

Cell Vs. Wifi:

On the Performance of Metro Area Mobile Connections

Anton Kapela tk@5ninesdata.com

Paul Barford pb@cs.wisc.edu

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Overview

- We're analyzing crowd-sourced data
 - What is speedtest.net and why do we care?
- Cell vs. WiFi
 - Different, yes; "how" is interesting
- Stats galore
 - Can you ping me now?

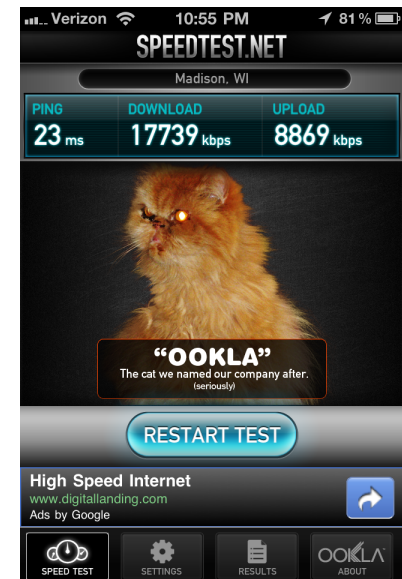
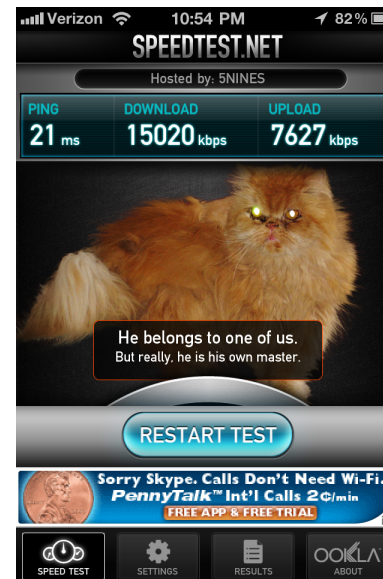
What is Speedtest.net?

- A fine contrivance of Flash and JS
 - Measures “http” RTT (L7 ping-ish)
 - Measures upstream bits/sec
 - Measures downstream bits/sec
- Provides server operators statistical data
 - This is the only reward an ISP gets

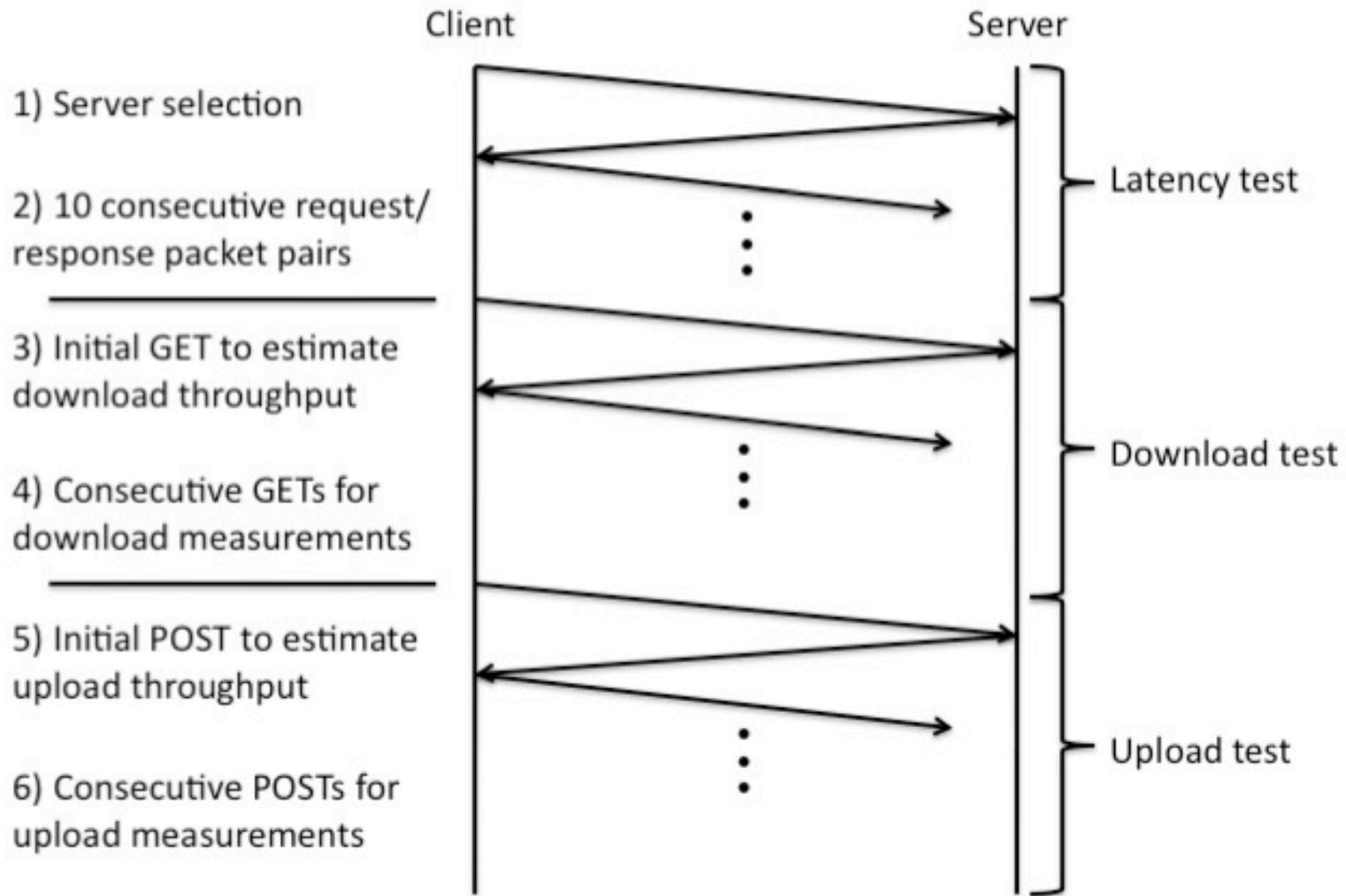
PLATFORM	CLIENT_IP	ISP	TEST_DATE	TEST_UTC	DOWNLOAD_KBPS	UPLOAD_KBPS	LATENCY	LATITUDE	LONGITUDE	CONNECTION_TYPE
iphone	174.252.11.135	Cellco Partnership DBA Verizon Wireless	2/22/11 2:30	2:30	1396	841	357	42.8475	-89.0614	Cell
iphone	166.137.141.207	Service Provider Corporation	2/22/11 2:51	2:51	969	112	433	42.8526	-89.0313	Cell

What runs speedtest.net?

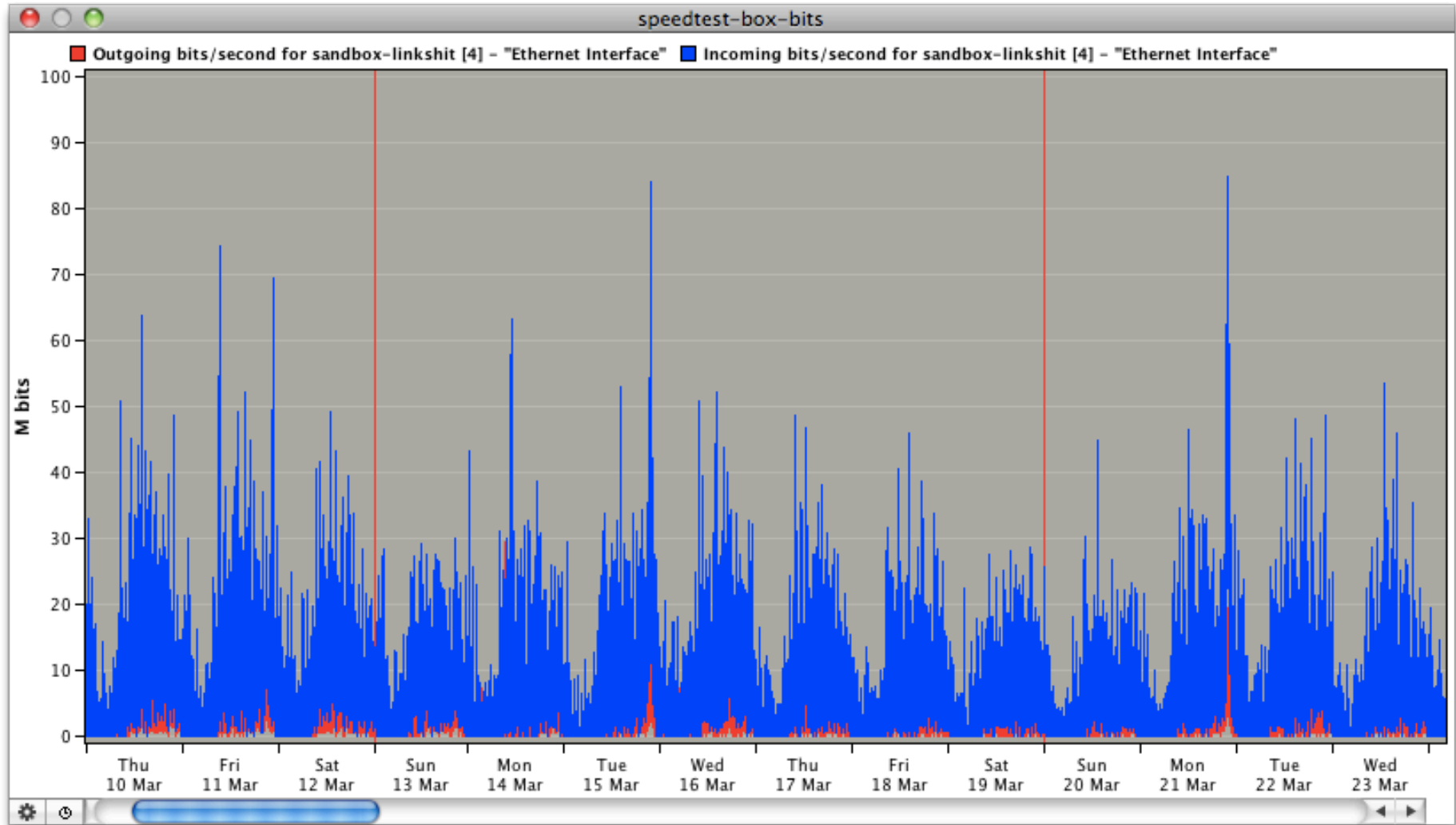
- Answer: Cats



Speedtest.net Methodology



Transit is cheap, right?



Speedtest.net Web UI – Gibson effect

The screenshot shows the Speedtest.net interface on the SNINES website. The browser address bar displays 'enjoy5nines.com/speedtest/'. The page features a dark theme with a central speedometer graphic. The speedometer shows a download speed of 64.78 Mbps and an upload speed of 54.93 Mbps. Below the speedometer, the user's IP address is listed as 208.66.128.11 and the ping is 5ms. A 'Restart Test' button is visible. The footer contains navigation links for COMPANY, SERVICES, SUPPORT, and COMMUNITY, along with the contact number 608.512.1000 and copyright information for SNINES Inc.

Speed Test | SNINES
enjoy5nines.com/speedtest/
portal-border1 portal-mytickets echo-subsonic Speedtest Metrics Other Bookmarks
Company | Community | News | Contact
What We Do
INFORM CONNECT HOST MANAGE PROTECT
608.512.1000
SUPPORT
5NINES
enjoy technology :)
IS YOUR CONNECTION BUILT FOR SPEED?
Download Speed 64.78 Mbps
Upload Speed 54.93 Mbps
Your IP: 208.66.128.11
PING: 5ms
Restart Test
Last Result:
Download Speed: 64784 kbps (8098 KB/sec transfer rate)
Upload Speed: 54928 kbps (6866 KB/sec transfer rate)
Latency: 5 ms
Mon May 16 2011 11:26:17 GMT-0500 (CDT)
608.512.1000
© 2011 SNINES Inc.
222 West Washington Ave. Ste.

The screenshot shows the Speedtest.net interface on the speedtest.net website. The browser address bar displays 'speedtest.net'. The page features a dark theme with a central speedometer graphic. The speedometer shows a ping of 5ms, a download speed of 71.33 Mbps, and an upload speed of 58.28 Mbps. Below the speedometer, there are buttons for 'SHARE THIS RESULT', 'TEST AGAIN', and 'NEW SERVER'. The page also includes a 'BANDWIDTH ONLY TELLS PART OF THE STORY' section, a 'PINGTEST.NET' section, and a 'GET A FREE SPEEDTEST.NET ACCOUNT' section. The footer contains navigation links for MY RESULTS, SUPPORT, and SETTINGS, along with the contact number 608.512.1000 and copyright information for SNINES Inc.

Speedtest.net - The Global...
speedtest.net
portal-border1 portal-mytickets echo-subsonic Speedtest Metrics Other Bookmarks
SPEEDTEST.NET™
LEARN WHAT'S NEW! LOGIN MY RESULTS SUPPORT SETTINGS
U-verse® Official Site Discover The Evolution of TV, Voice & Internet. AT&T Makes Life Easier. att.com/u-verse
High-Speed Internet TDS High-Speed DSL Connection. Fast Downloads & Uploads. Order Online! www.TDSTeleco
Ads by Google
PING 5 ms
DOWNLOAD SPEED 71.33 Mbps
UPLOAD SPEED 58.28 Mbps
SHARE THIS RESULT
BANDWIDTH ONLY TELLS PART OF THE STORY
PINGTEST.NET
COMPARE YOUR RESULT
CONTRIBUTE TO NET INDEX
GET A FREE SPEEDTEST.NET ACCOUNT
Your Email Address
CREATE
Being logged in would allow you to start a Speed Wave here!
Registration is free and only requires a valid email address.
208.66.128.11
SNINES Data, LLC
Rate Your ISP
TEST AGAIN
NEW SERVER
Madison, WI
Hosted by 5NINES
608.512.1000
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222 West Washington Ave. Ste.

Paper; maybe CoNEXT, etc

Cell vs. WiFi: On the Performance of Metro Area Mobile Connections

Anton Kapela
5Nines
tk@5ninesdata.com

Paul Barford
University of Wisconsin and Qualys
pb@cs.wisc.edu

Over the last five years there has been an explosion in the availability and use of mobile devices that are both cellular and 802.11 WiFi enabled. The combination of a short range, high-speed capability and a longer range, lower speed capability is compelling and enables a wide range of new mobile applications. Driven by the popularity of applications that run on hybrid cell phones such as the iPhone and Android-based devices, there is a large and growing demand for bandwidth by mobile users.

A vexing problem for WiFi enabled cell phone users, service providers and application designers is seeking out the connectivity option that provides the best performance. Over shorter time scales issues that affect performance include local availability of services, load at a particular site, characteristics of the handset, and interference among others. Over longer time scales, performance is affected by issues such as the ongoing introduction of new technology and deployment of new service provider infrastructure.

To assist users in the effort of understanding their connectivity options, a number of commercial and open-source bandwidth testing applications are now available. When invoked, these applications attempt to determine the maximum bandwidth for both uploads and downloads to the target device. At basis, these applications send streams of random bytes (*e.g.*, data blobs through GET and POST methods) via HTTP with random characters between the target

such as: what is the relative performance of cell/WiFi in a given geographic area? How does cell/WiFi performance vary in sub-regions within the metro area? How does cell/WiFi performance vary temporally in the metro area and in sub-regions? Are there any specific features in the data that differentiate performance? and how does cell/WiFi performance compare and contrast in different metro areas? The long-term goal of our work is to formulate conclusions about the spatio-temporal aspects of WiFi enabled cell phone performance that will lead to improvements in the relevant protocols, configurations, and infrastructure.

We are unaware of any prior empirical studies that compare and contrast cellular and WiFi performance in metro areas. However, there are bodies of work that examine the performance of each technology in relatively constrained settings. For example Birk et al. describe the first detailed empirical analysis of a commercial WiFi mesh network in [1]. Similarly, Tan et al. describe an empirical study of 3G cellular networks that includes an examination of throughput and other performance characteristics [3]. Finally, Speedtest.net data has been used in several manuscripts that provide a general analysis of broadband capabilities (*e.g.*, [4]).

Speedtest.net has servers deployed throughout the globe, which facilitate client performance tests. User requests initiated through their client applications are directed to local servers based on geolocation estimates. Each speed test re-

Cell vs. WiFi: Different, But How?

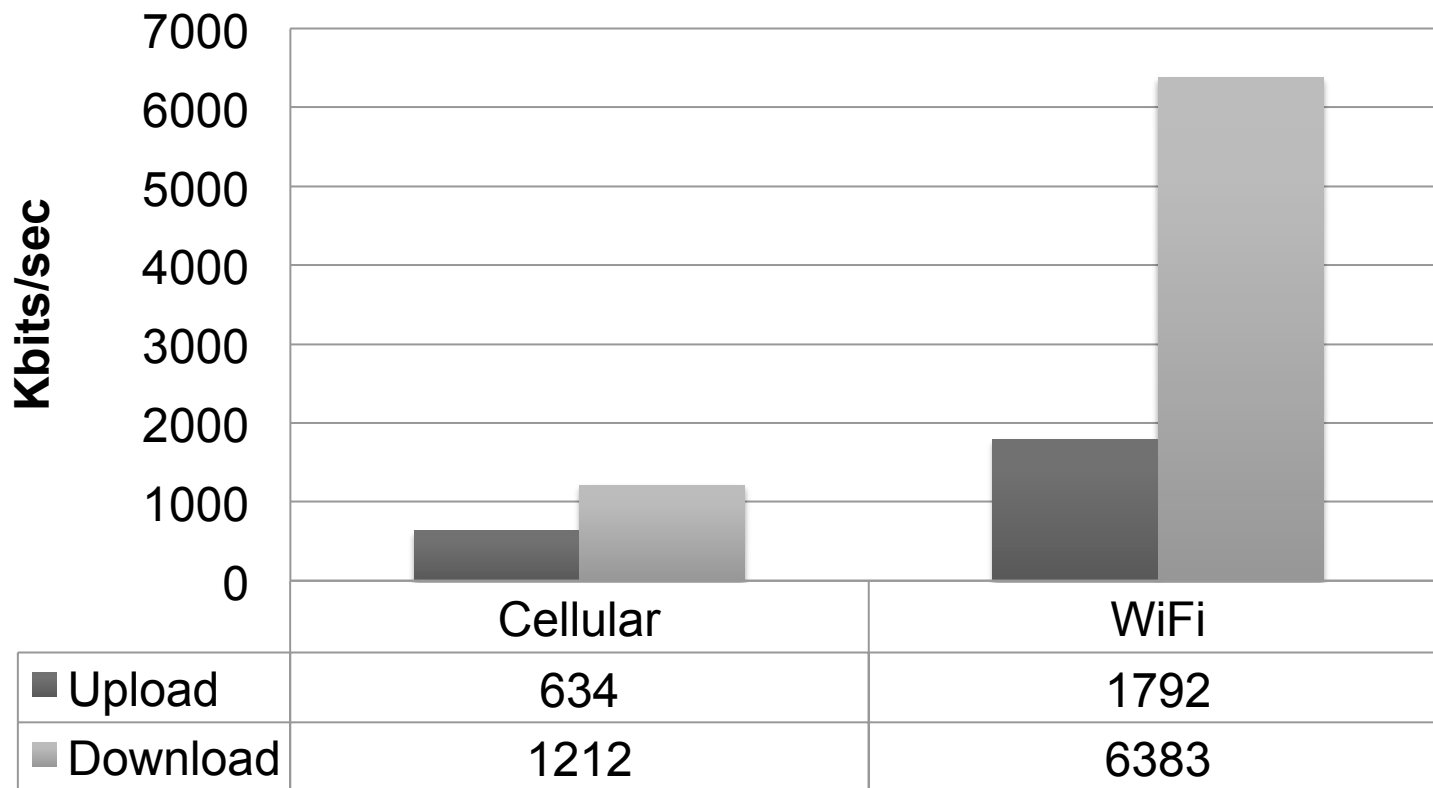
- Analyzed data from 2/22 to 3/31/2011
 - Sampled via madison.speedtest.net server
- Browsers/Desktops dominate
 - ~155k tests
- Mobile tests outnumbered ~4:1
 - ~38k tests
- Mobiles using WiFi dominate
 - ~24k from wifi, ~14k from cellular

Processed a bit...

- 7718 Mobile tests within Dane County
 - ~42.845' to 43.294' and -89.841' to -89.004'
- 7628 non-error-ed results
 - Failure of any sub-test: ~1.1%
- ~2k via Cellular IP
- Verdict: wifi is faster, more nines'
 - Until it isn't (lte, 4g, etc)

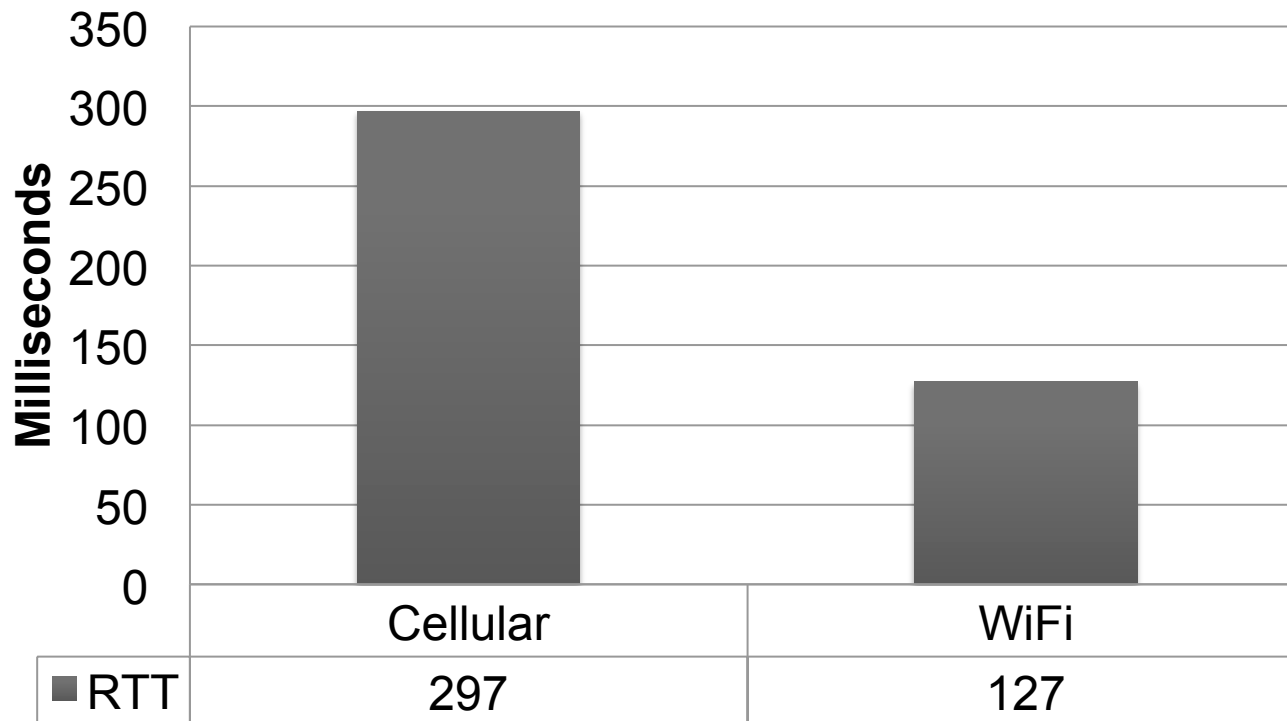
Dane County WiFi vs. Cell – Raw Speed

Average Of All Tests 2/21-3/31

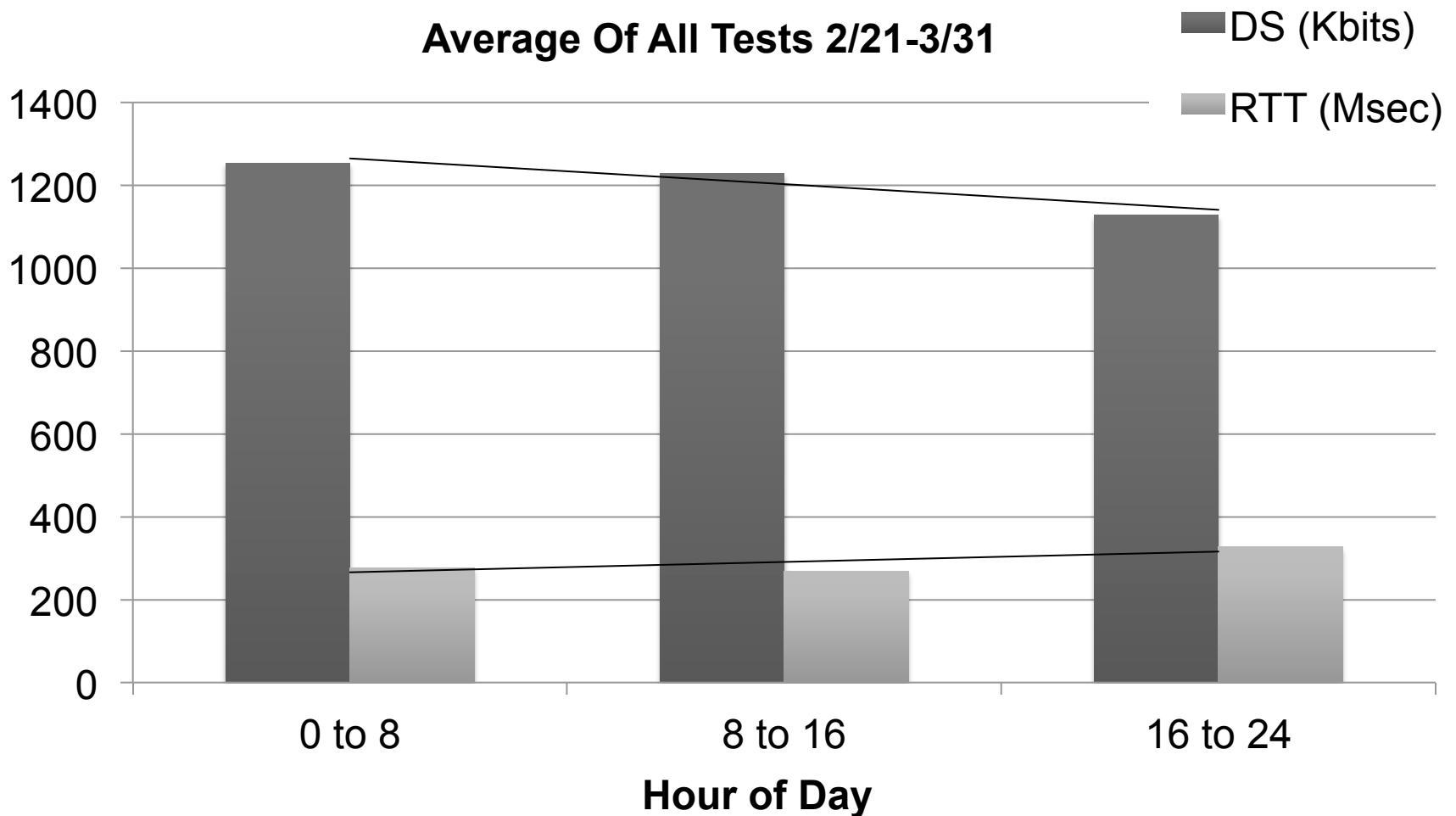


Dane County WiFi vs. Cell RTT

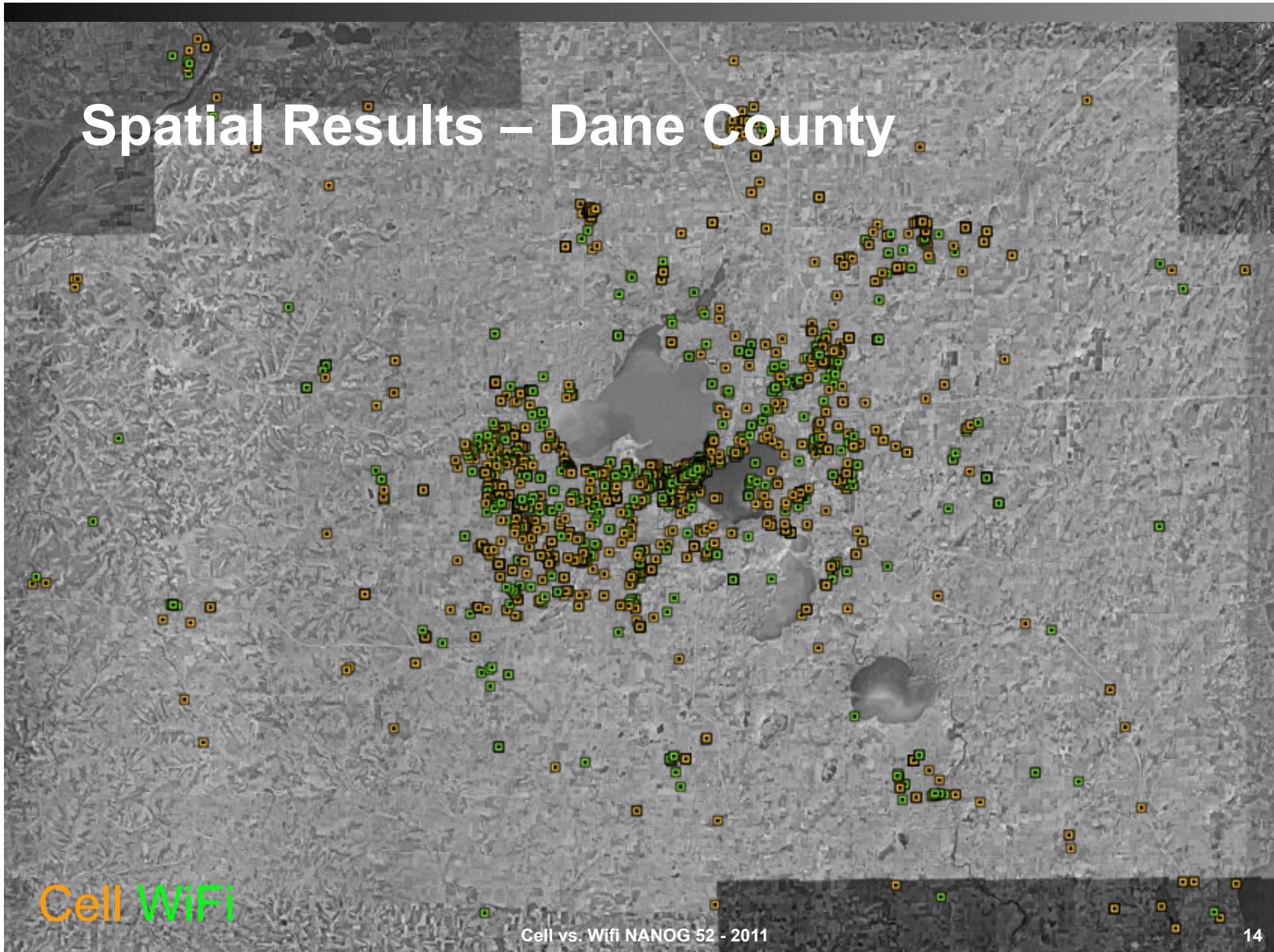
Average Of All Tests 2/21-3/31



Dane County Cell Perf vs. Time of Day



Spatial Results – Dane County



Cell WiFi

Spatial Results – City Only

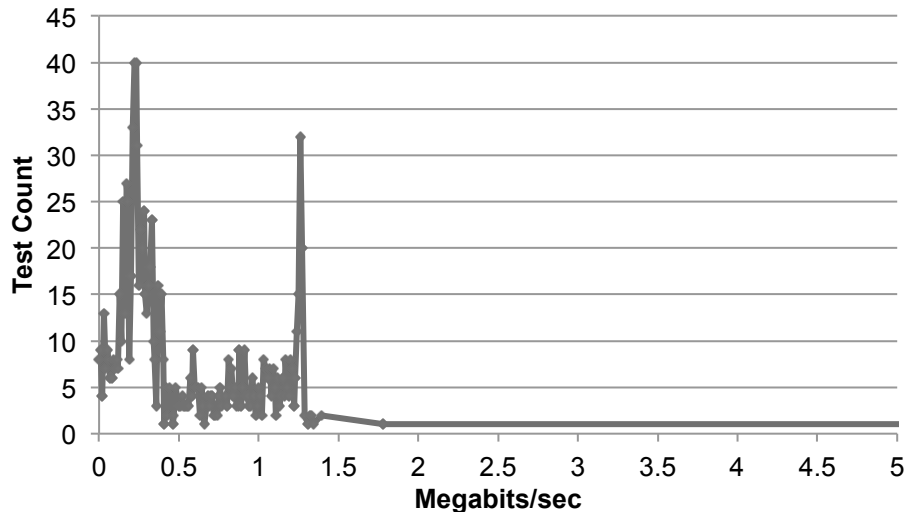


Cell WiFi

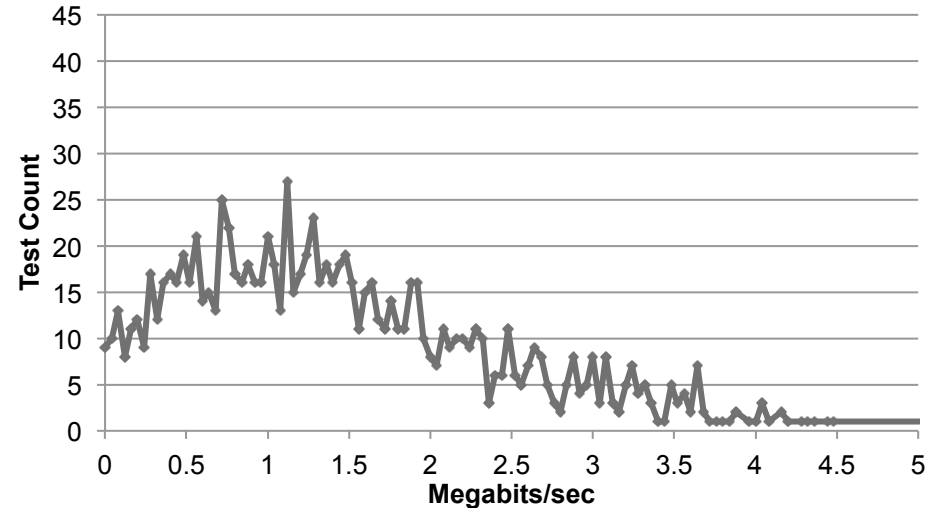
Dane County Carrier Statistics

- Distributions reveal DS bias, US impairments
 - DS longer-tail than US

AT&T US Histogram

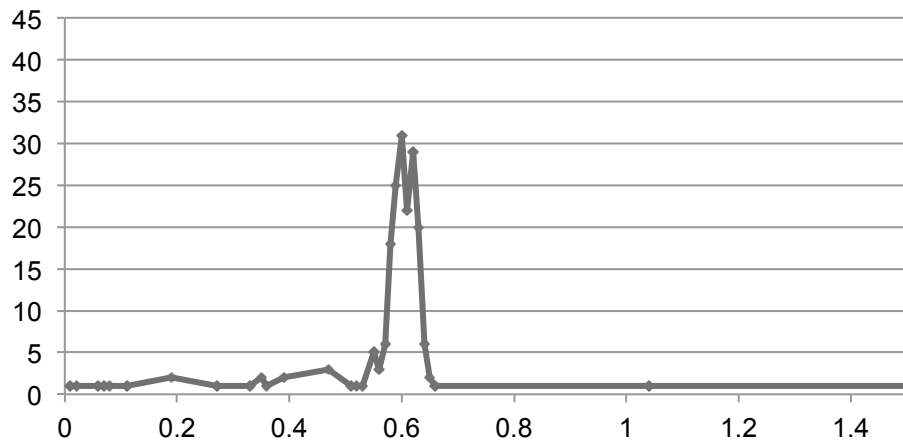


AT&T DS Histogram

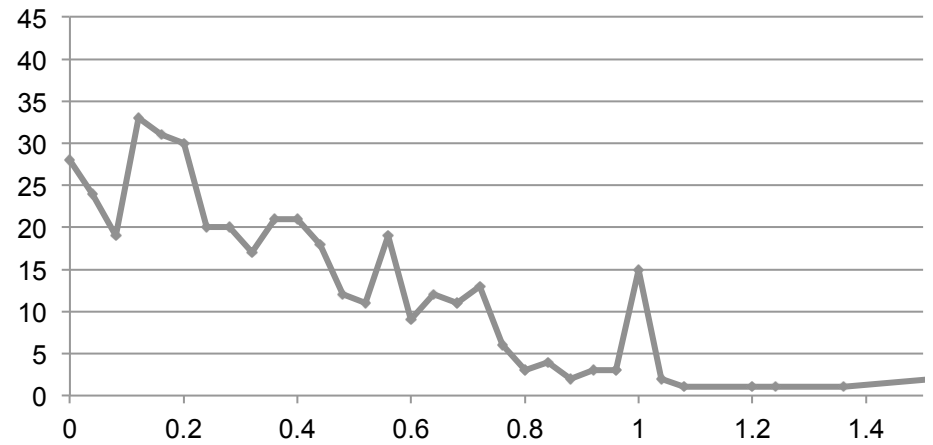


Dane County Carrier Statistics – US in Mbps

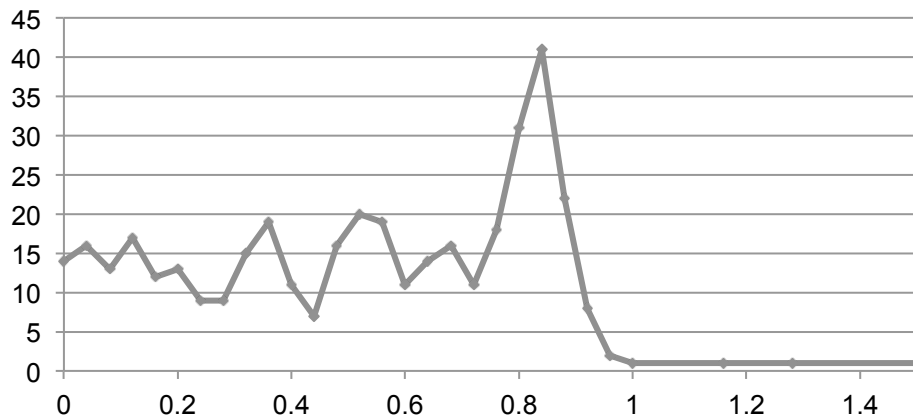
T-Mobile



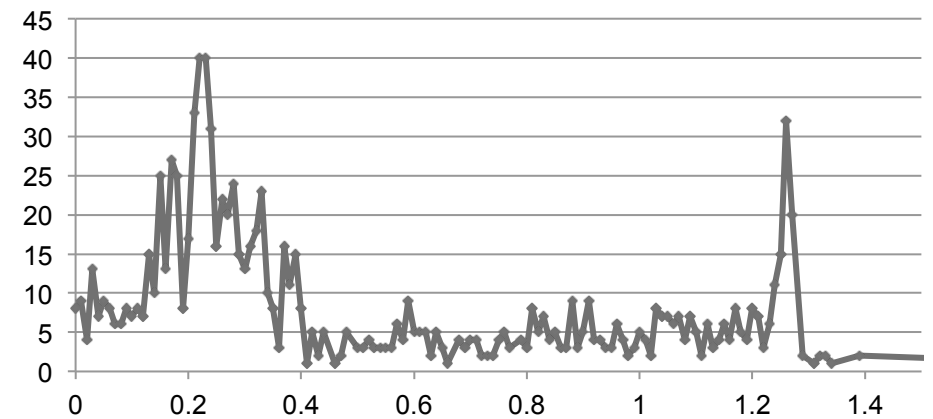
Sprint



Verizon Wireless



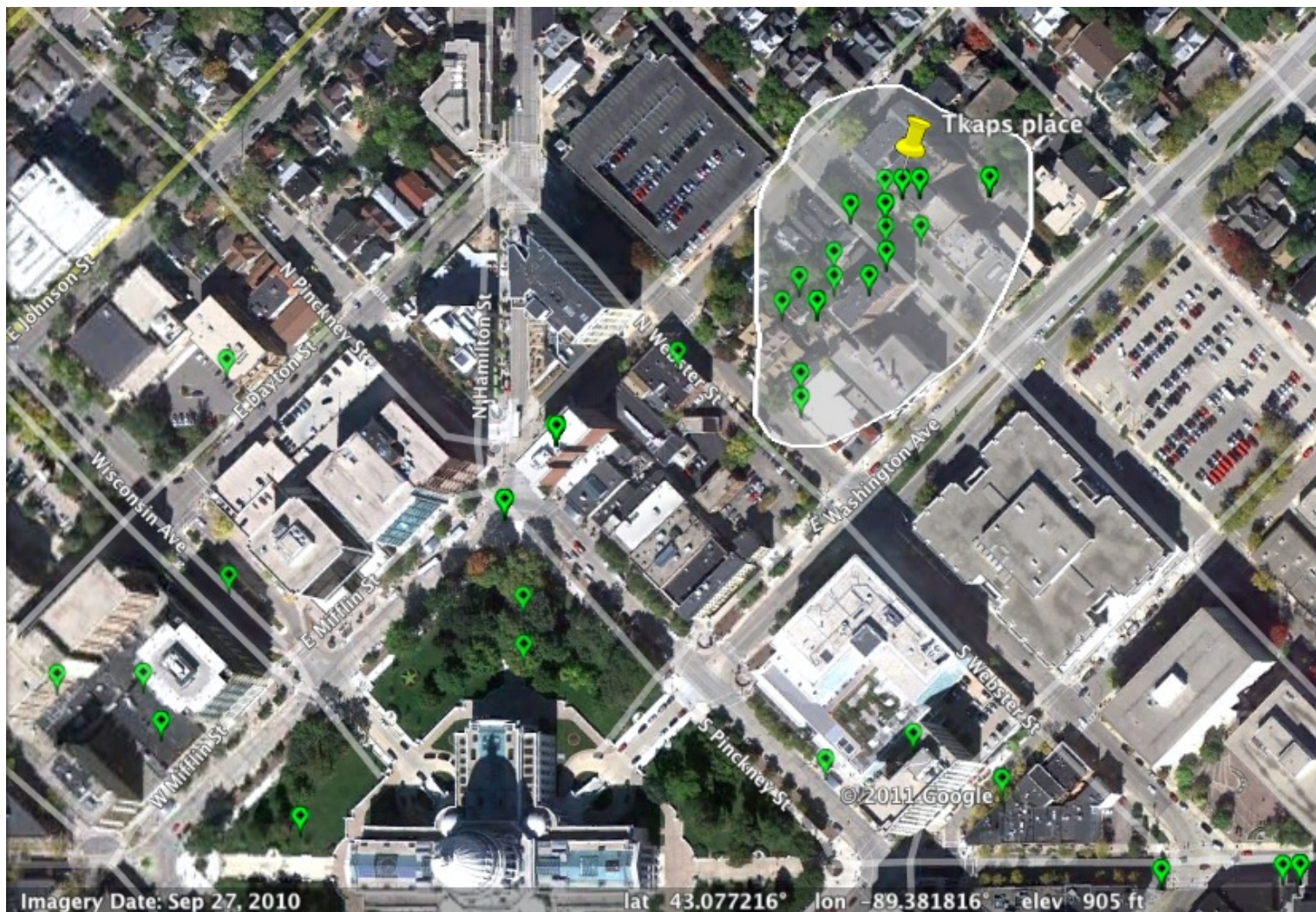
AT&T



Data Forensics

- GPS = Global Positioning “Suggestions”
 - Speedtest App doesn't filter GPS data
 - Confirmed: GPS only sampled at application *load*
 - Hey, you're saving batteries, man
 - Device may report same coordinates until app is closed → exec'd again
- Active testing confirms
 - (cont..)

Where's that centroid again...



Send questions, comments, complaints, etc:

Anton Kapela tk@5ninesdata.com

Paul Barford pb@cs.wisc.edu