

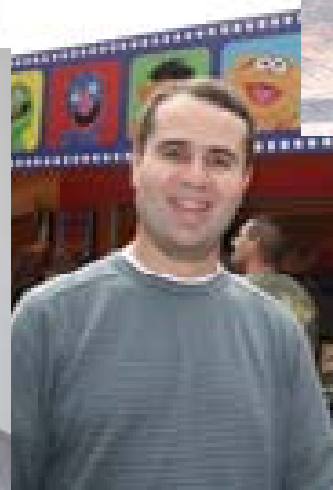


Measuring and Modeling Spectrum Occupancy: A Massachusetts Perspective

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The Team





How Much Spectrum is Really Available?

- Worst-case scenarios observed
 - Investigate four mid-size U.S. cities
- Single location considered per city
 - Take measurements at several locations within urban core of U.S. city
- Single time snapshot
 - Periodic spectrum measurements over a duration of years



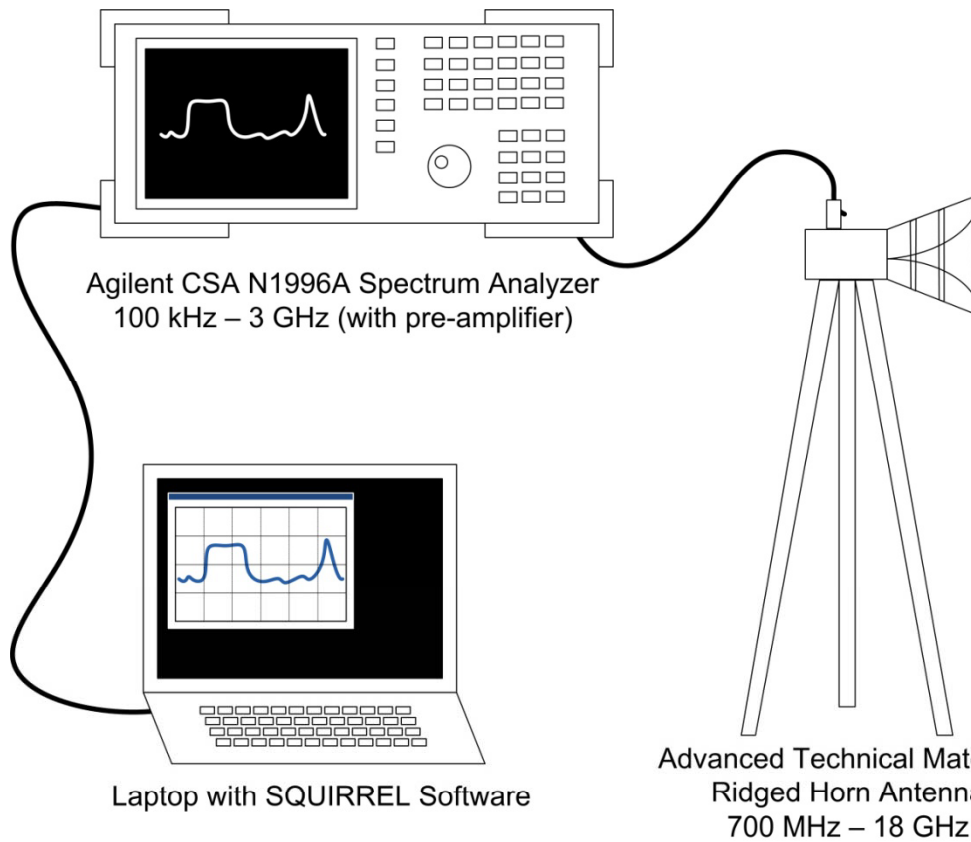
Spectrum Measurement Team



WPI Spectrum Measurement Team in Rochester, NY on June 20, 2008



Spectrum Measurement Setup (I)



Ridged horn antenna in Buffalo, NY



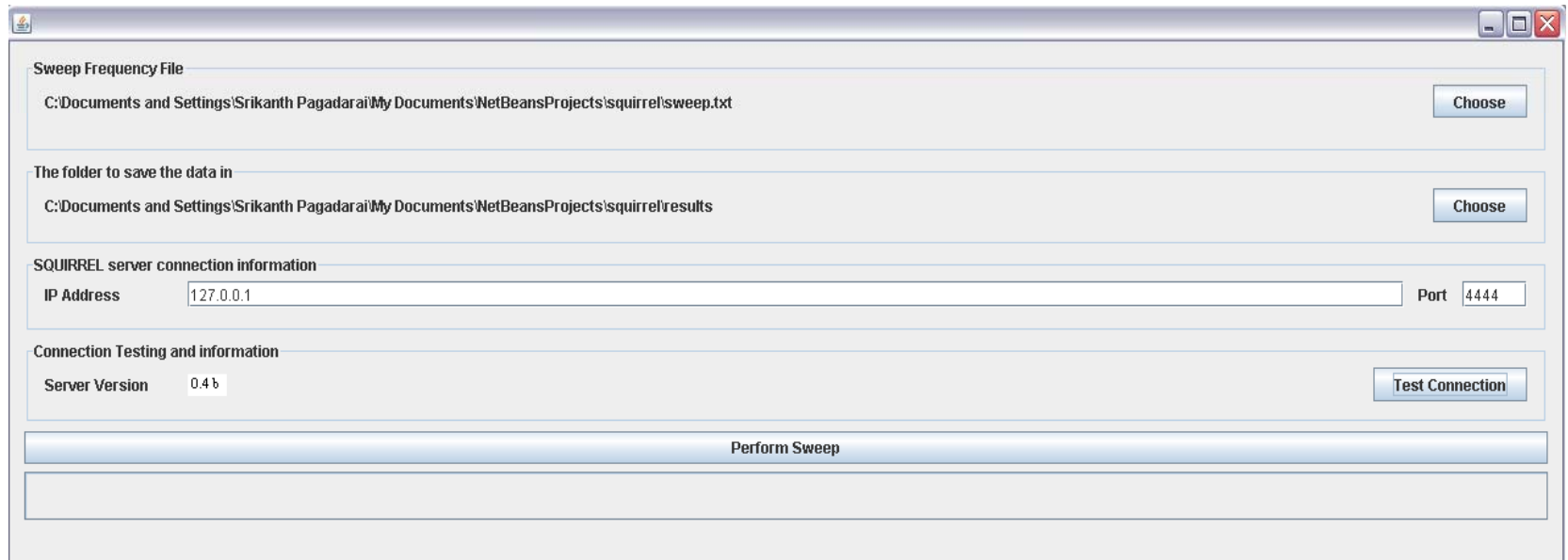
Spectrum Measurement Setup (II)



Wireless spectrum measurement test-bed



Spectrum Measurement Setup (II)



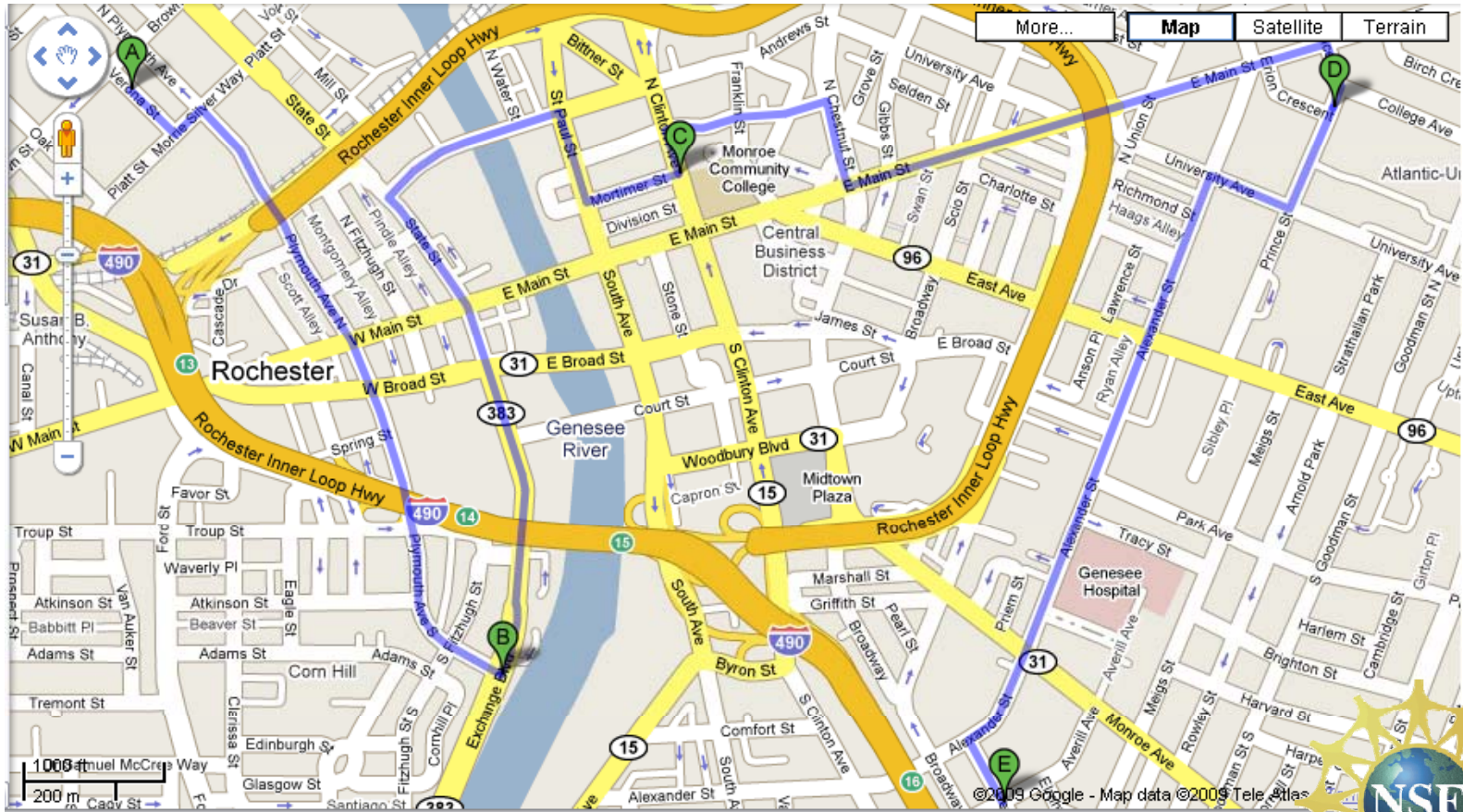
The screenshot shows a software window titled "SQUIRREL" with the following fields and buttons:

- Sweep Frequency File:** C:\Documents and Settings\Srikanth Pagadarai\My Documents\NetBeansProjects\squirrel\sweep.txt (Choose)
- The folder to save the data in:** C:\Documents and Settings\Srikanth Pagadarai\My Documents\NetBeansProjects\squirrel\results (Choose)
- SQUIRREL server connection information:**
 - IP Address: 127.0.0.1
 - Port: 4444
- Connection Testing and information:**
 - Server Version: 0.4b (Test Connection)
- Perform Sweep** (button)

Screen capture of the SQUIRREL (Spectrum Query Utility Interface for Real-time Radio Electromagnetics) interface



Wireless Spectrum Measurements



Measurement Sites in Rochester, NY



Online Spectrum Measurements

Welcome to SQUIRRELWeb
Spectrum Query Utility Interface for Realtime Radio Electromagnetics

SQUIRRELWeb is a Wireless Spectrum Observatory developed by the Wireless Lab located at [Worcester Polytechnic Institute \(WPI\)](#), Worcester, Massachusetts. The goal of this [NSF](#) funded project is to allow users from all over the world to access our server and take free spectrum measurements at any given time. The range of our *Agilent CSA-N 1996A Spectrum Analyzer* is 100kHz to 3GHz. To learn more about the Wireless Innovation Lab, please visit our [website](#).

Spectrum Analyzer Access:
If you are a registered user, [Login here](#)
If you are a new user, email us at spectrum@ece.wpi.edu in order to set up your account.

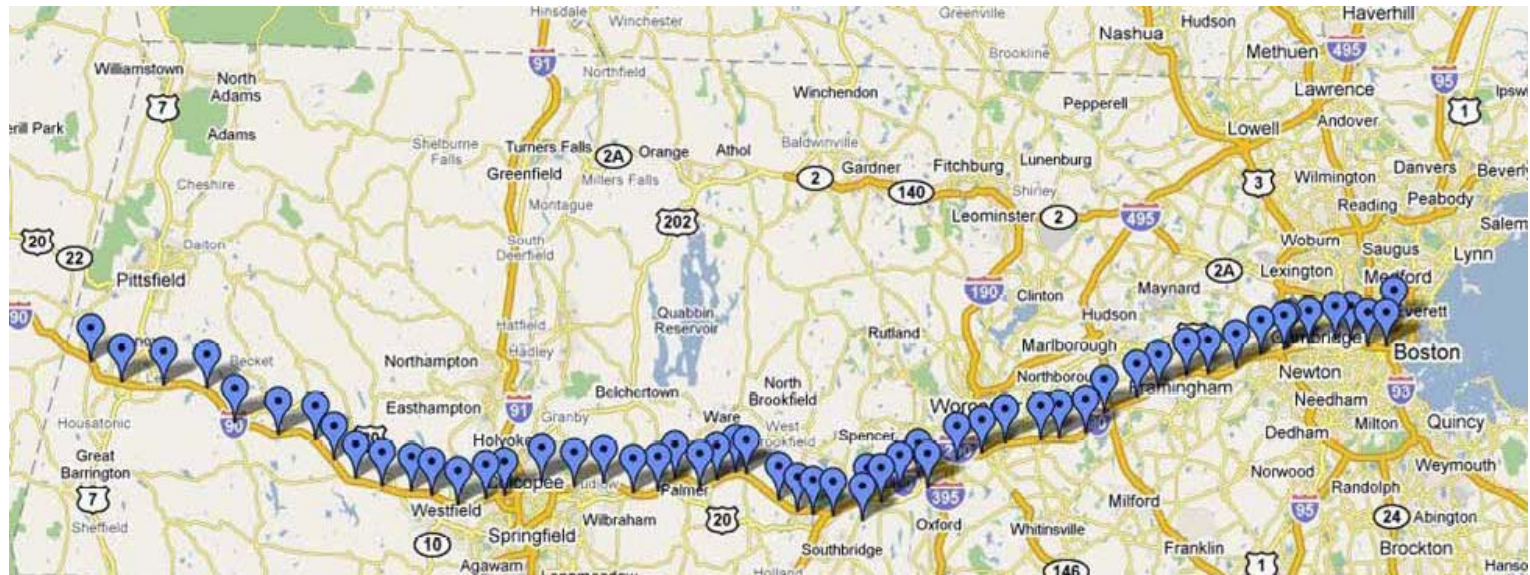
<http://spectrum.ece.wpi.edu/>



WPI

Vehicular Spectrum Campaign

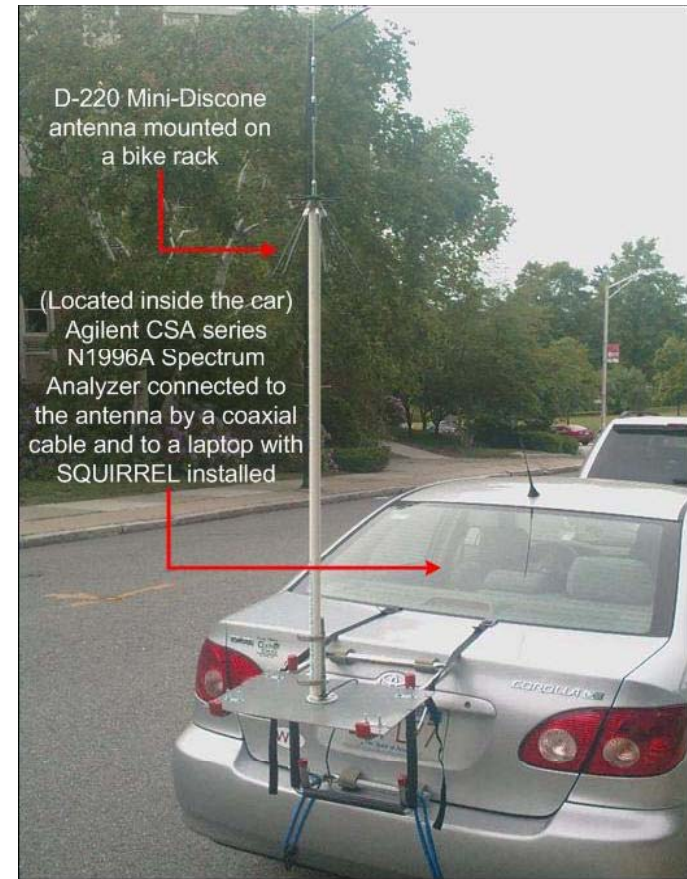
- 48 locations chosen across I-90 in the state of Massachusetts approximately 2 miles apart.
- Spectrum measurements taken in a moving vehicle on 06/30/2009.



A map of the locations close to I-90 between Boston, MA and Blandfield, MA over which spectrum measurements were collected on 06/07/2009, 06/11/2009, 06/12/2009 and 06/30/2009

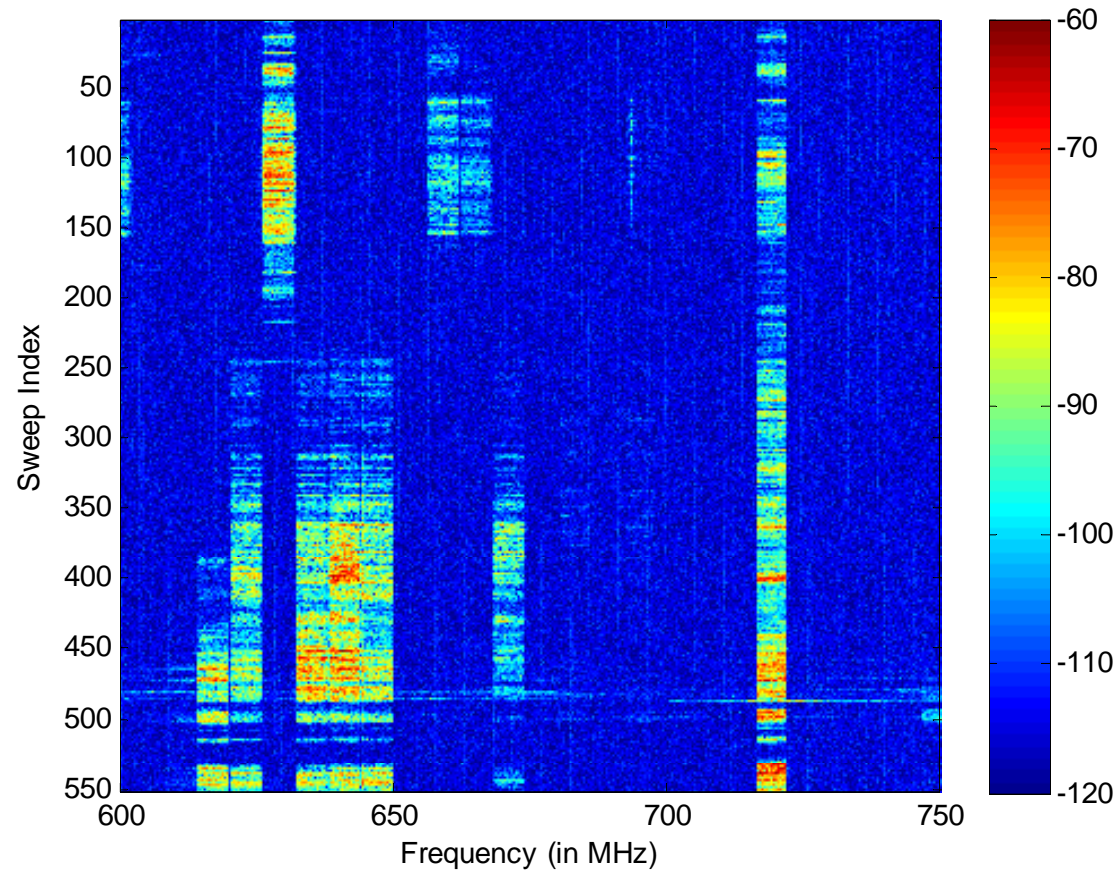
Mobile Spectrum Measurements

- **Measurement setup consists of**
 - A spectrum analyzer,
 - A laptop installed with SQUIRREL (both of them located inside the car) and
 - A mini-disccone antenna
- **Frequency resolution chosen – 20 kHz**
- **Time sweeps per site – 10 minutes**



Measurement setup fixed to a bike-rack on the trunk of a car

Preliminary Observations



Energy Spectral Density plots for the TV frequencies in the frequency range, 600 – 750 MHz over 550 time sweeps close on I-90 between Boston, MA and West Stockbridge, MA. The measurement setup was located in a vehicle moving at an average velocity of 60 miles/hr.



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