Mobile Performance in Dane County – “Big4”

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Overview

Motivation

- Market Intelligence

We’re analyzing crowd-sourced data

- What is speedtest.net and why do we care?

Devices

- iOS, Android, Windows Phone, & Web Browser

What is Speedtest.net?

A fine contrivance of Flash and JS

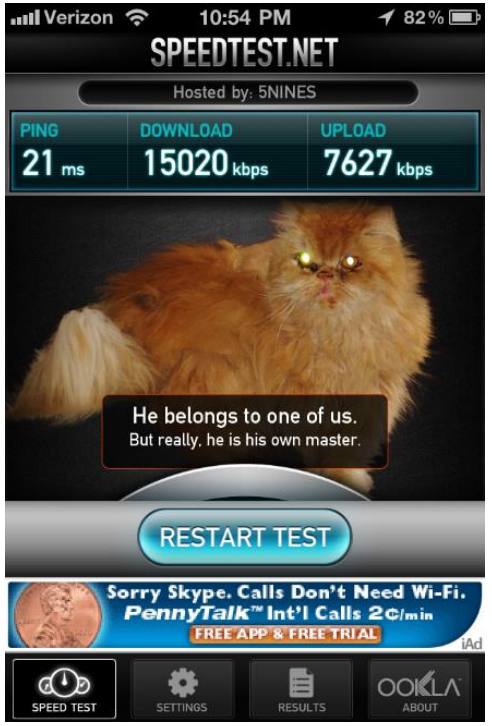
- Measures “http” RTT (L7 ping-ish)
- Measures usable upstream bandwidth
- Measures usable downstream bandwidth
  - This is *NOT* the actual network bandwidth, and is stomped on by many things in carrier networks
  - This runs inside browser plugin containers (ewwww), uses get/post API through that

Provides server operators statistical data

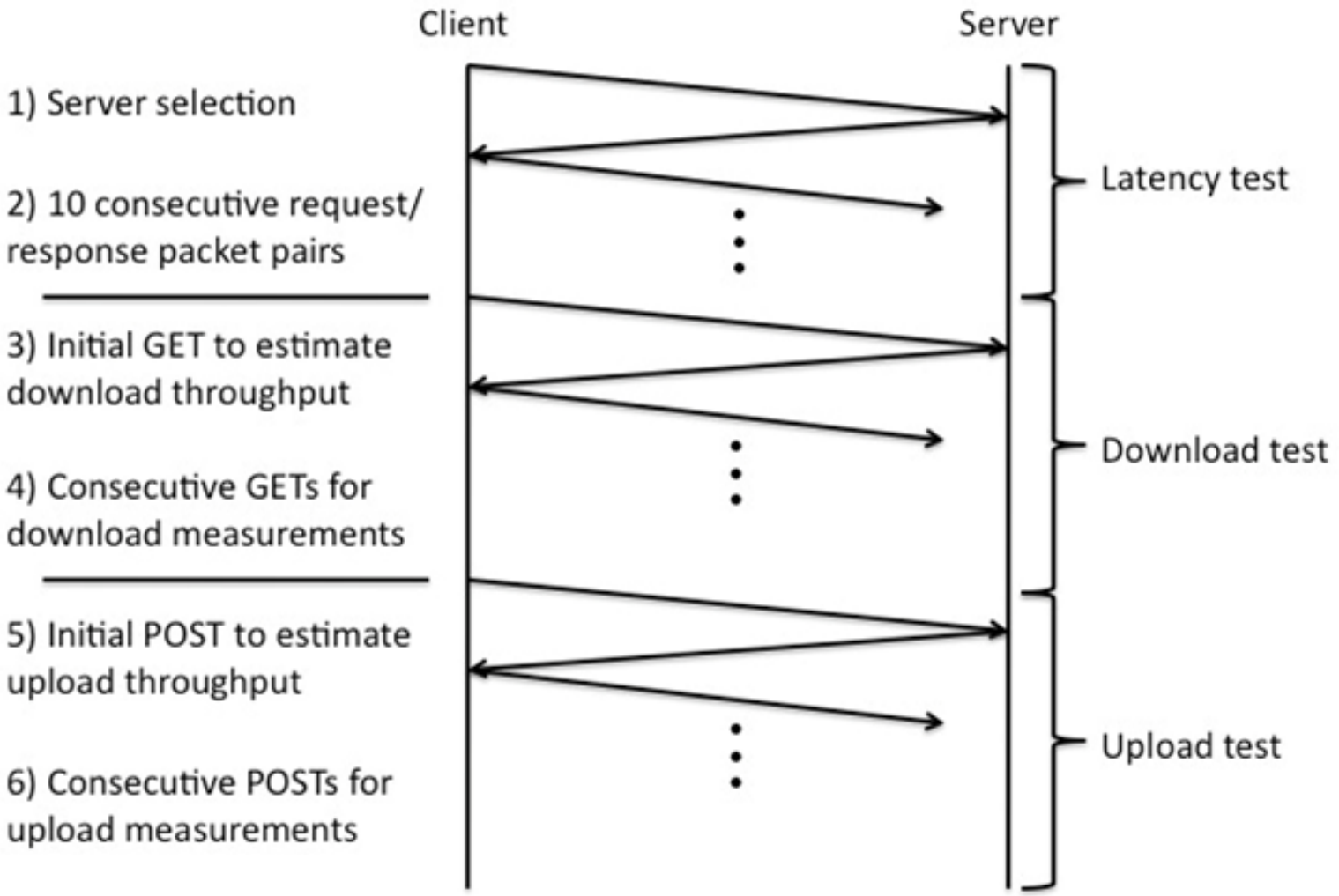
- This is the only reward an ISP gets
- “Gets” to donate tons of bits/transit, too

Science + Cats = Speedtest.net

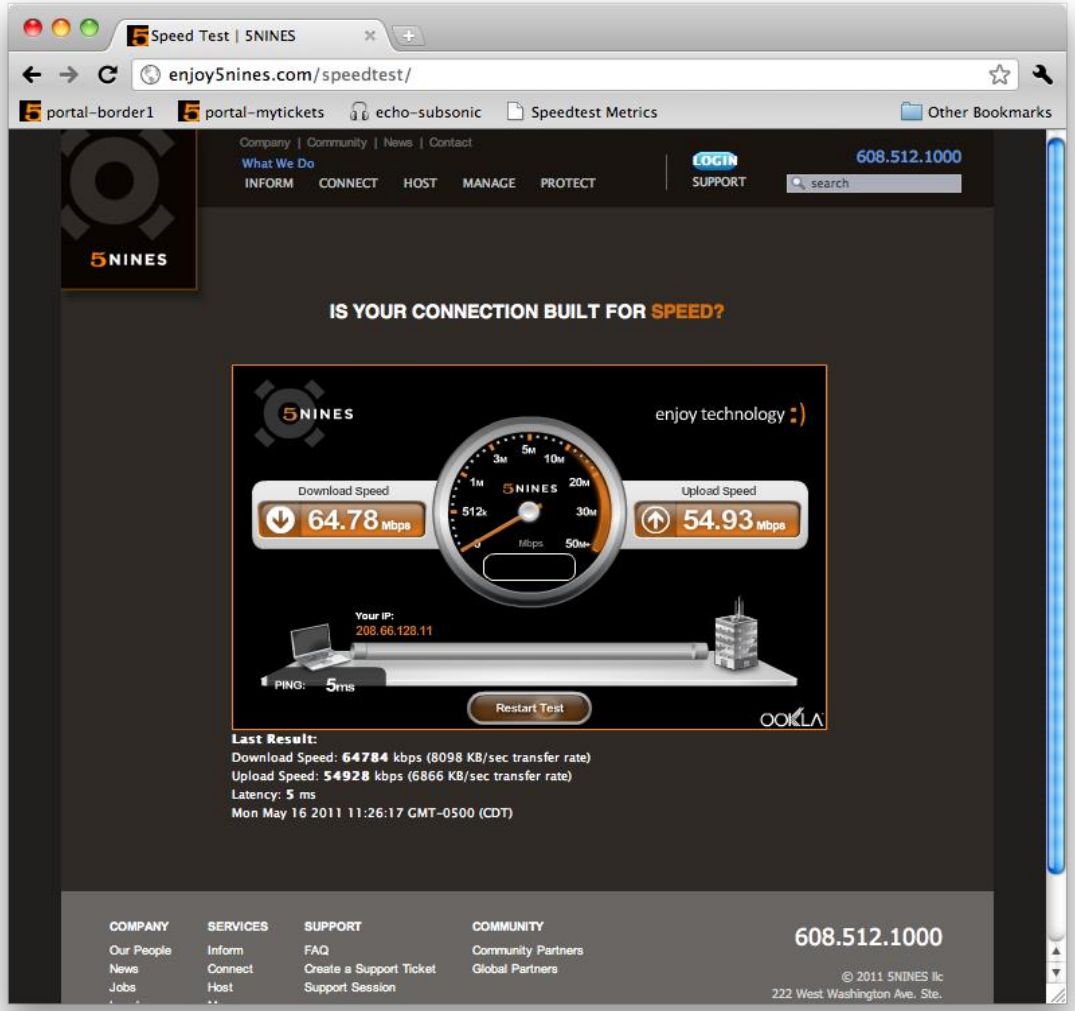
iOS easter egg

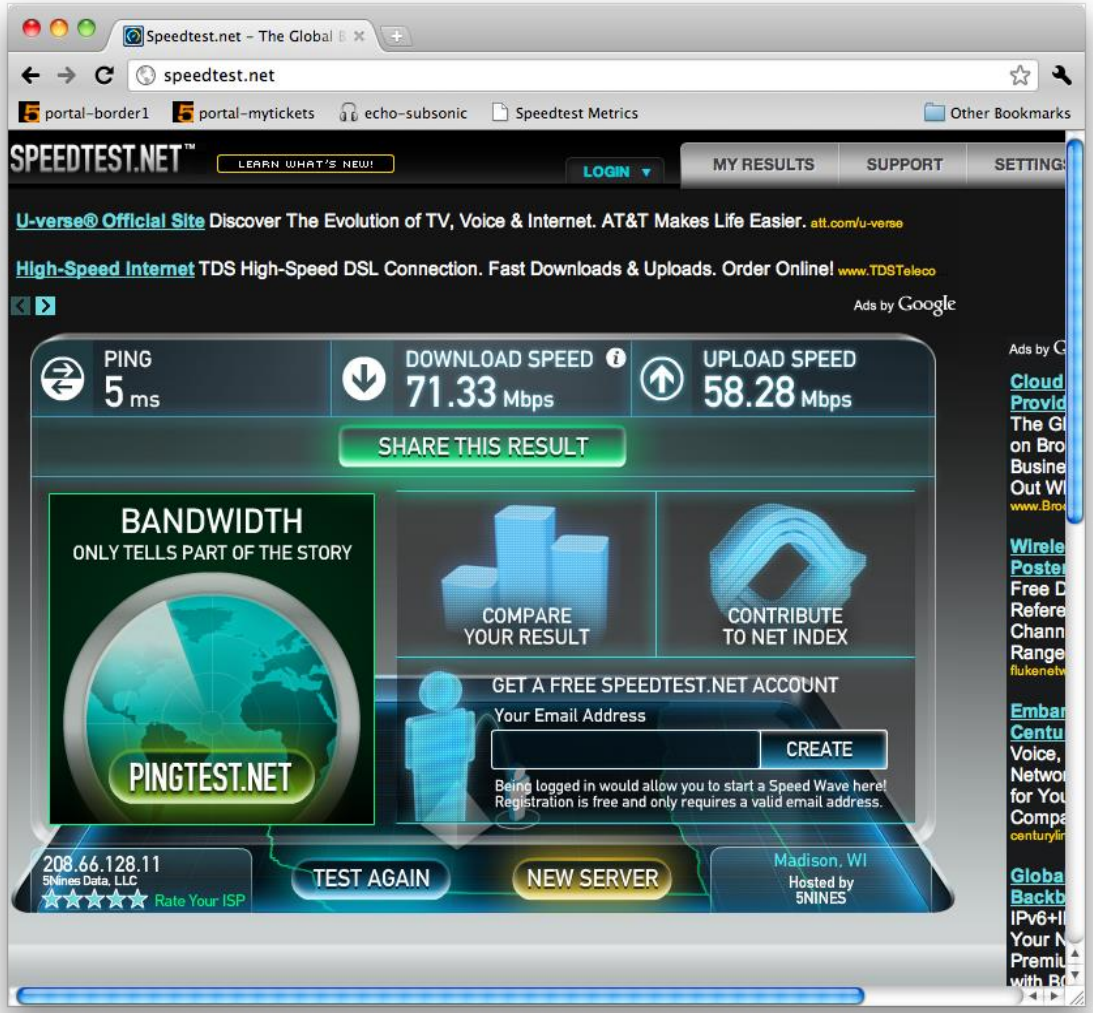


Speedtest.net Methodology



Speedtest.net Web UI





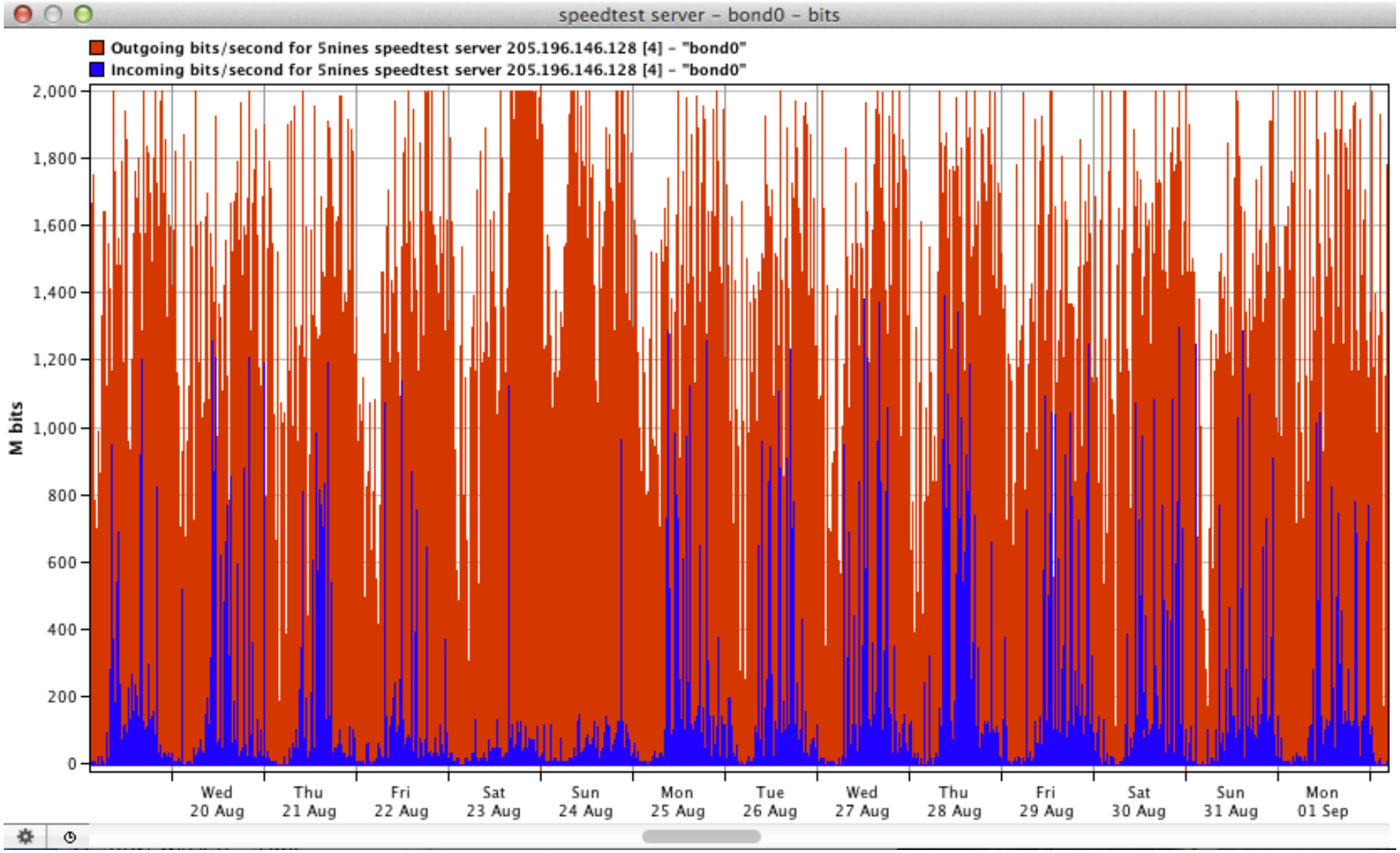
5NINES Madison Speed Test Host

Low Spec Sever is all we need!

- ~10 year old Dell PE750, no joke
  - Turns out DMA and MSI to Gige chips isn't any faster on newer boxes
- No Storage i/o involved (use SSD's anyway)
- Dual gige in LACP bundle, L3+4 TX hash
  - Supported in 5NINES sandbox, direct access to transit border routers & peering
- Speedtest native POSIX binary + apache&php handles all test traffic
- Haven't observed system load >0.1, ever

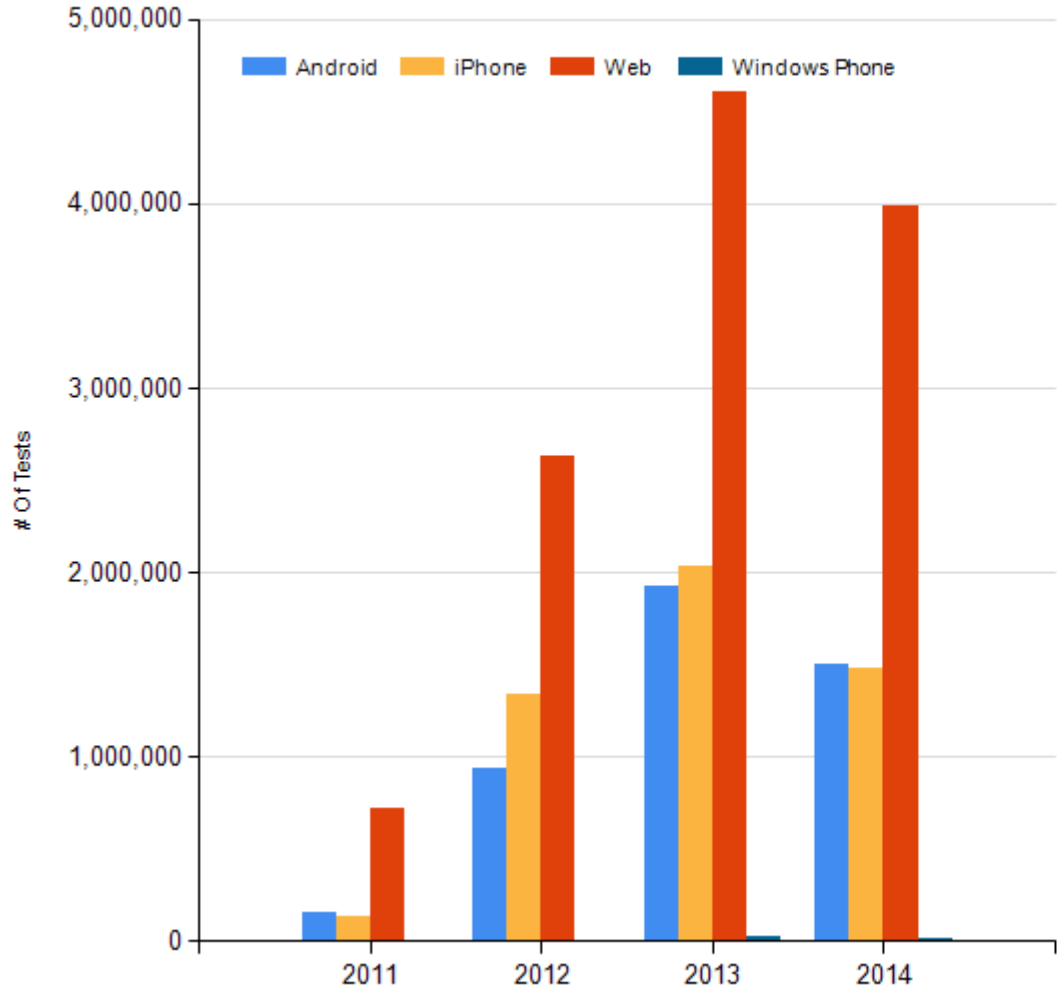

```
Host Resources General Information
  System Uptime:  6 days, 0 hrs, 38 mins, 29 secs
  System Date:  2014-11-18, 15:40:37.00, -6:00
  Number of User Sessions:  0
  Number of Processes Loaded/Running:  77
  Installed Memory:  4024980 KB
  Description: Linux speedtest-msn 3.2.0-4-686-pae #1 SMP Debian 3.2.63-2+deb7u1 i686
Host Resources Storage Table Information
  Index       Used (MB)       Size (MB)  % Full    Fail  Descr.
    1             483           3,930      12       0  Physical memory
    3             483           7,067       6       0  Virtual memory
    6               0           3,930       0       0  Memory buffers
    7             394             394     100       0  Cached memory
    8               0               0       0       0  Shared memory
   10               0           3,136       0       0  Swap space
   31               0              10       0       0  /dev
   32           1,265          73,144       1       0  /
Host Resources Processor Table Information
  Index Load
  768    1%
  769    1%
UCD-SNMP Load Table Information
  Index Type      Load
    1  Load-1    0.00
    2  Load-5    0.01
    3  Load-15   0.05
UCD-SNMP System Stats CPU Information
  CPU Utilization: 0%
UCD-SNMP Memory Information
  Swap (KB): Total:     3,212,284  Used:            0 (0%)
  Real (KB): Total:     4,024,980  Used:       90,900 (2%)
  Total Shared  :             0 KB
  Total Buffered:           976 KB
  Total Cached  :       403,660 KB
```

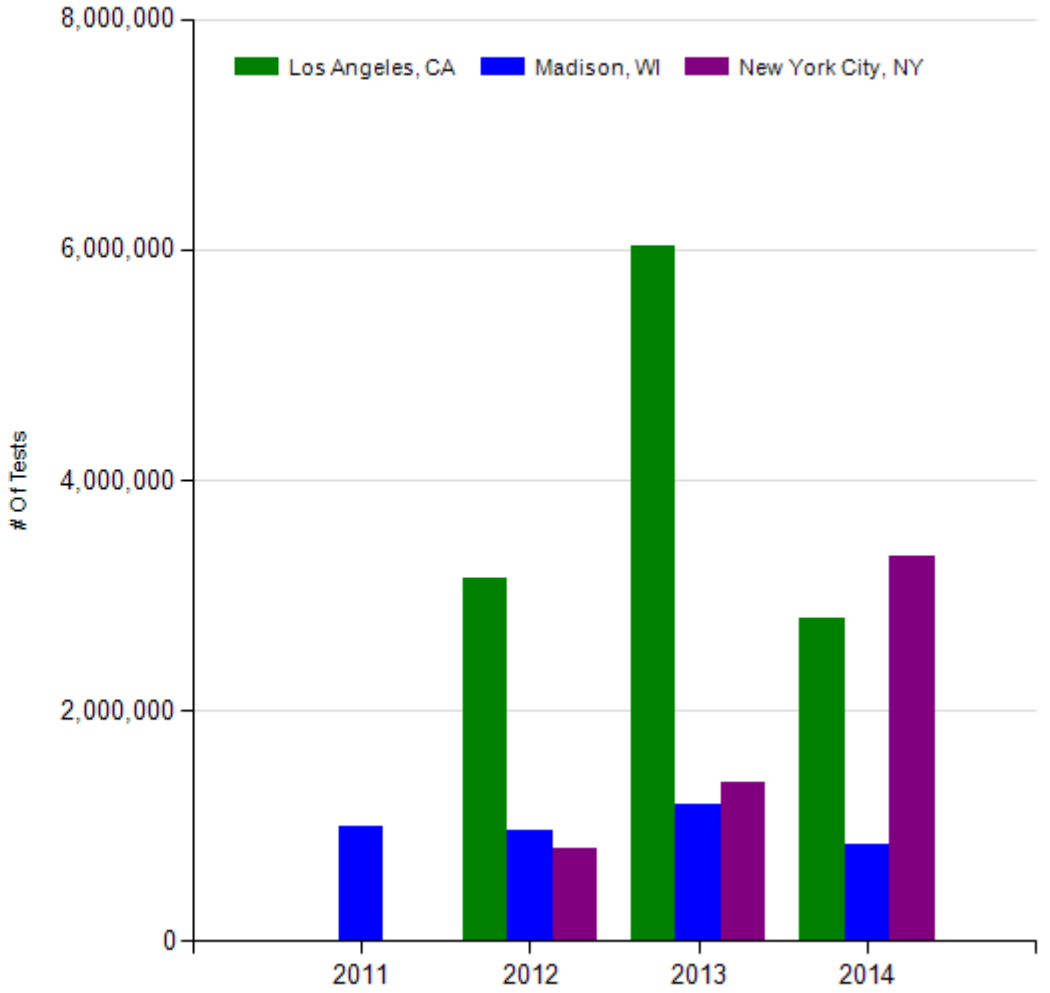
Transit is cheap, right?



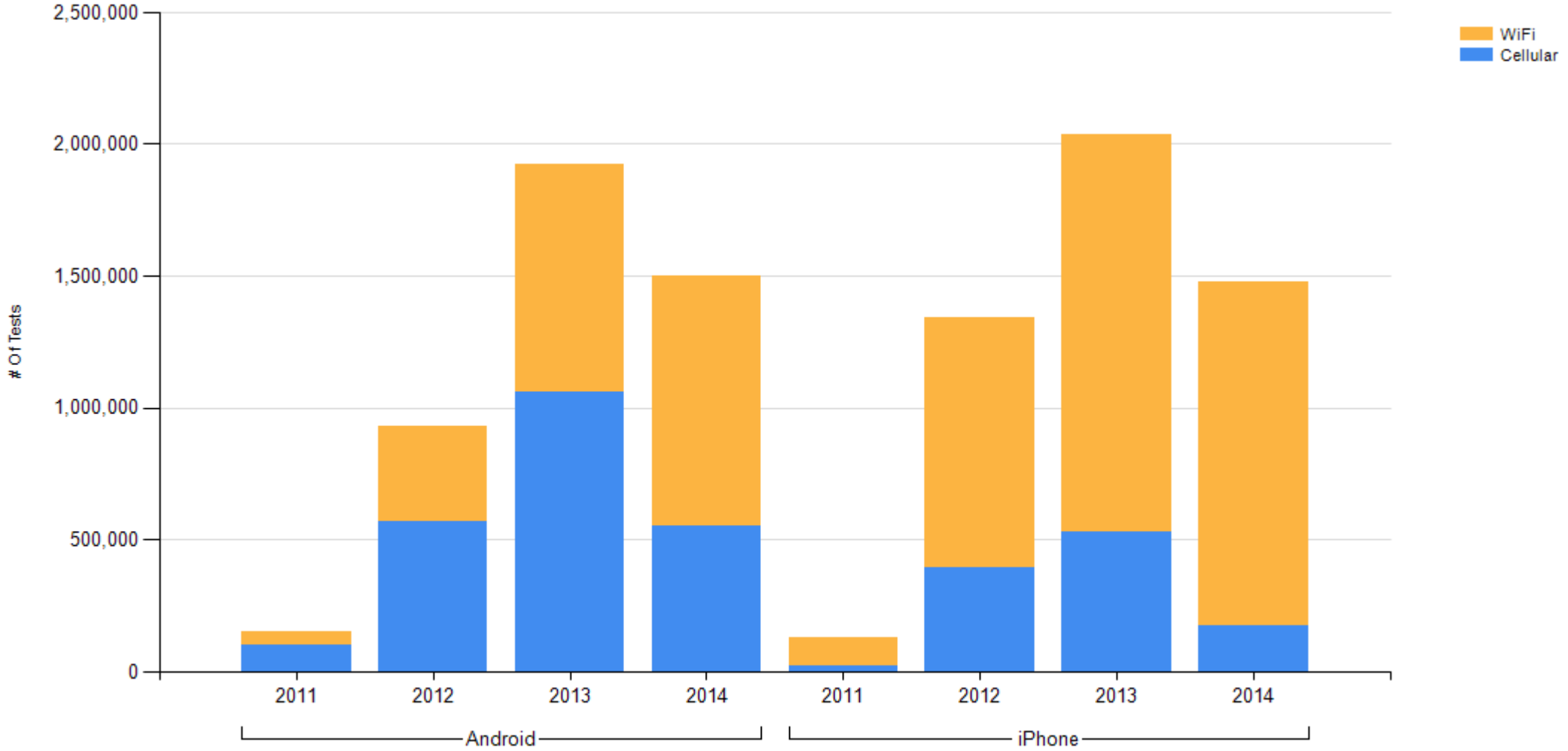
Total Test Counts

Total # Of Tests: 21,455,027

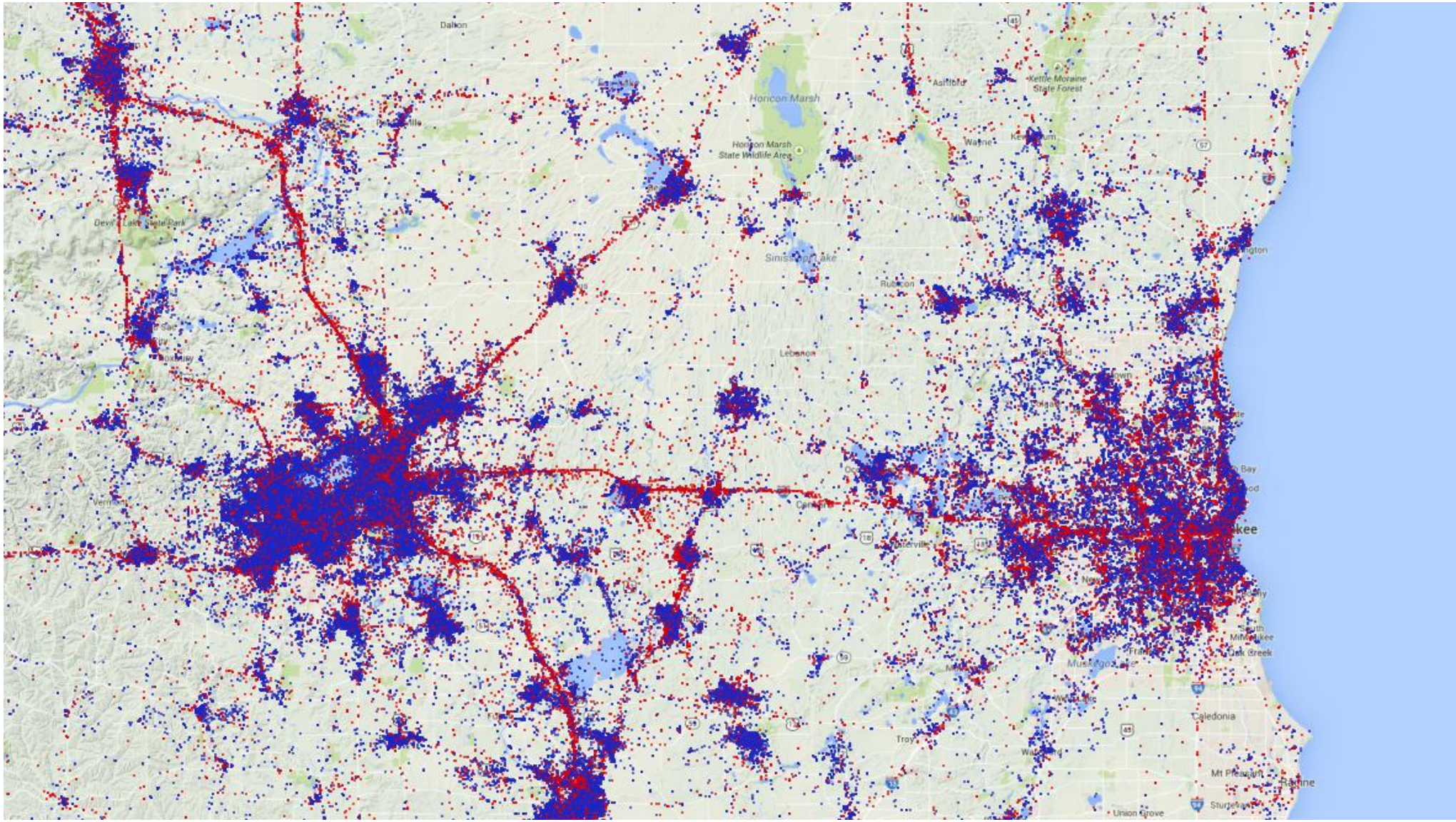




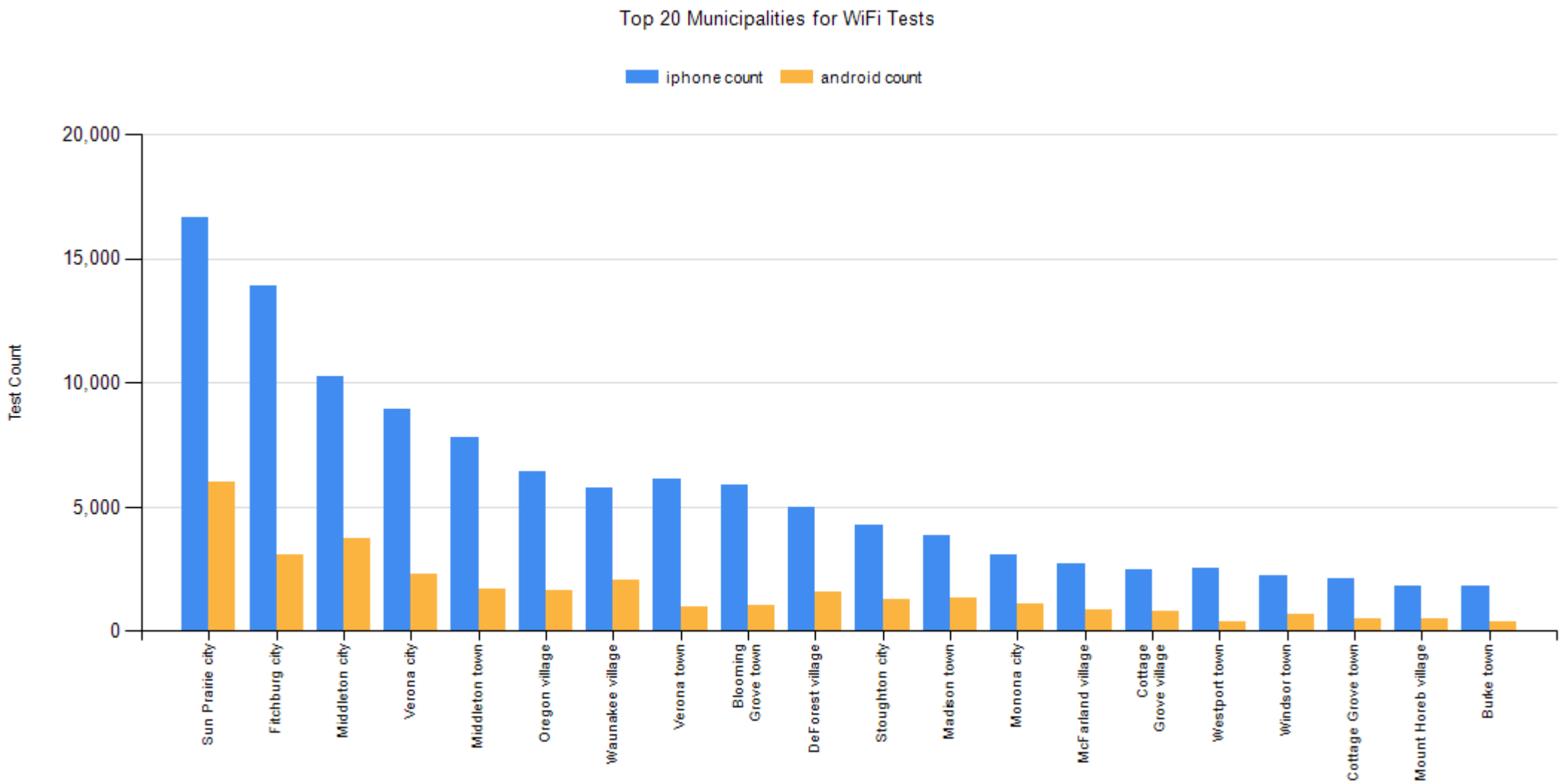
Goodbye Web+Windows Phone



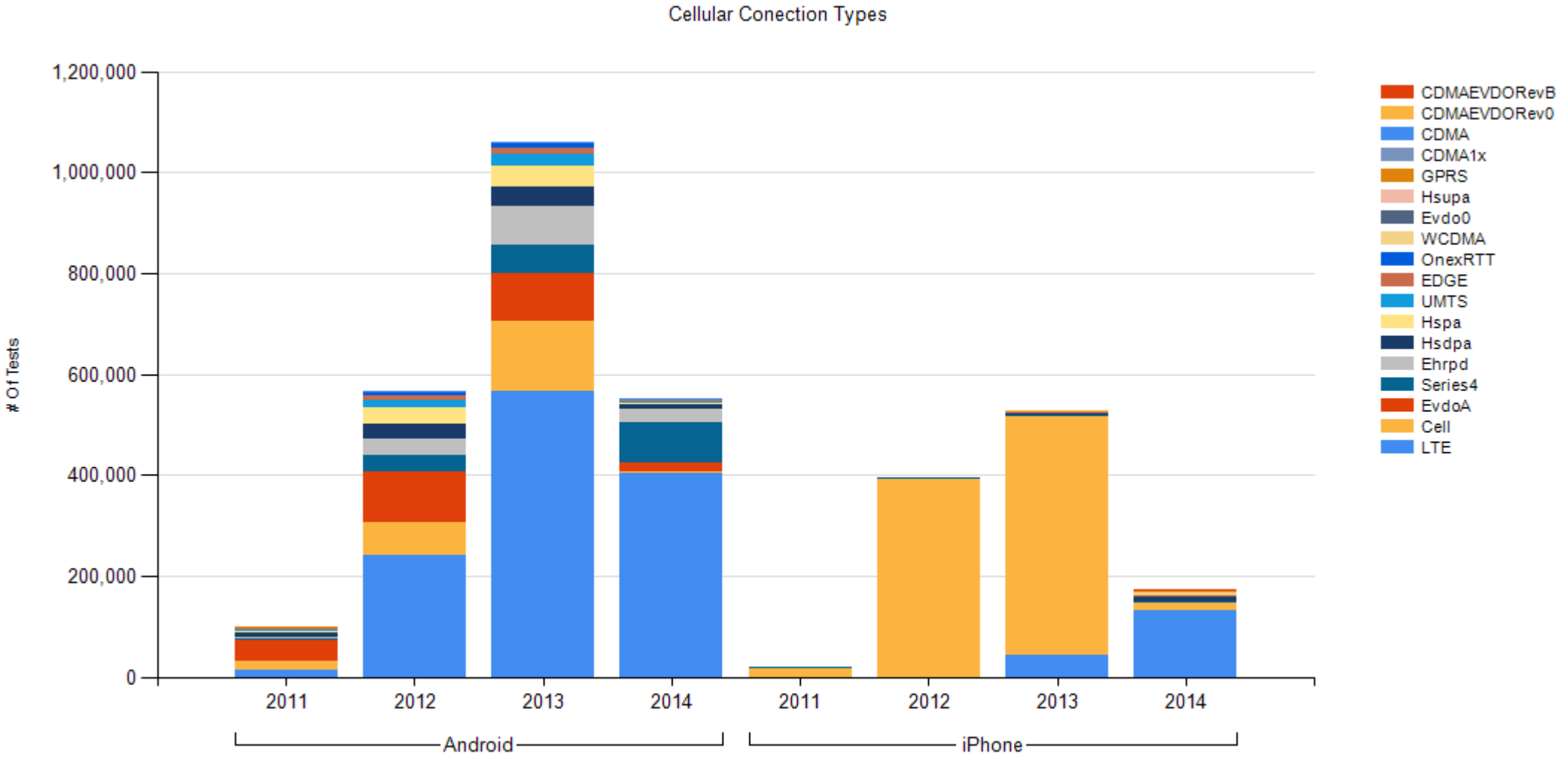
Where's the WiFi?



http://myjimmycloud.com/qgiswebclient.html?map=/home/jimmy/qgis/projects/towns2.qgs



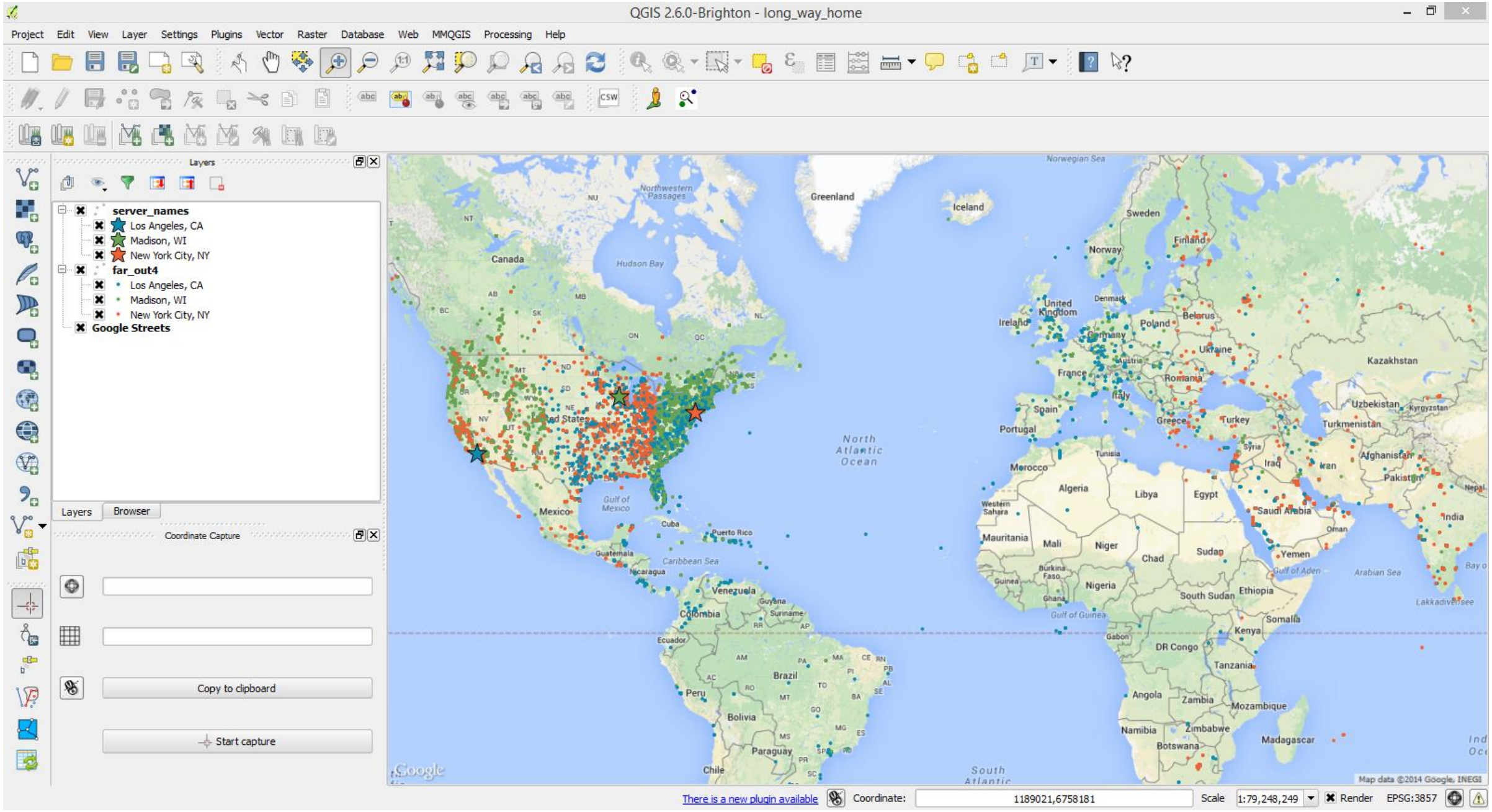
Goodbye WiFi



Take the long way home…

http://myjimmycloud.com/qgiswebclient.html?map=/home/jimmy/qgis/projects/long_way_home.qgs

```
WHERE server_name LIKE 'Madison, WI'
AND
(
        ST_Distance(geom, ST_GeomFromText('POINT(-89.4000 43.0667)', 4326)) >
        ST_Distance(geom, ST_GeomFromText('POINT(-74.0059 40.7127)', 4326))
        OR
        ST_Distance(geom, ST_GeomFromText('POINT(-89.4000 43.0667)', 4326)) >
        ST_Distance(geom, ST_GeomFromText('POINT(-118.2500 34.0500)', 4326))
)
```

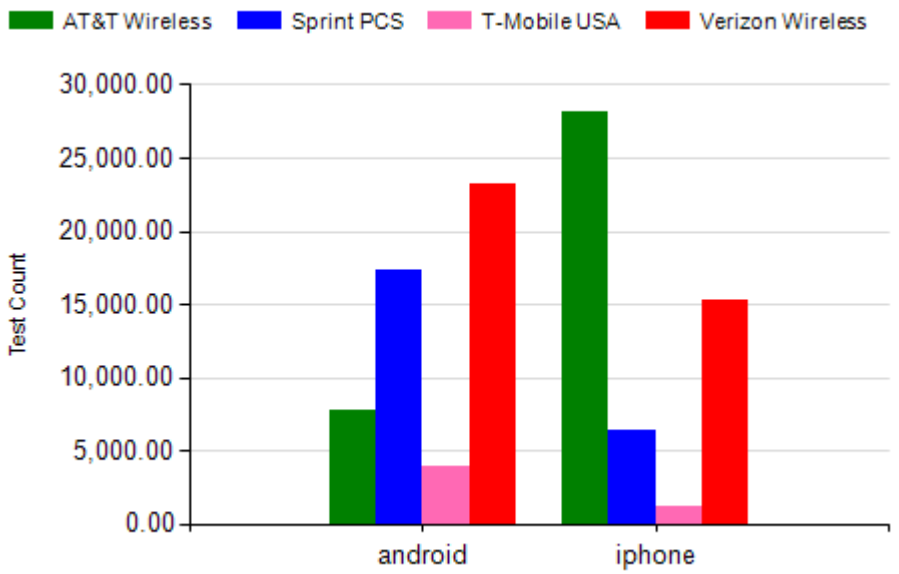

QGIS 2.6.0-Brighton - long_way_home
Project Edit View Layer Settings Plugins Vector Raster Database Web MMQGIS Processing Help
Layers
server_names
Los Angeles, CA
Madison, WI
New York City, NY
far_out4
Los Angeles, CA
Madison, WI
New York City, NY
Google Streets
Layers
Browser
Coordinate Capture
Copy to clipboard
Start capture
Canada
Greenland
Iceland
Norway
Sweden
Finland
United Kingdom
Ireland
Poland
Belarus
Ukraine
Kazakhstan
France
Spain
Portugal
Italy
Greece
Turkey
Uzbekistan
Turkmenistan
Afghanistan
Pakistan
Iraq
Iran
Syria
Morocco
Algeria
Libya
Egypt
Saudi Arabia
India
Mexico
Cuba
Puerto Rico
Guatemala
Nicaragua
Venezuela
Colombia
Ecuador
Peru
Brazil
Bolivia
Paraguay
Chile
Mauritania
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
South Sudan
Somalia
Kenya
DR Congo
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Botswana
Madagascar
North Atlantic Ocean
South Atlantic
Arabian Sea
Gulf of Mexico
Caribbean Sea
Gulf of Aden
Gulf of Guinea
Hudson Bay
Northwestern Passages
Norwegian Sea
Google
Map data ©2014 Google, INEGI
There is a new plugin available
Coordinate:
1189021,6758181
Scale
1:79,248,249
Render
EPSG:3857

Cleanup + Dane County + “Big 4”

```
WHERE connection_type NOT LIKE 'WiFi'
AND connection_type IS NOT NULL
AND download_kbps > 0
AND upload_kbps > 0
AND latency > 0
```

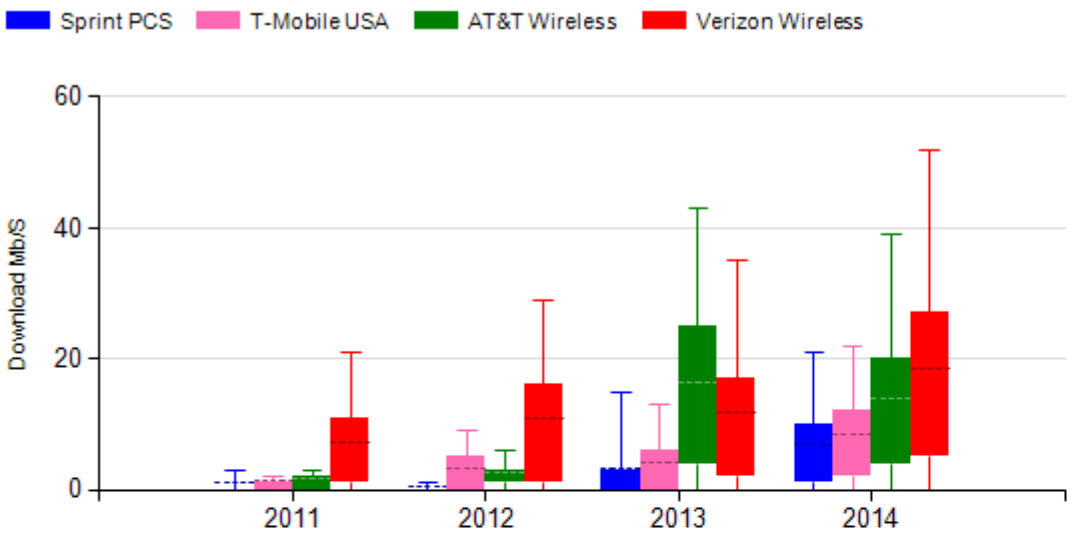
Device	Dirty	Clean	%Error
iPhone	1116912	1106573	0.934326068
Android	2107640	2106552	0.051648381

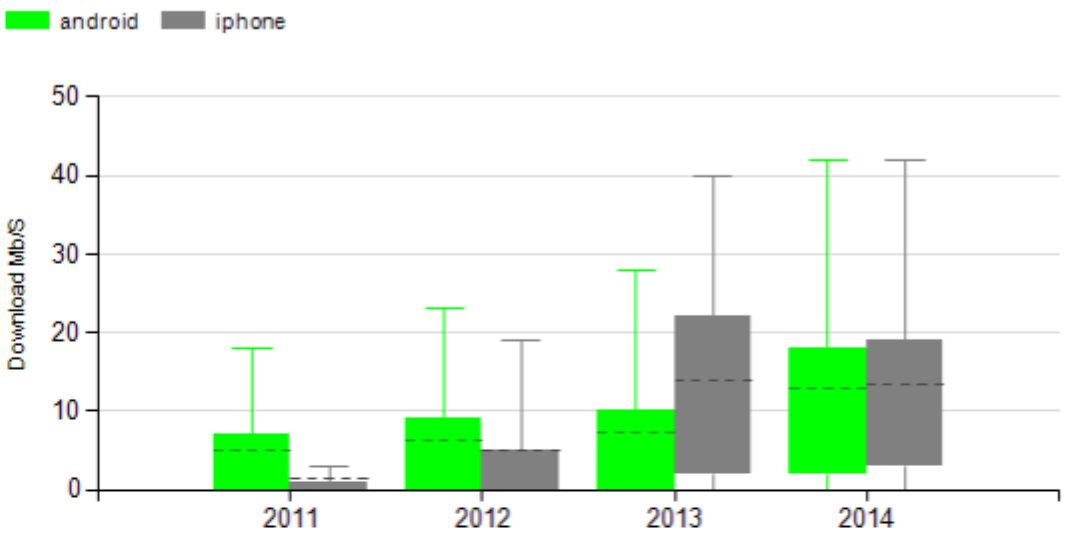
```
    SELECT
    client_ip, isp, server_name, connection_type,
    download_kbps, upload_kbps, latency,
    test_date AT TIME ZONE 'UTC' AS test_date,
    geom, 'iphone' AS device, latitude, longitude
    FROM geo_iphone
    WHERE
    test_date AT TIME ZONE 'UTC' BETWEEN '2011-03-01' AND '2014-11-01'
AND longitude BETWEEN -89.85 AND -89.00
AND latitude BETWEEN 42.85 AND 43.3
AND connection_type NOT LIKE 'WiFi'
AND connection_type IS NOT NULL
AND download_kbps > 0
AND upload_kbps > 0
AND latency > 0
  AND (
  isp LIKE 'AT&T Wireless' OR
  isp LIKE 'Verizon Wireless' OR
  isp LIKE 'T-Mobile USA' OR
  isp LIKE 'Sprint PCS')
```

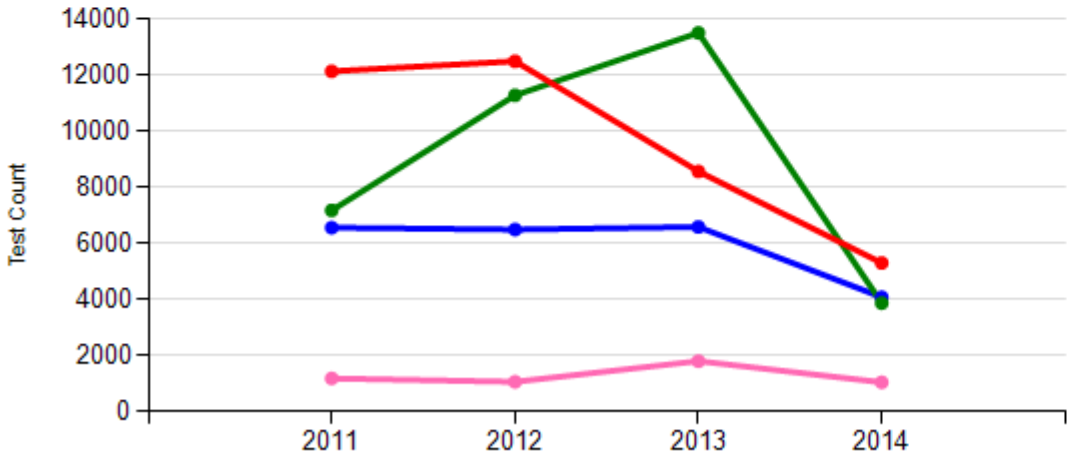


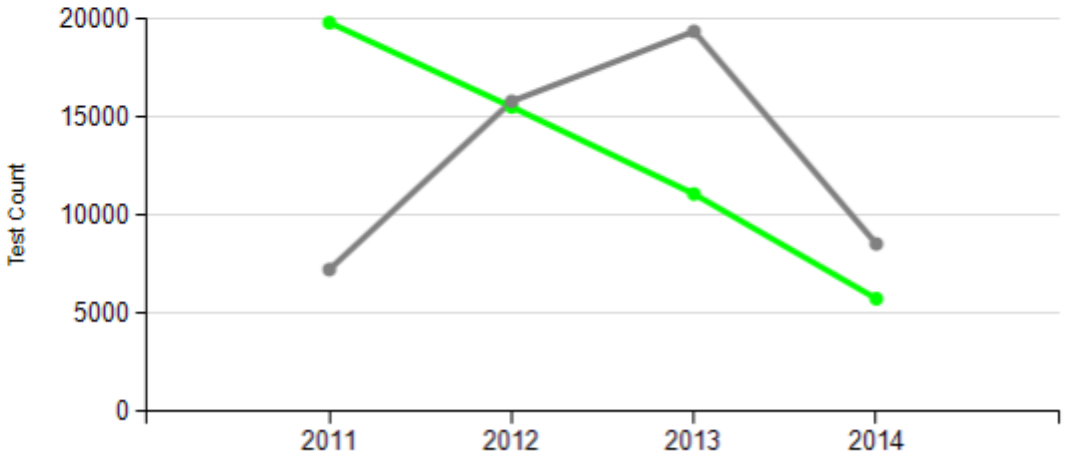
Total Tests: 103,183

Dane County


Sprint PCS
T-Mobile USA
AT&T Wireless
Verizon Wireless
Download Mb/S
60
40
20
0
2011
2012
2013
2014


android
iphone
Download Mb/S
50
40
30
20
10
0
2011
2012
2013
2014


Test Count
14000
12000
10000
8000
6000
4000
2000
0
2011
2012
2013
2014


Test Count
20000
15000
10000
5000
0
2011
2012
2013
2014

VIDEOS!

Stats

- 33,480 tests
- 5/4/2011 - 10/31/2014 = 3.5 Years

Times

- AT&T @ 1/20/2013 ~ 11s
- Sprint @ 7/14/2013 ~ 14s
- iPhone @ 9/29/2013 ~ 15s
- T-Mobile @ 10/6/2014 ~ 16s

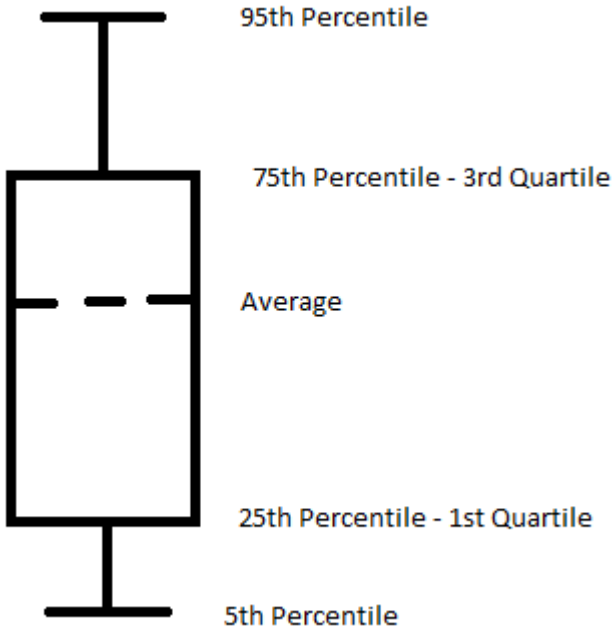
LTE Colors

- Attempt at density decay
- 1 Week step interval

Big4 2x2 LTE

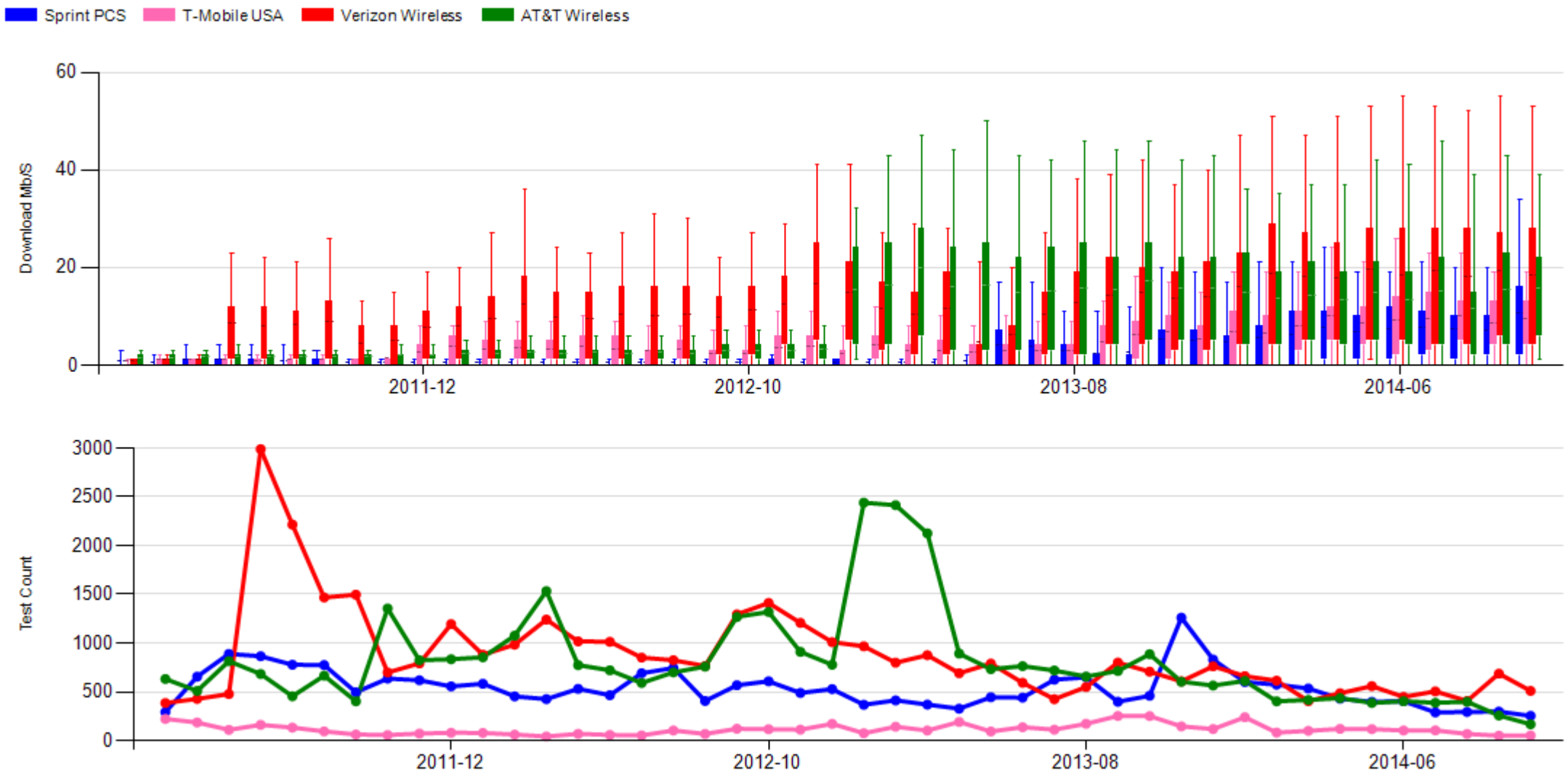
- No decay
- %90 Transparent dots

Box and Whisker Explanation

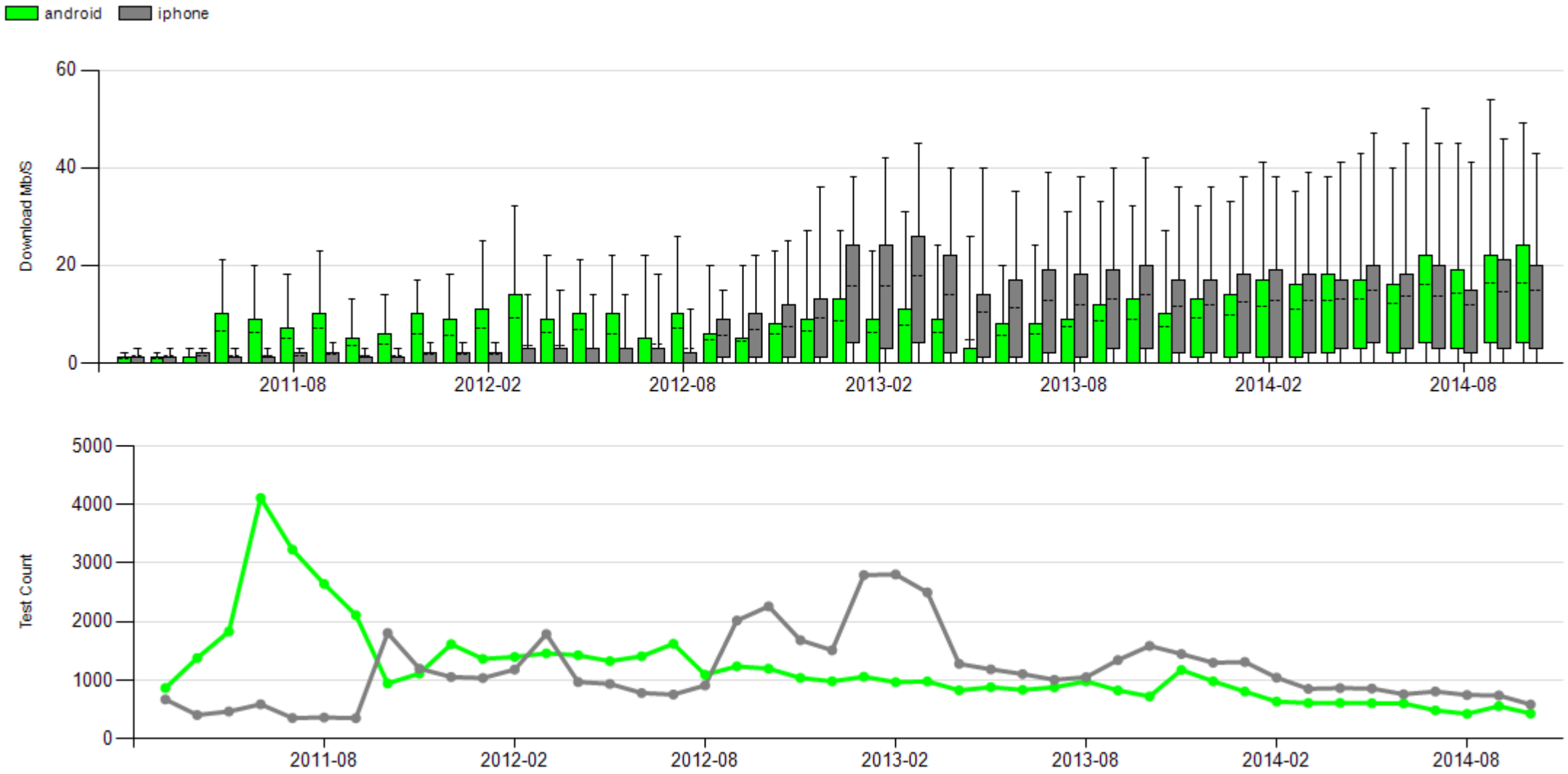



```
1  WITH percentiles AS
2  (
3  SELECT
4  isp, connection_type,
5  to_char(test_date, 'YYYY-mm') AS test_time,
6  download_kbps, upload_kbps, latency,
7  test_date, device,
8  ntile(20) over (partition by isp, to_char(test_date, 'YYYY-mm') order by download_kbps) AS percentile
9
10 FROM dane_mobile6
11 WHERE
12 test_date BETWEEN ? AND ?
13 )
14 SELECT
15 isp, test_time,
16 AVG(download_kbps)/1024 AS avg_dl,
17 MAX(CASE WHEN percentile=1 THEN download_kbps ELSE NULL END)/1024 AS min_dl,
18 MAX(CASE WHEN percentile=5 THEN download_kbps ELSE NULL END)/1024 AS low_dl,
19 MAX(CASE WHEN percentile=15 THEN download_kbps ELSE NULL END)/1024 AS high_dl,
20 MAX(CASE WHEN percentile=19 THEN download_kbps ELSE NULL END)/1024 AS max_dl,
21
22 MAX(CASE WHEN percentile=1 THEN upload_kbps ELSE NULL END)/1024 AS min_ul,
23 MAX(CASE WHEN percentile=5 THEN upload_kbps ELSE NULL END)/1024 AS low_ul,
24 MAX(CASE WHEN percentile=15 THEN upload_kbps ELSE NULL END)/1024 AS high_ul,
25 MAX(CASE WHEN percentile=19 THEN upload_kbps ELSE NULL END)/1024 AS max_ul,
26
27 MAX(CASE WHEN percentile=1 THEN latency ELSE NULL END)/1024 AS min_lat,
28 MAX(CASE WHEN percentile=5 THEN latency ELSE NULL END)/1024 AS low_lat,
29 MAX(CASE WHEN percentile=15 THEN latency ELSE NULL END)/1024 AS high_lat,
30 MAX(CASE WHEN percentile=19 THEN latency ELSE NULL END)/1024 AS max_lat,
31
32 count(*) AS count
33 FROM
34 percentiles
35 GROUP BY isp, test_time
36 ORDER BY test_time
```

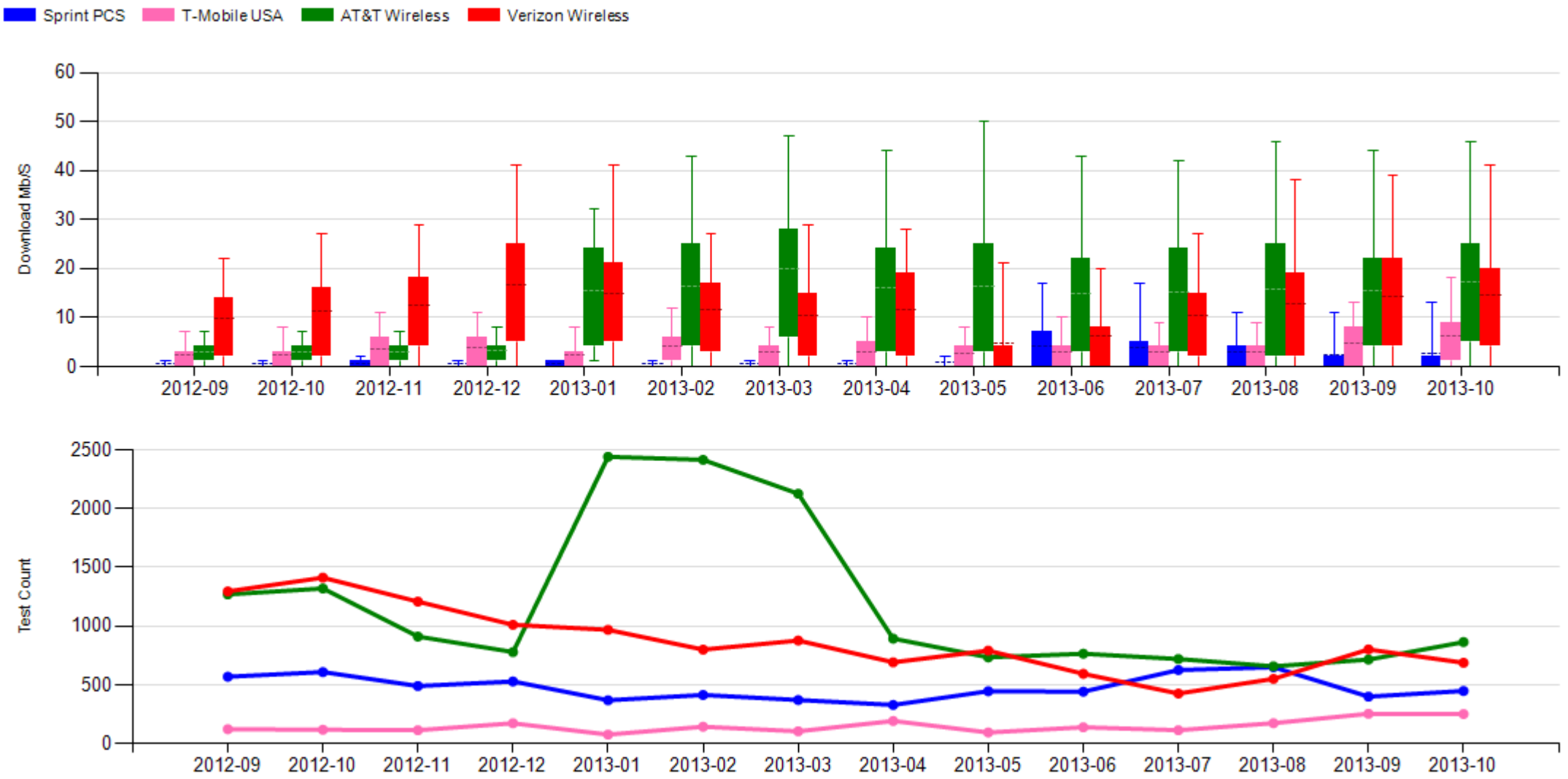
ISPs by Month



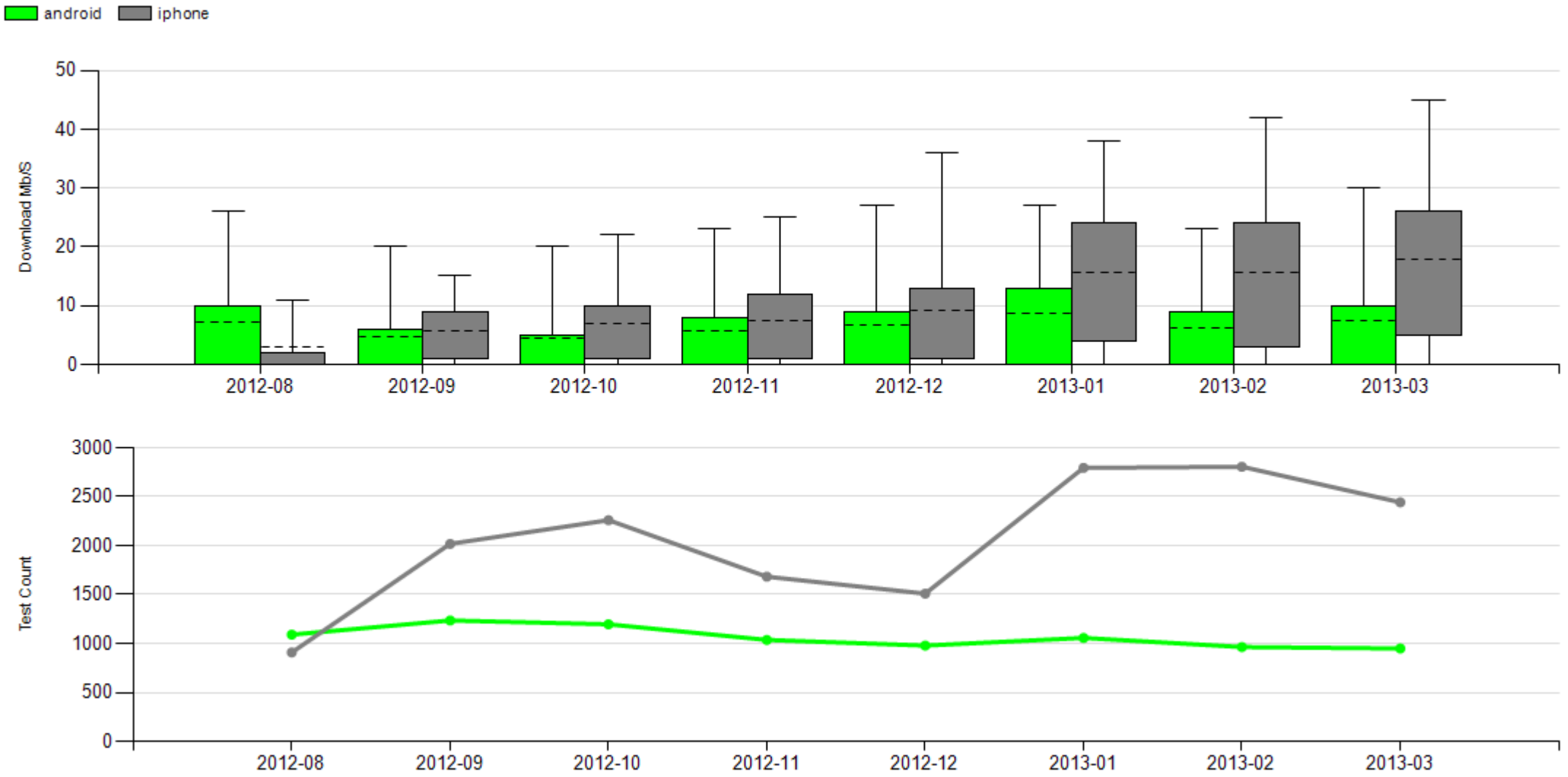
Device by Month



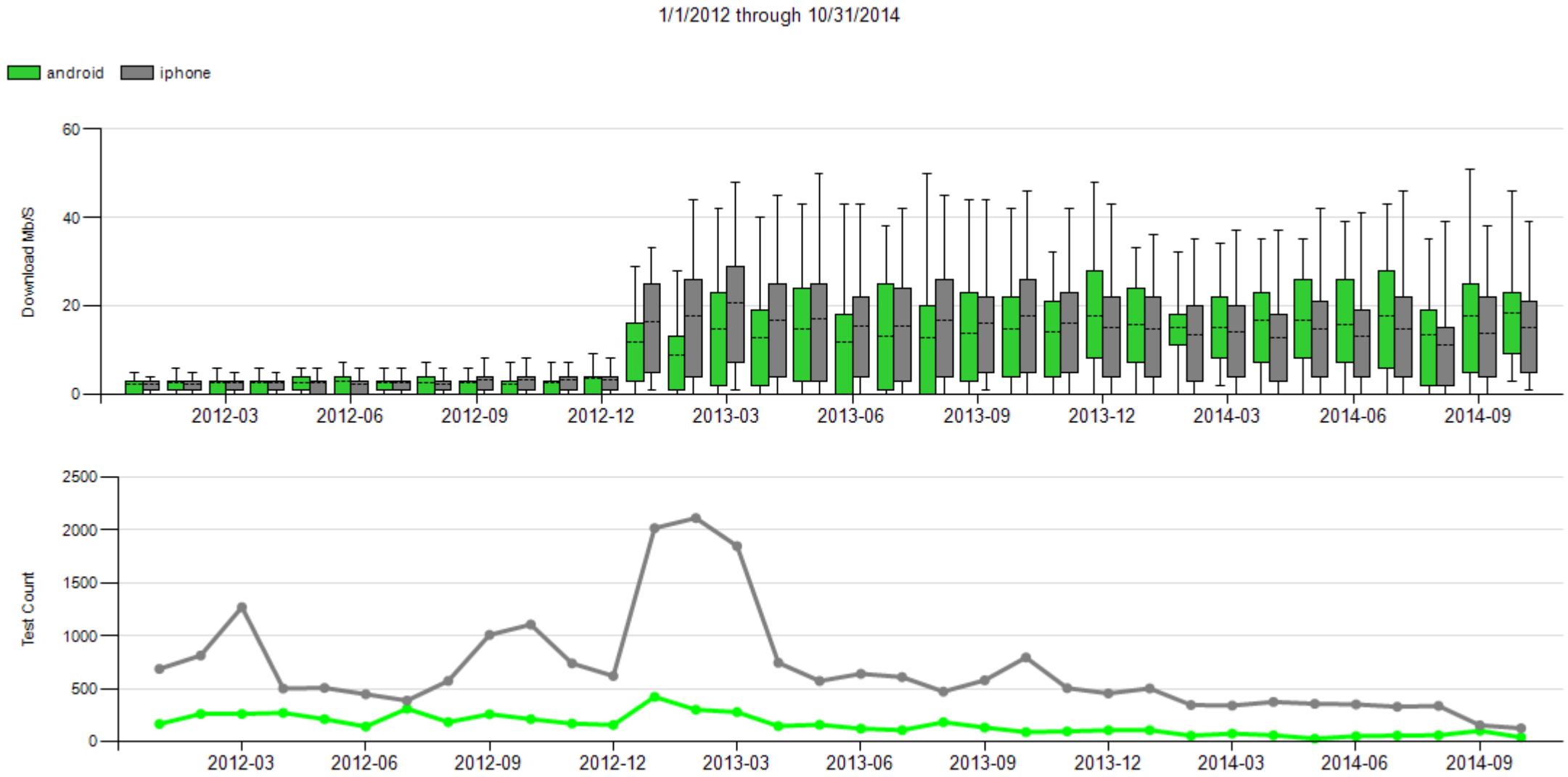
AT&T LTE Deployment or iPhone5?



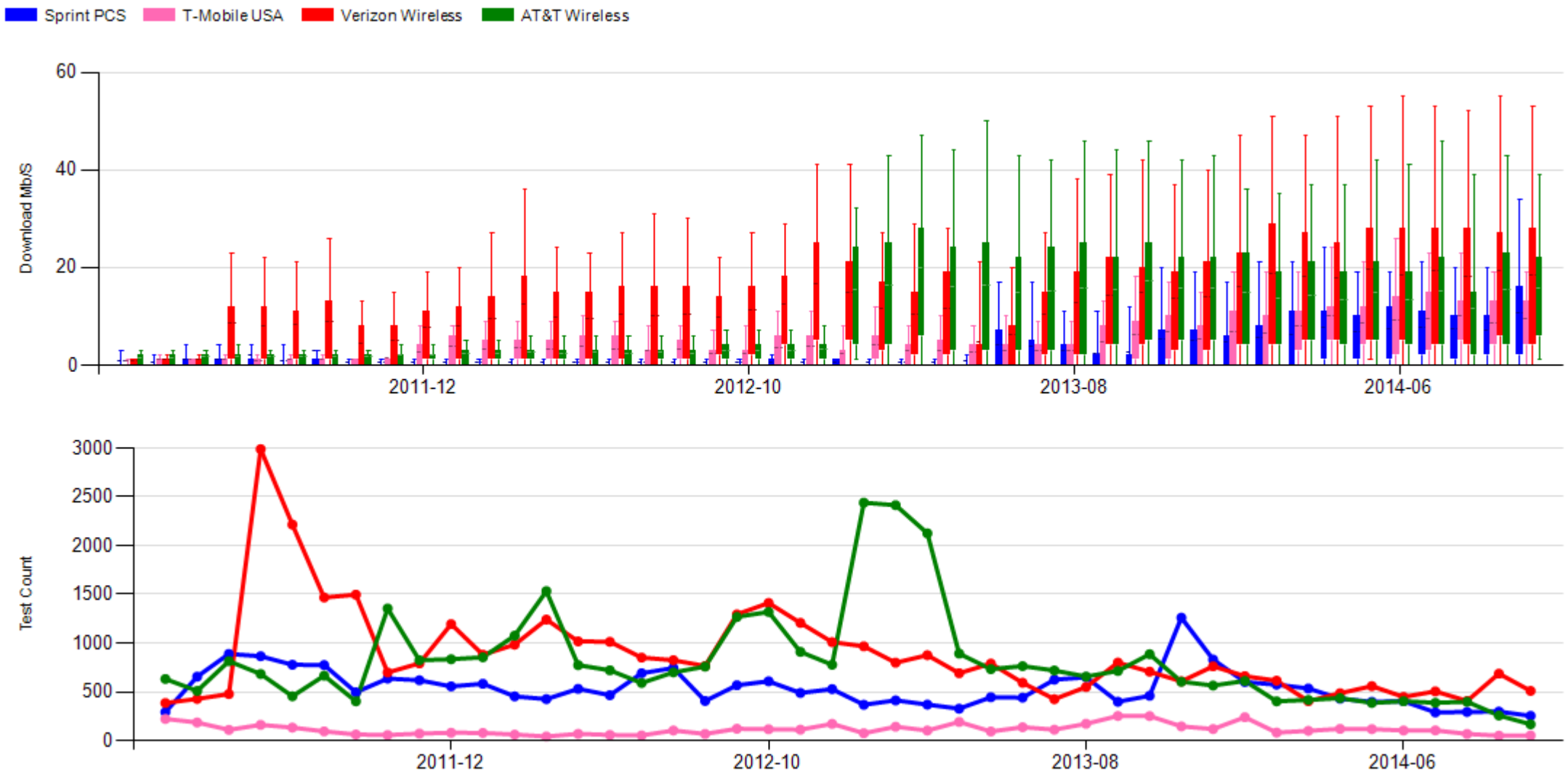
iPhone5? (September 21, 2012)



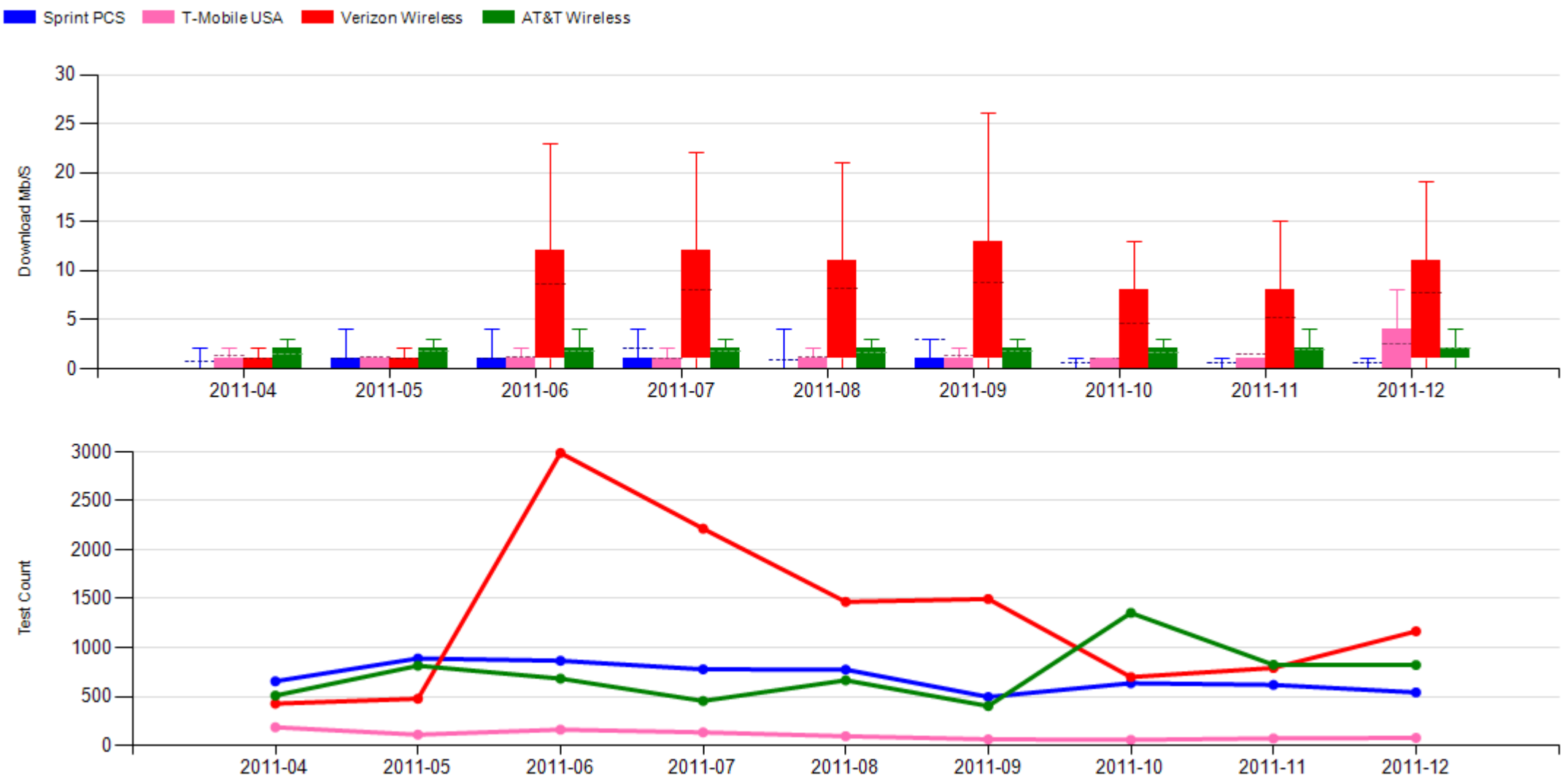
iPhone5 + AT&T LTE Deployment (AT&T Only)



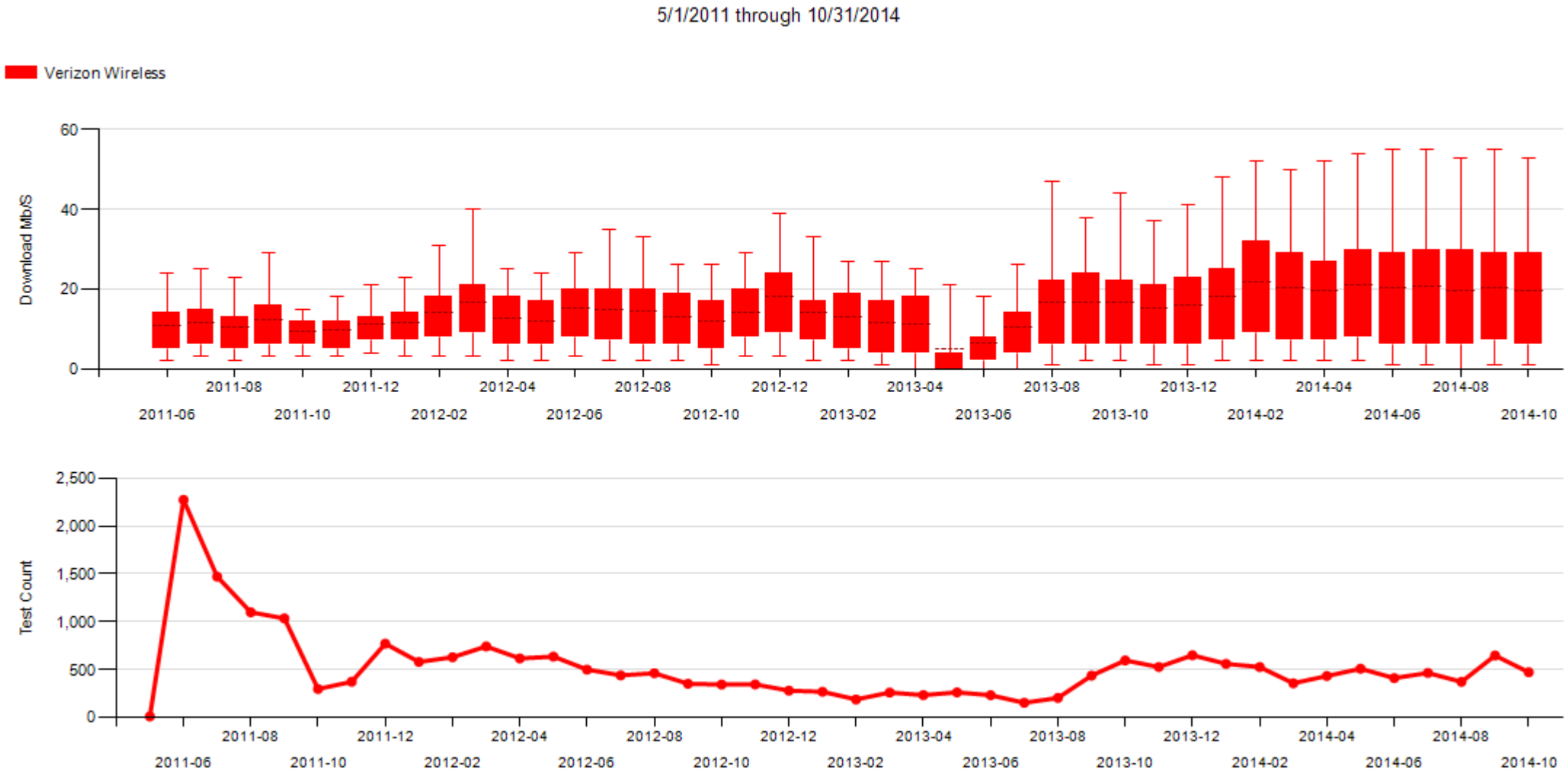
ISPs by Month (Again)



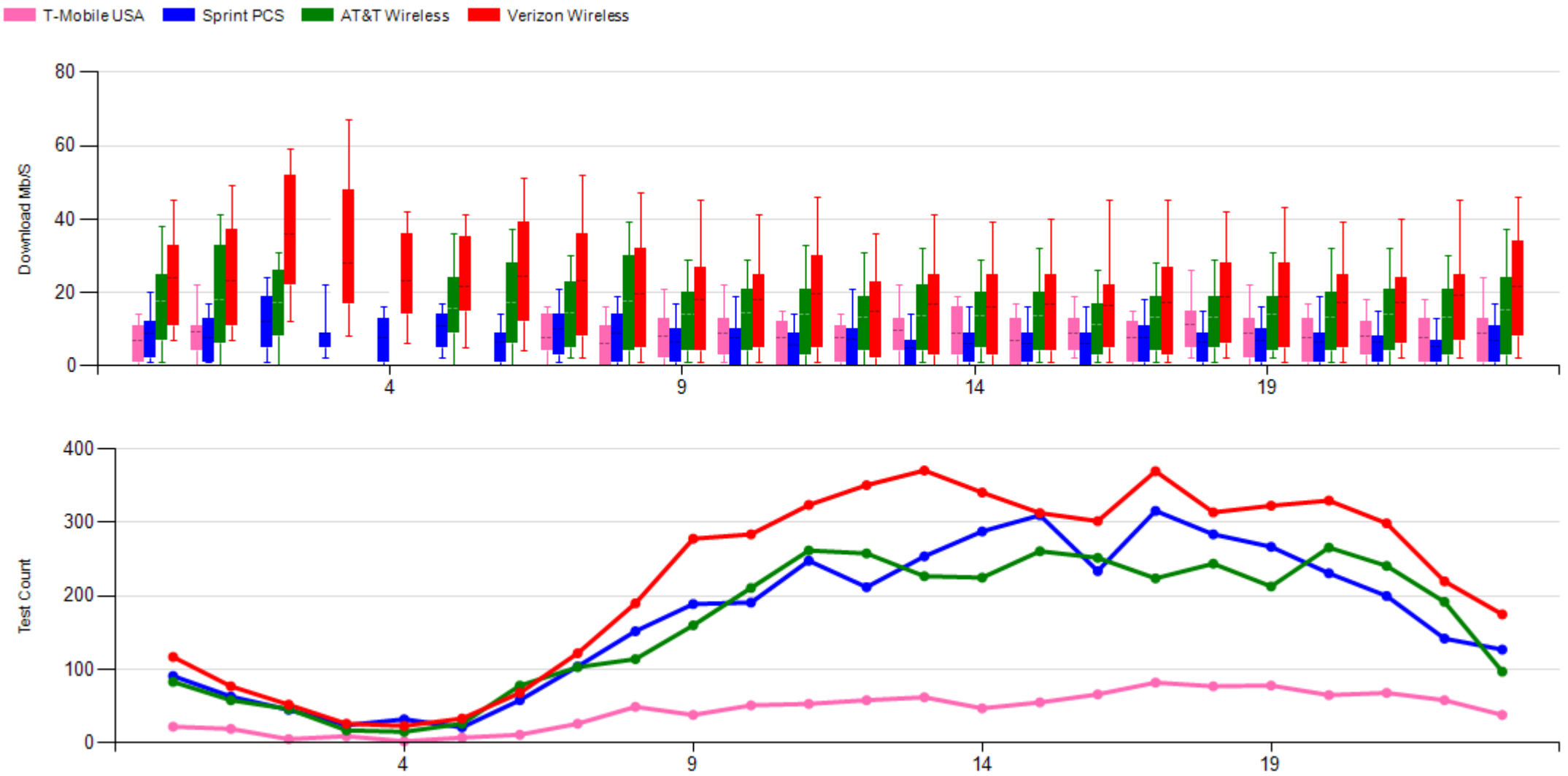
LTE Deployment or HTC Thunderbolt? (March 15, 2012)



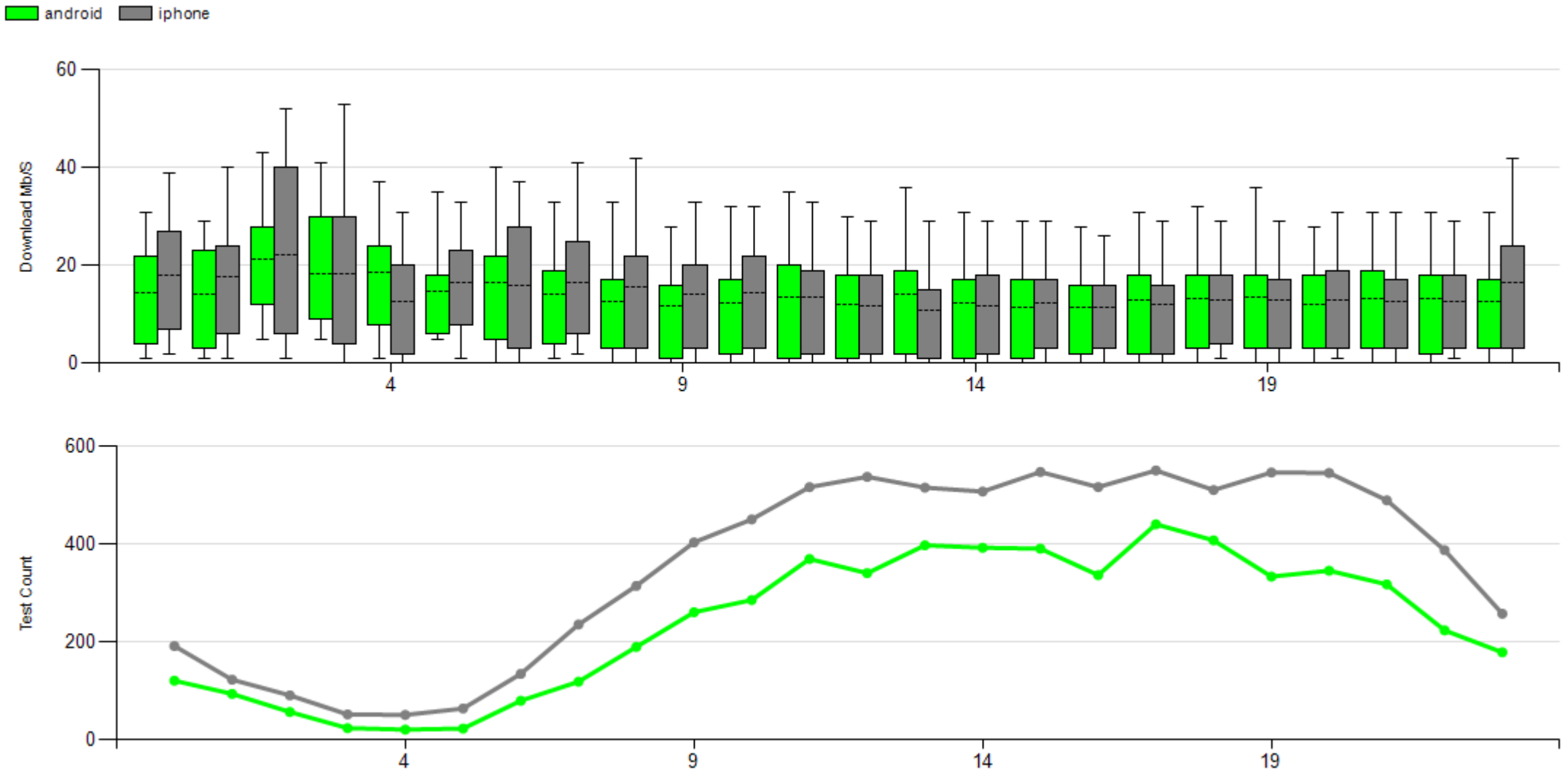
Verizon LTE Only



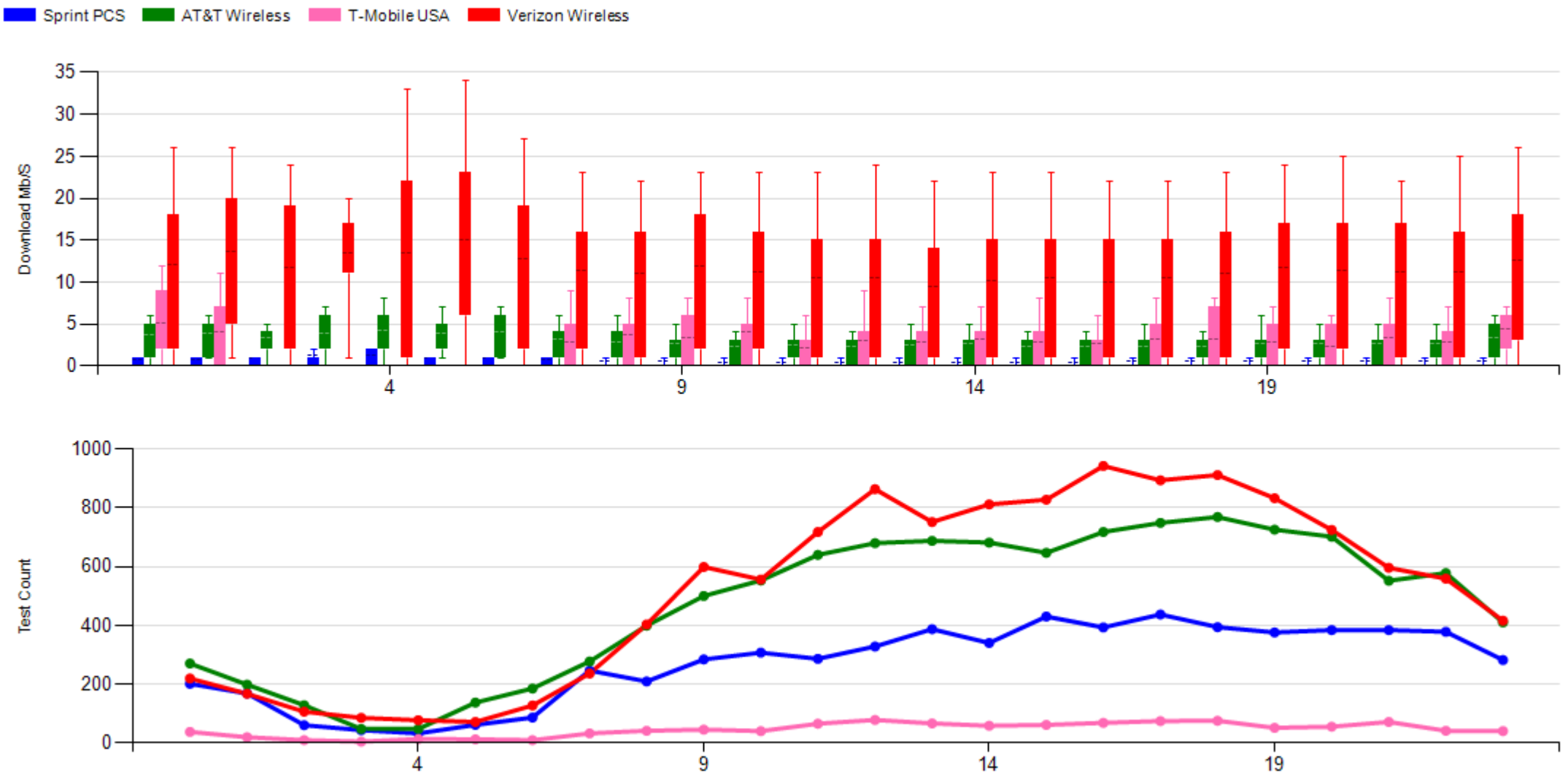
Time of Day (2014)



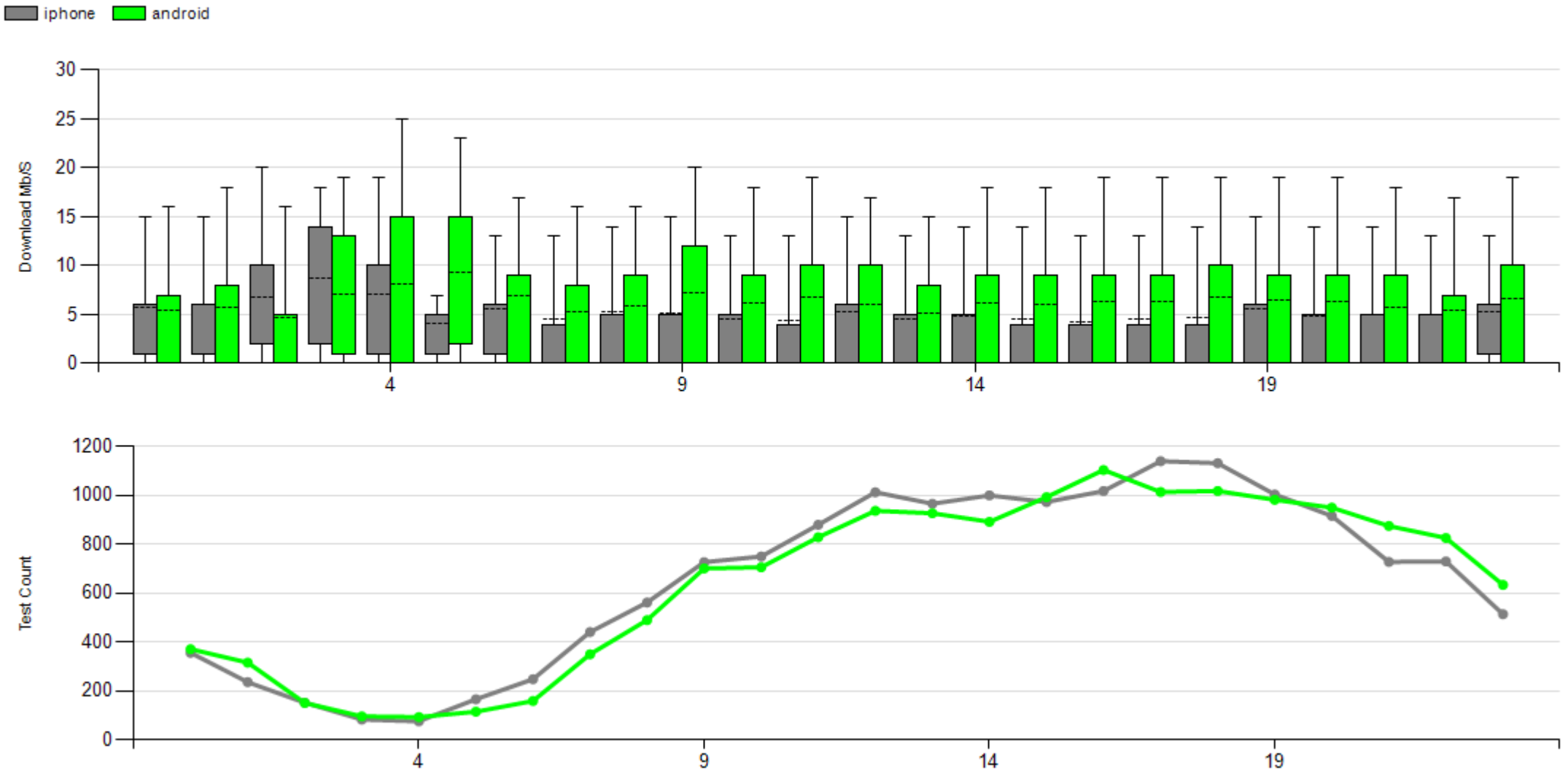
Time of Day (2014)



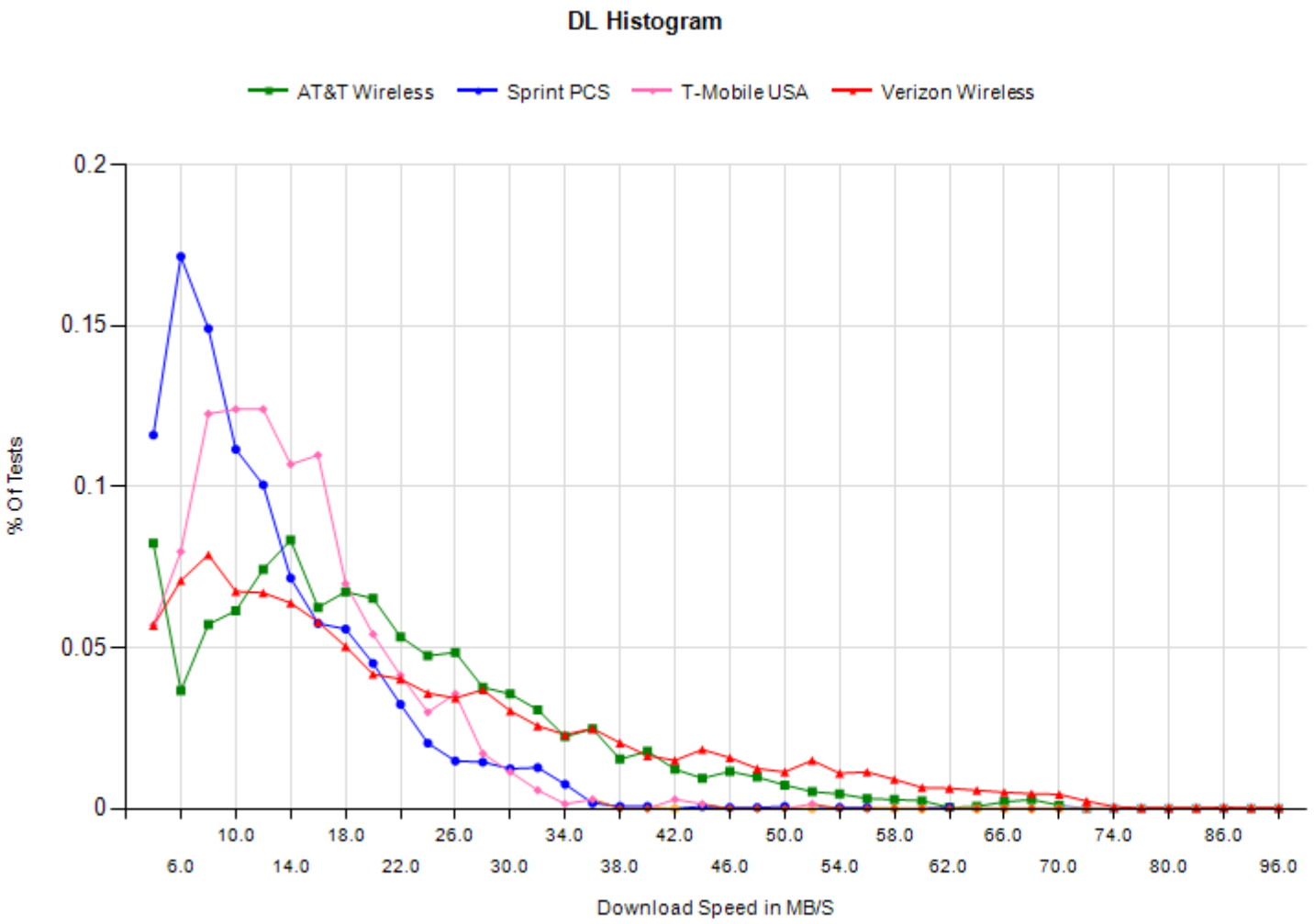
Time of Day (2012)

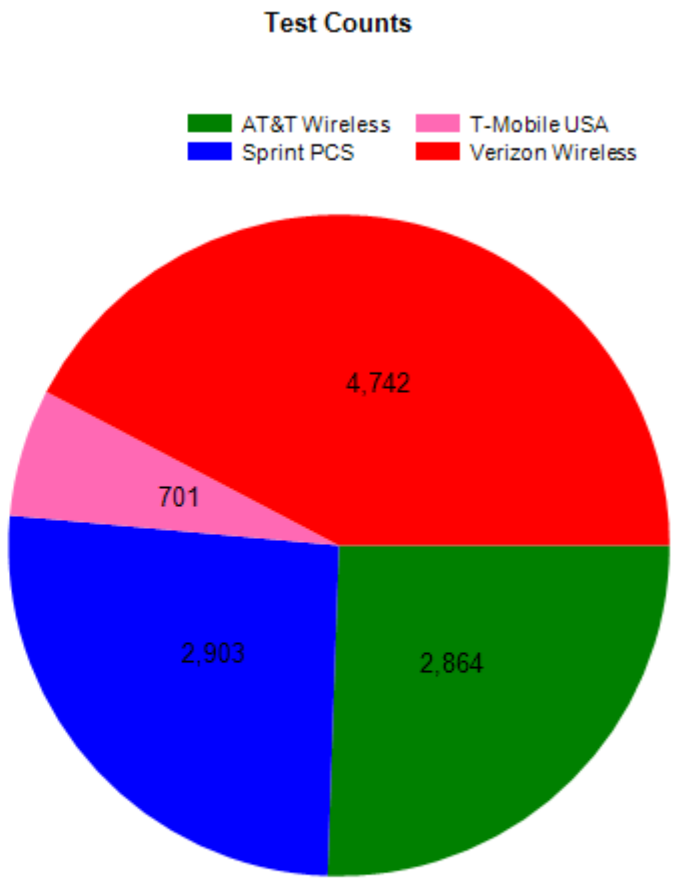


Time of Day (2012)

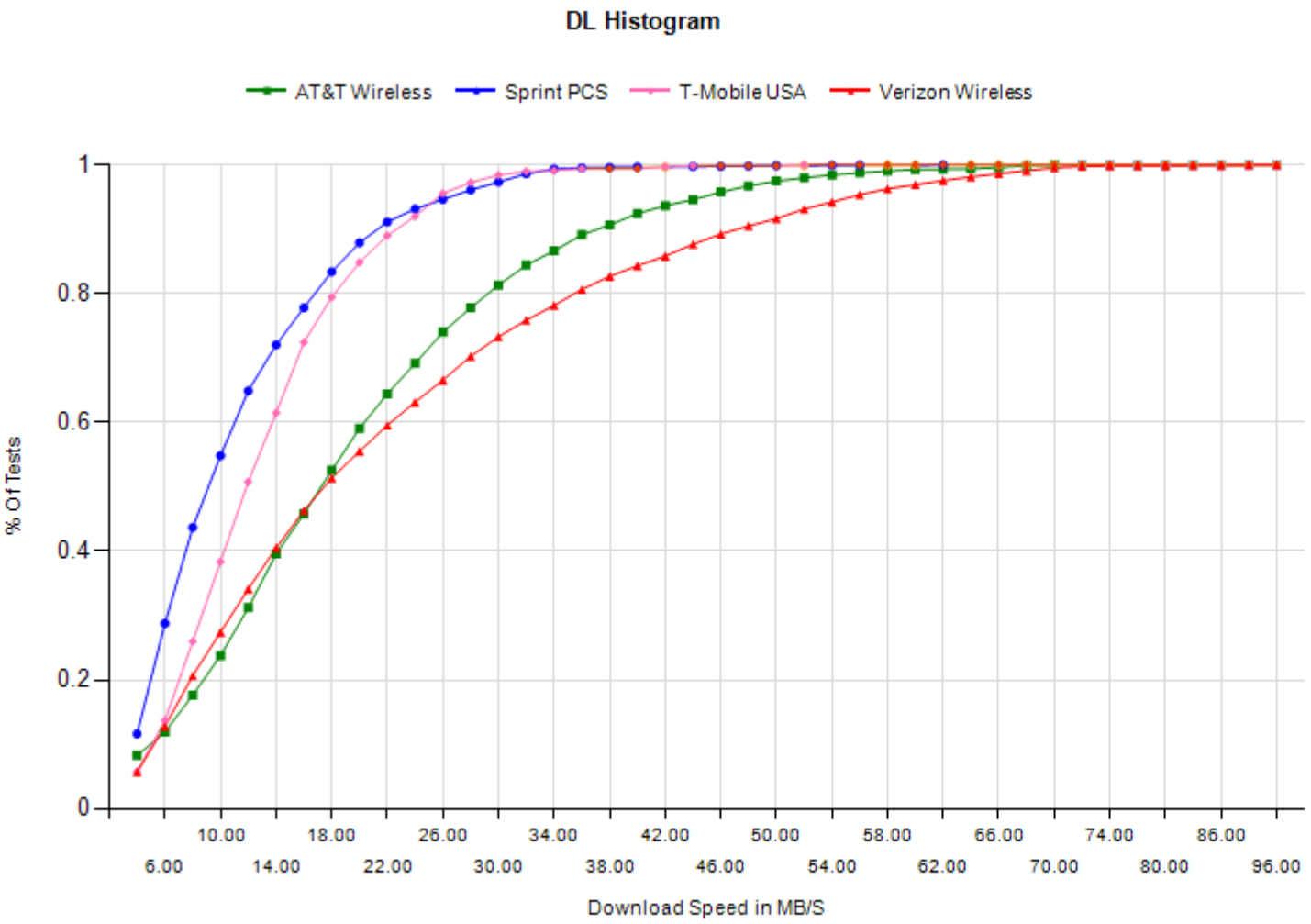


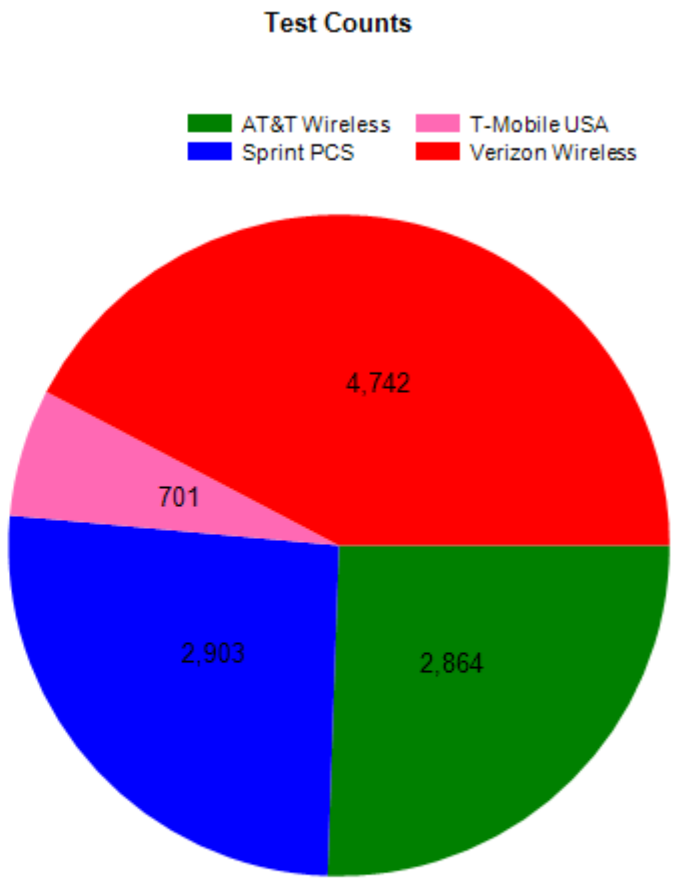
Histogram (LTE, 50 Buckets, 0-100Mb/s, 2014)



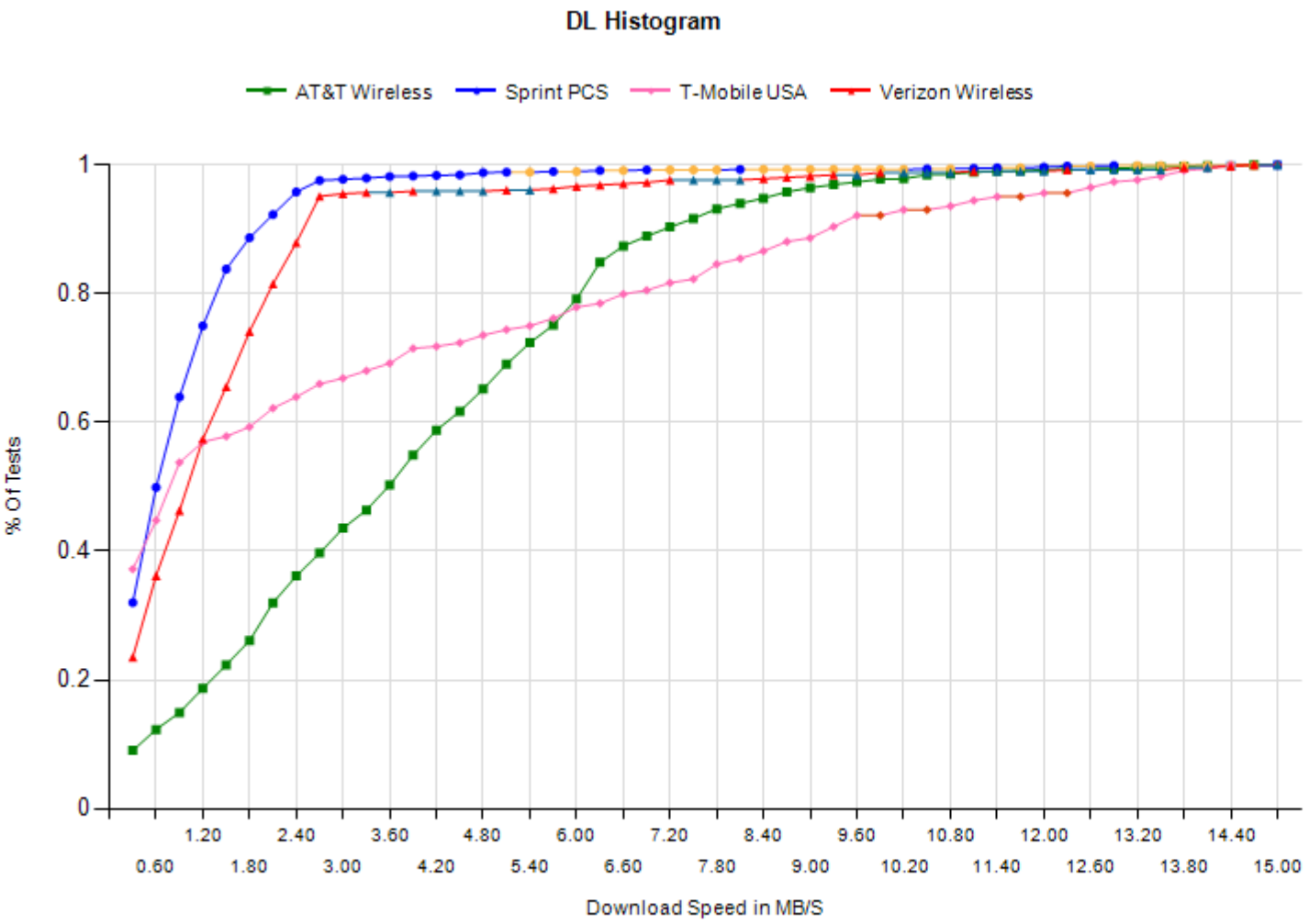


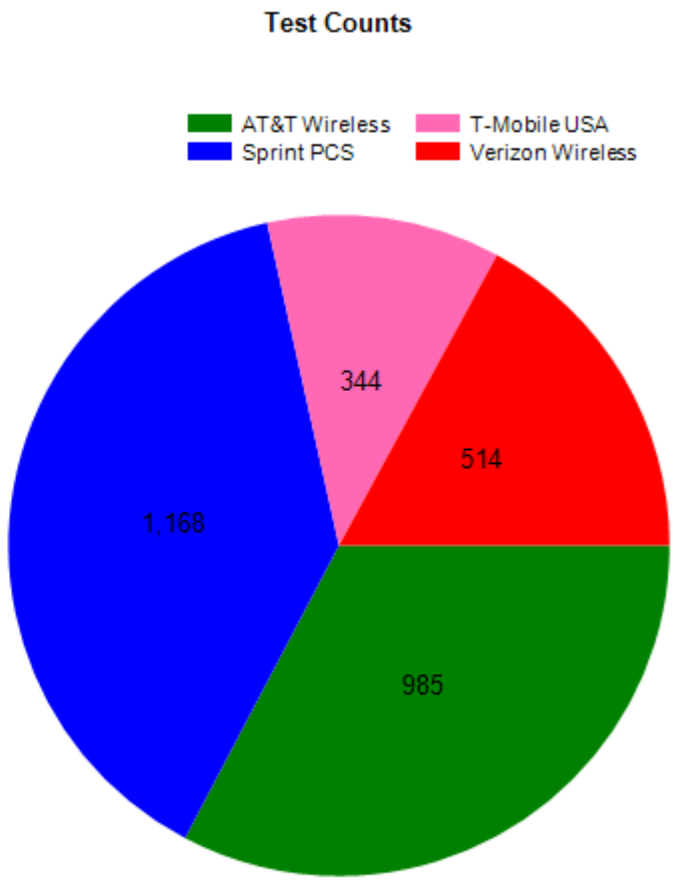
CDF! (LTE, 50 Buckets, 0-100Mb/s, 2014)



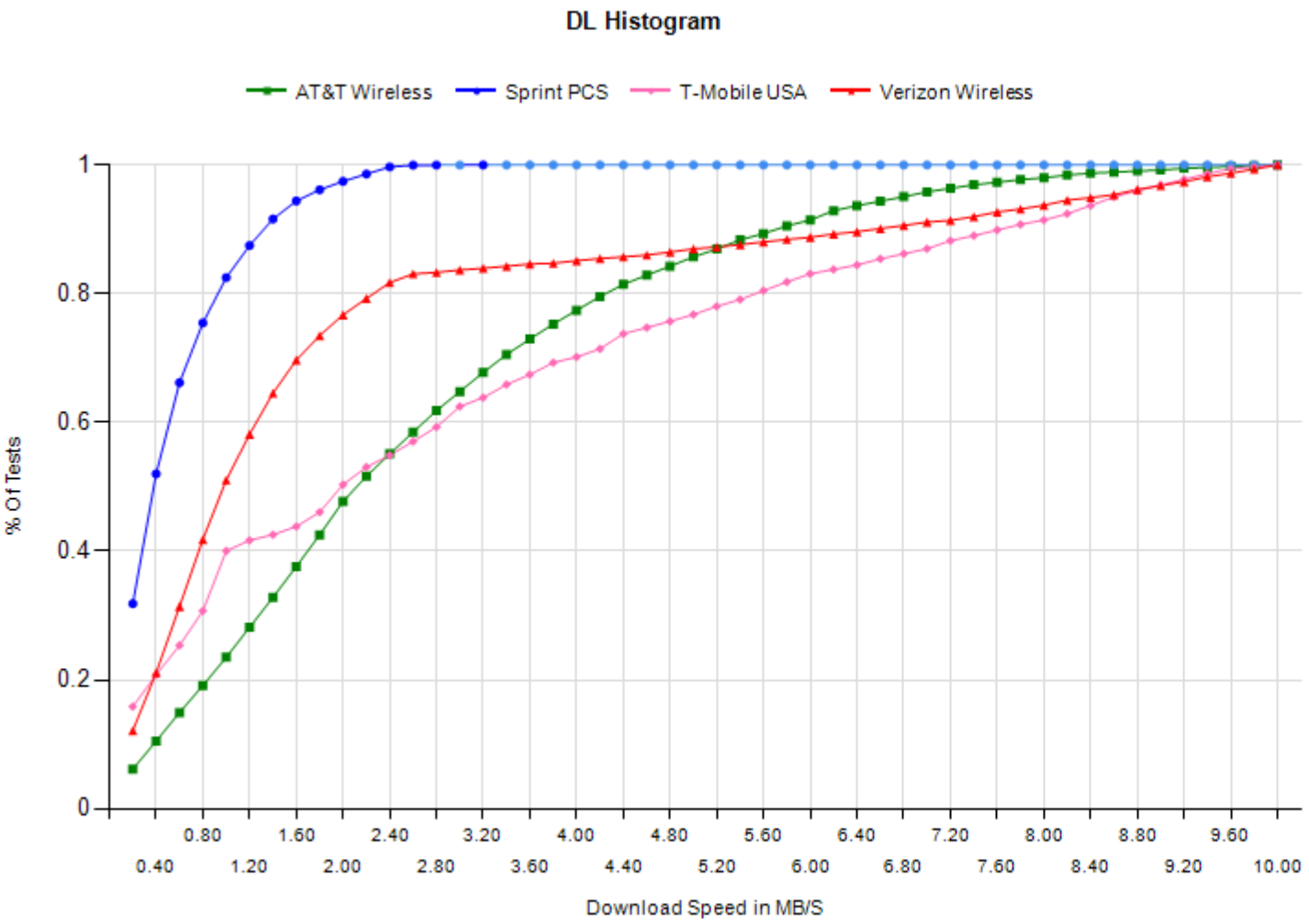


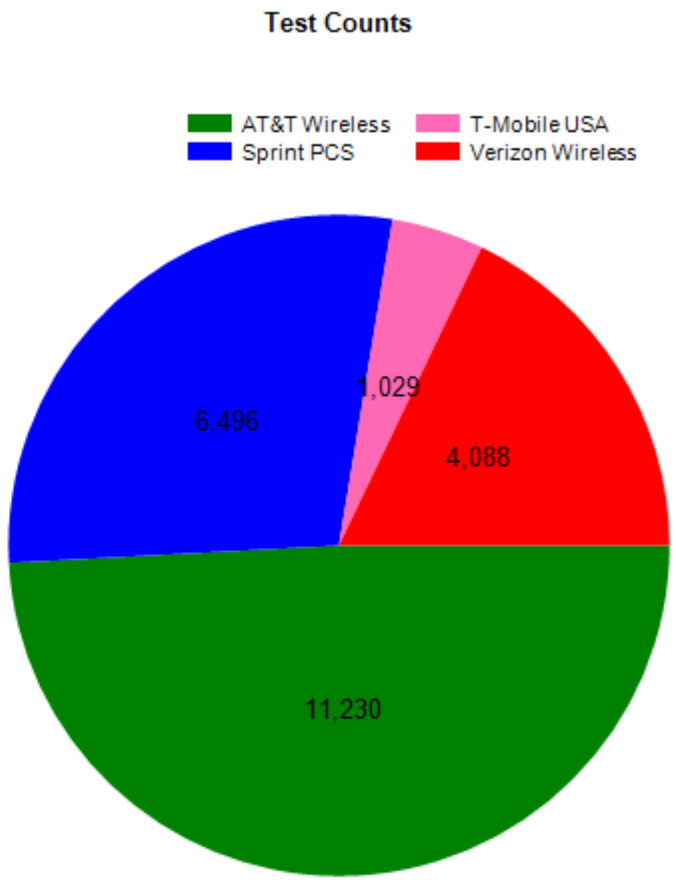
CDF! (NON-LTE, 50 Buckets, 0-15Mb/s, 2014)





CDF! (NON-LTE, 50 Buckets, 0-10Mb/s, 2012)





Conclusions

Verizon > AT&T > Sprint & T-Mobile

- Verizon = First with LTE
- LTE, %Chance of > 38Mb/s
  - Verizon ~%18
  - AT&T ~10%

iPhone vs Android Usage

- More iPhone tests on WiFi

Additional Questions

How to find tower locations?

- Max speed by location
- Isthmus cause issues with density?
- Try LA or New York (more spread out?)

Chronic Testers?

- Same IP, close in location and time
- K-Means clustering?