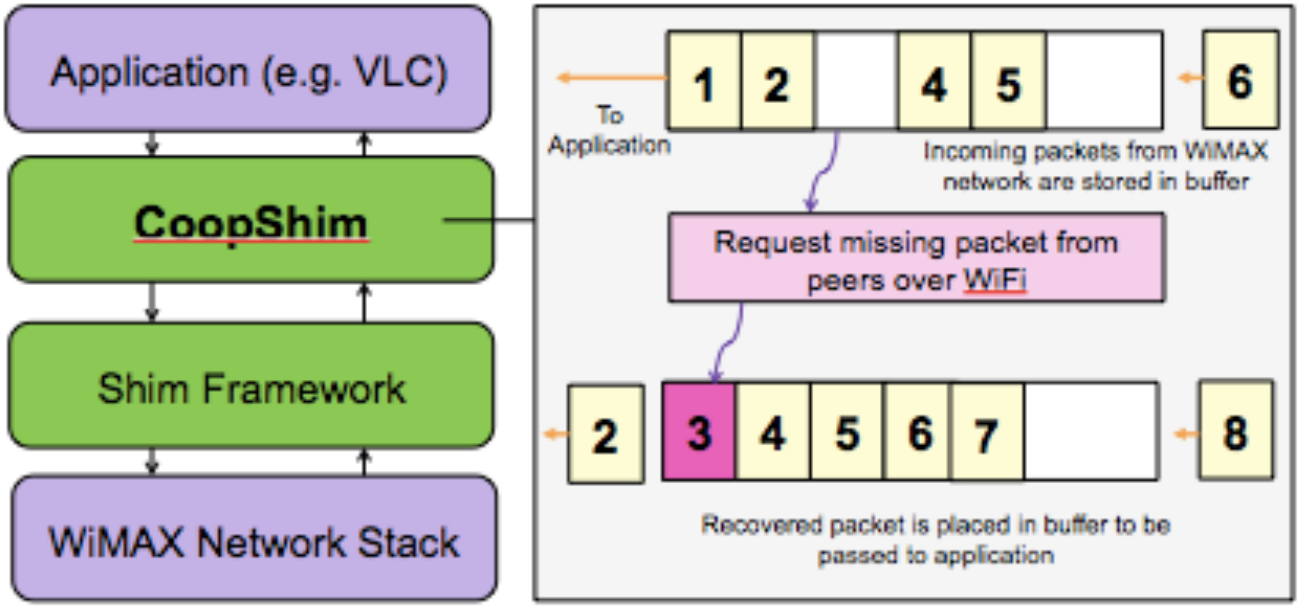
Develop WiFi/WiMAX schemes

- Cooperative recovery though heterogeneous networks (implementation solution)



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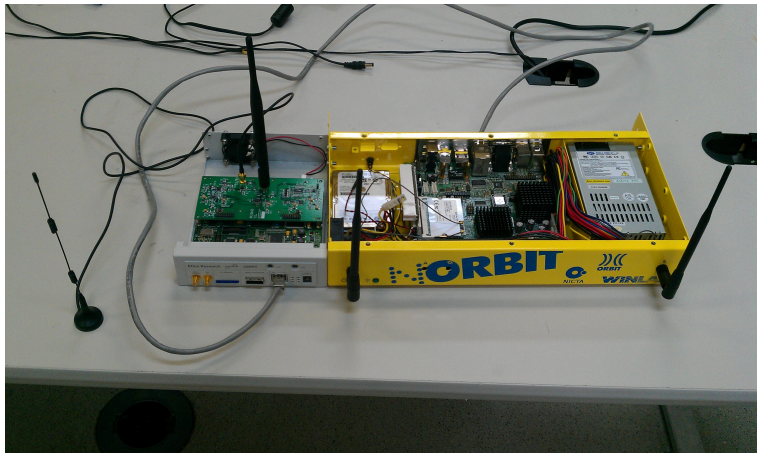
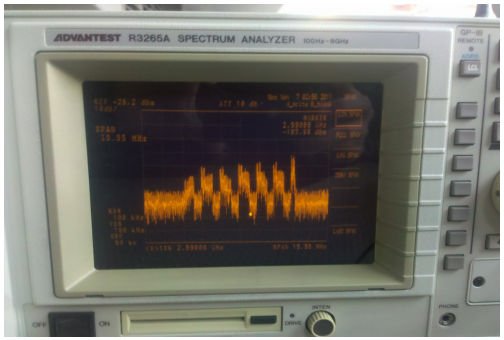
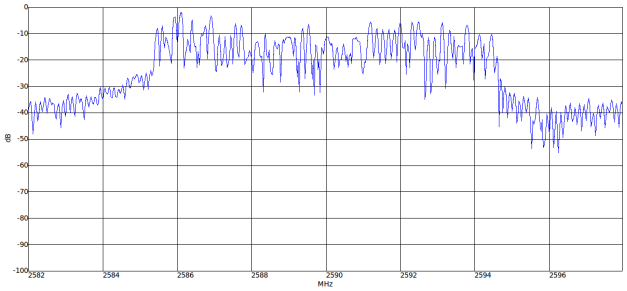
WiMAX Measurement Framework

- Using software defined radios







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Thank You!

http://witestlab.poly.edu

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