OpenSignal

Measuring Mobile QoS with Crowdsourced Data

ITU – Dubai – November 2014

OpenSignal Company Overview

- Founded in 2010 by 4 Oxford University Physics Graduates.
- HQ is London, UK with office in San Francisco, US
- Backed by $5million in VC investment from Qualcomm.
- Use crowdsourced data to gather accurate and independent data on the mobile coverage and performance.
- Over 10 Million downloads of our mobile apps worldwide.
- We provide this data to MNOs, Regulators, Consulting Companies, Consumer Groups and Academic Partners.

Backed By

QUALCOMM

10M+ Downloads

Customers Include

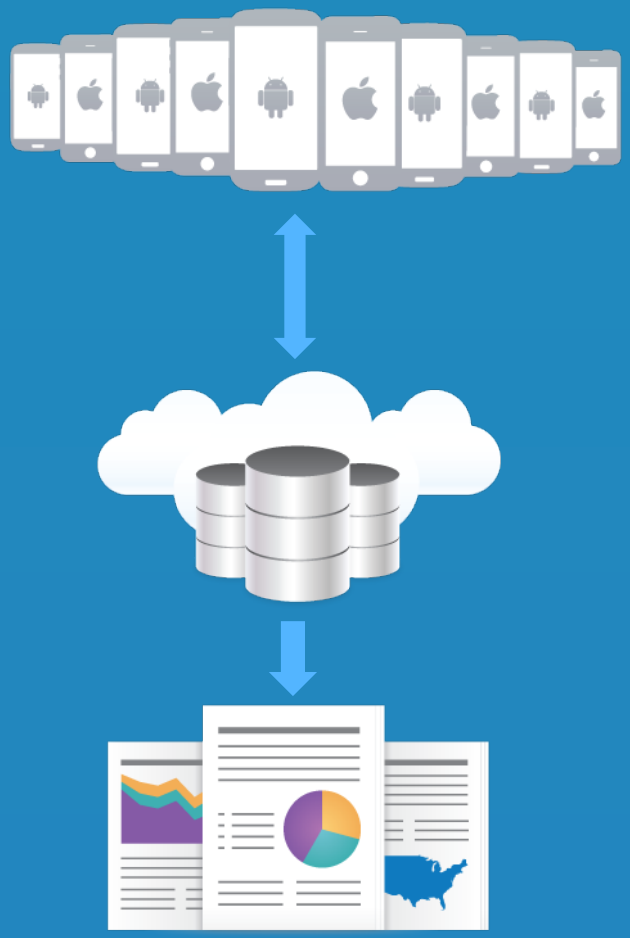
TELUS

Telefonica

Virgin media

中国移动通信 CHINA MOBILE

The OpenSignal Platform

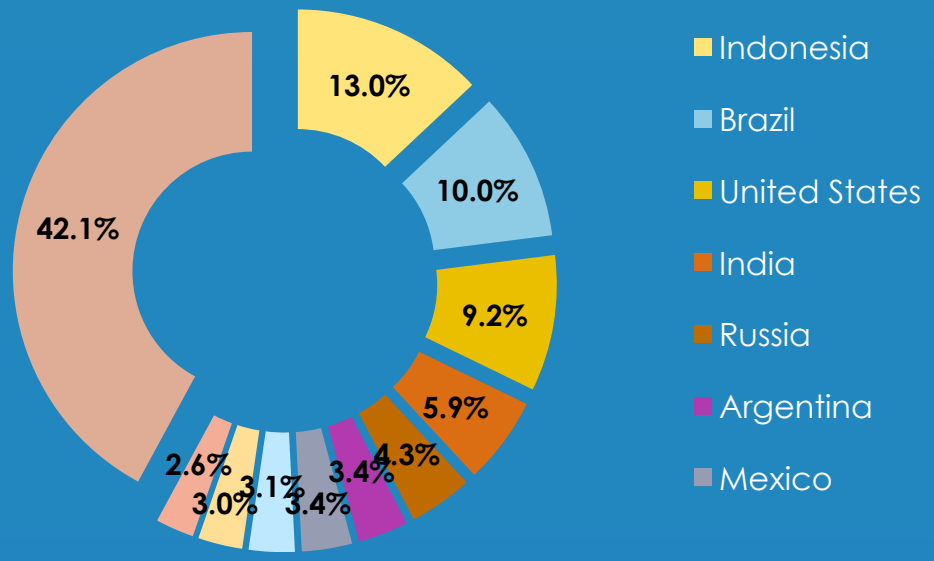


- Mobile apps free to download on consumer app store.
- Client devices monitor network QoS continually and report back to cloud based server.
- Cloud based server processes data and feeds back useful insight to client applications.
- This insight also feeds into a reporting platform for our clients so they can understand the mobile QoS

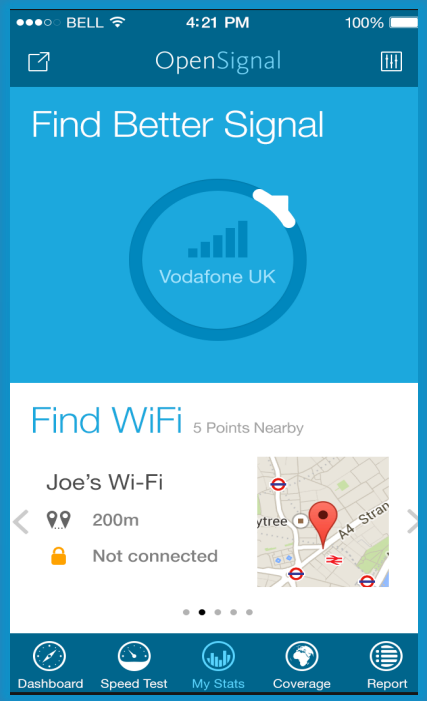
The Global OpenSignal Network

Global Downloads	10 Million
Global Active Users	1.5 Million
Global Signal Measurements	40 Billion
WiFi Hotspots Located	350 Million

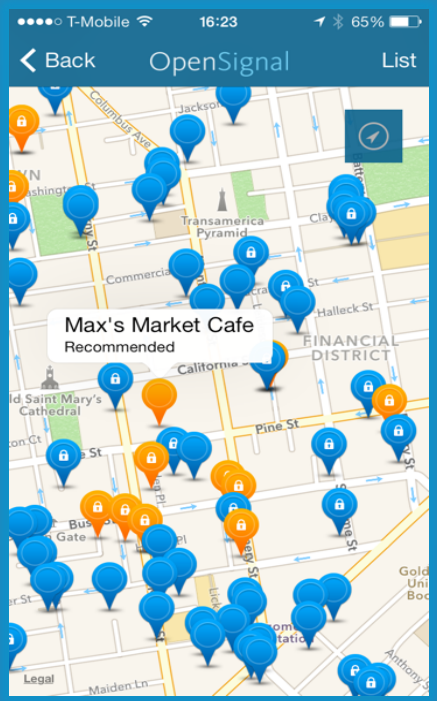
Global Breakdown:



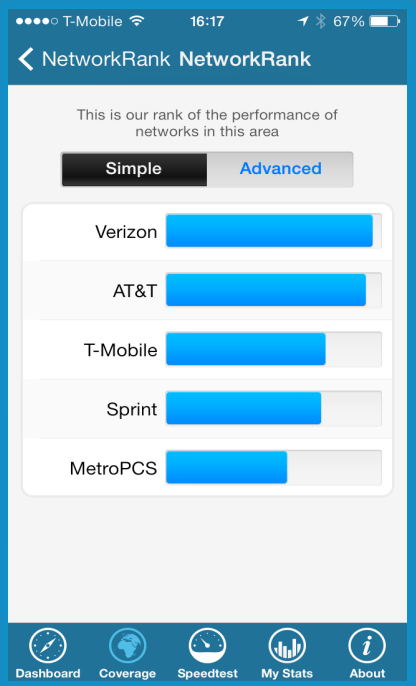
What Is the Incentive For Consumers?



Realtime Signal Dashboard



Find WiFi in any city worldwide



Source best network based on personalized history

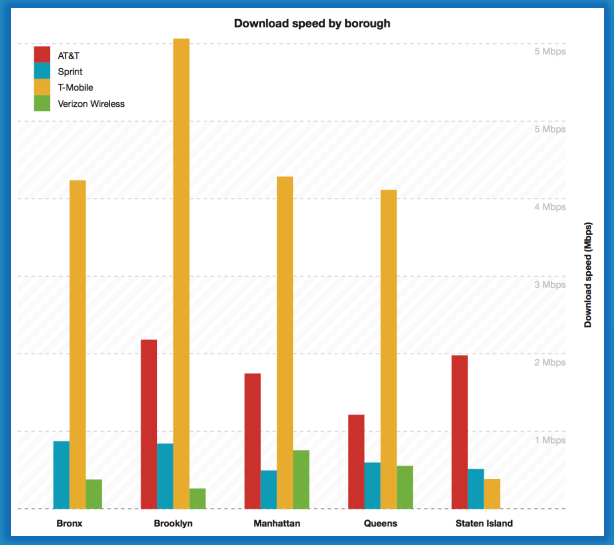
The OpenSignal mobile app provides realtime information on signal quality; helps users diagnose network issues and gives them tools to improve their signal experience

Data Collection & Privacy

- App runs passively in the background under default settings.
- Users can control the rate of data collection and even opt out of any collection should they choose.
- Data is cached locally on device and uploaded intermittently in order to minimize battery and data plan usage.
- No demographic data is collected.
- RF measurements are taken every 15mins in background under default conditions.
- Background speedtests are run every 10 days per user but never using more than 1% of monthly data.

OpenSignal *Insights*

Regular reports showing the true customer experience based on billions of real world data points. Available globally.



Detailed analysis of key customer experience KPIs:

- Download/upload throughout.
- Network latency.
- Data success rates.
- Proportion of time with no signal.
- Proportion of time/data on 3G or 4G.
- Proportion of time/data on Wi-Fi.

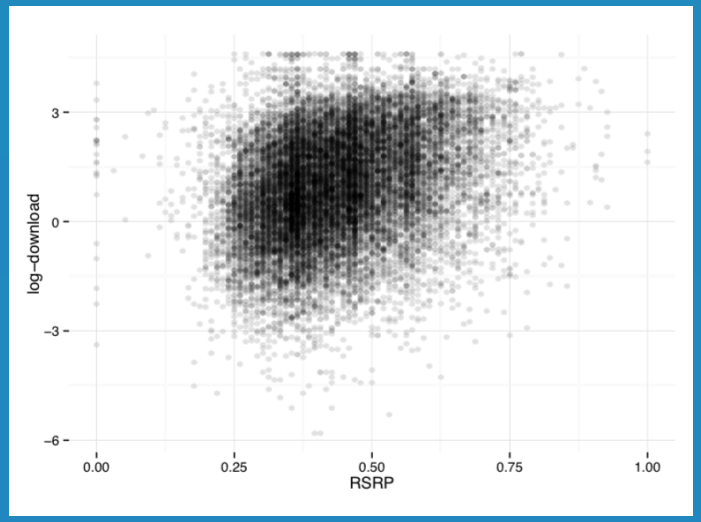
All metrics benchmarked against MNOs in market

Crowdsourcing Compared To Traditional QoS

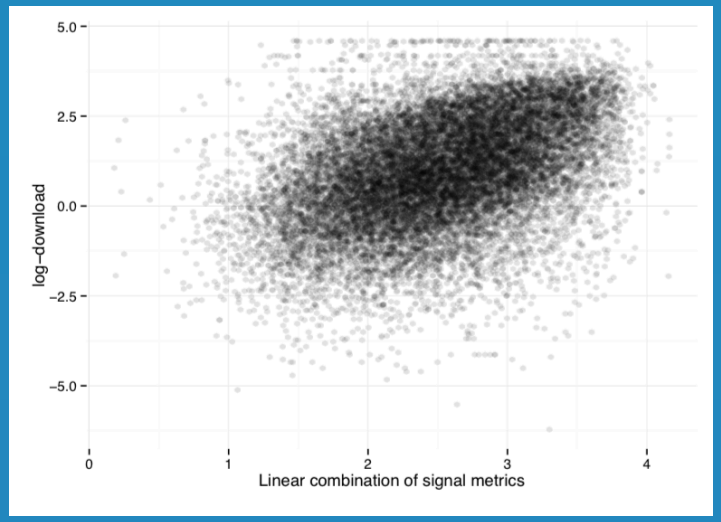
Crowdsourced On-Device Data	Traditional QoS Methodologies
The true end-to-end experience measured from millions or real consumer devices	Often limited to simulated data from small sample sizes
QoS measured on all network types (2G/3G/4G)	Sometimes QoS not available on all network types
Detailed insight into how handset choice impacts QoS (18k models tested)	Usually limited to a small number of test devices
User centric coverage metrics (Time spent on each network type)	Usually limited to geographic coverage maps based on predicted coverage
Global benchmarking available	Cost is usually prohibitive to benchmark globally
Insight into WiFi behavior and QoS	Usually not available as requires real world usage
Near Realtime data and large already-existing consumer panel available	Often up to 6 months between data refreshes and a custom panel must be generated

Research: A Model of Network QoS

Developed a model which regresses LTE download throughput on a series of independent variables including time of day, device model, RF state & network operator. Published in 10th IEEE International Workshop on Performance of Wireless and Mobile Networks.



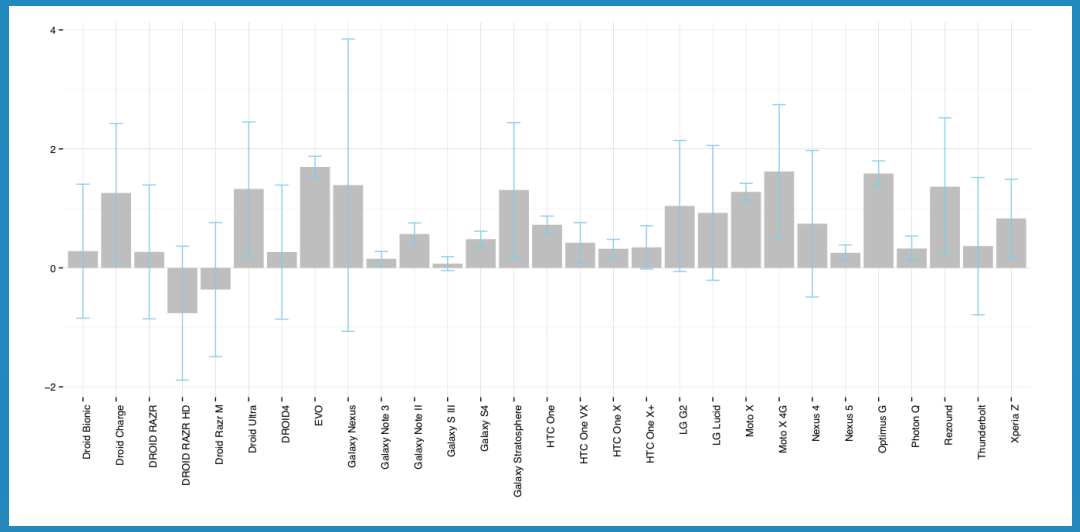
LTE throughput displays a lot of variance for every value of RSRP



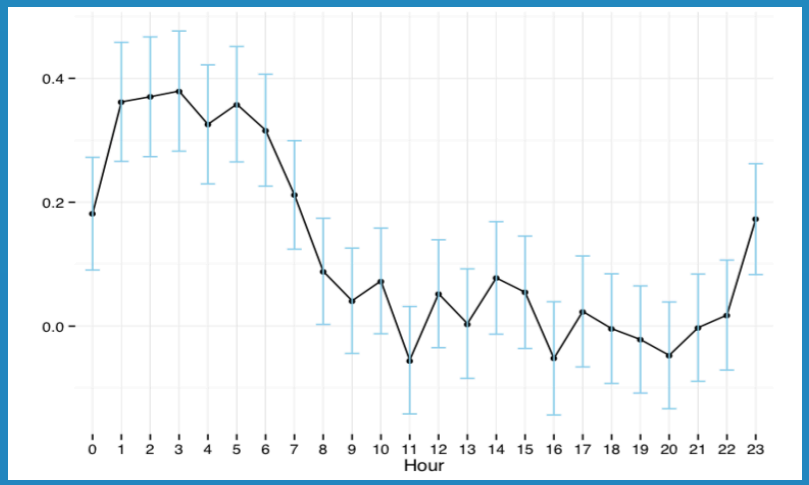
Model can be improved by using RSSNR, RSRQ and RSRP

LTE throughput shows correlation with linear combination of RSRP, RSSNR & RSRQ but we hypothesize device model, network operator and time of day are also responsible for variances in throughput performance.

Research: A Model of Network QoS



Impact of device model on LTE throughput.



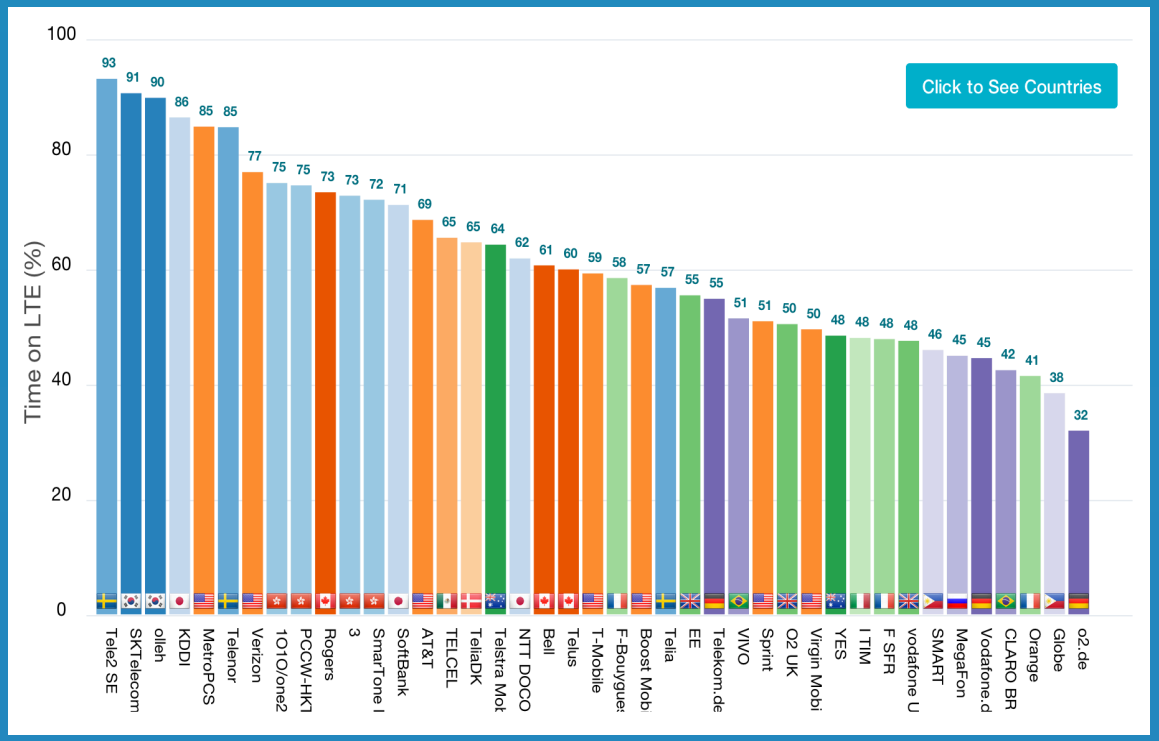
Impact of time of day on LTE throughput.

TABLE I
SELECTED MODEL COEFFICIENTS

	Coefficient	Standard Error
Intercept	-1.905	0.069
RSRP	0.995	0.046
RSRQ	1.607	0.033
RSSNR	1.857	0.039
Sprint	-0.730	0.061
T-Mobile	0.423	0.328
Verizon	-0.059	0.577

Impact of RF metrics and network operator

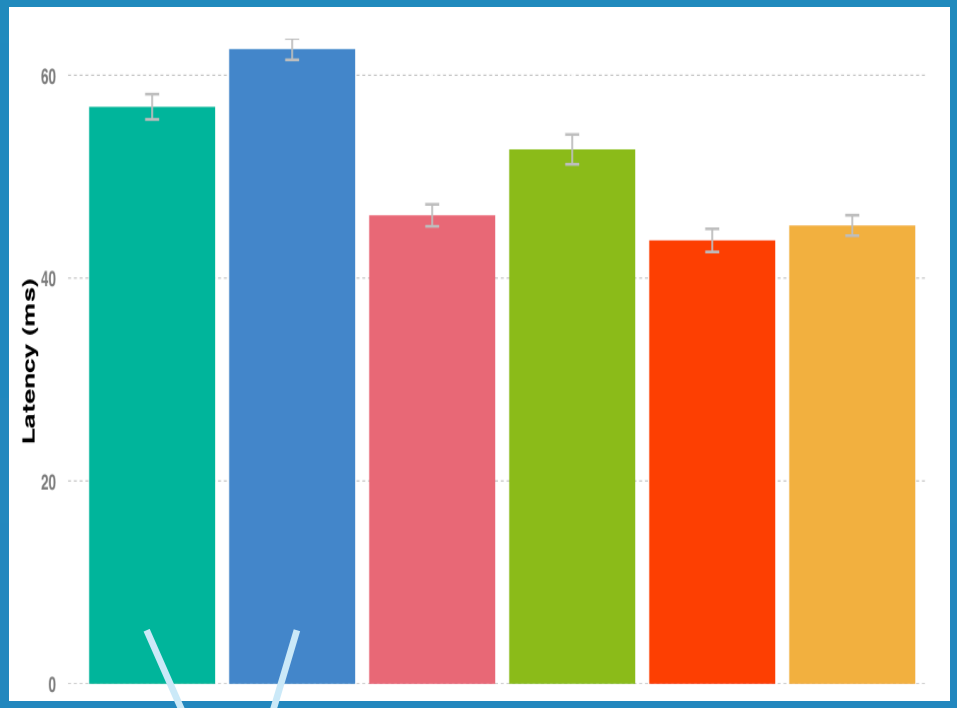
Case Study: Global LTE Network QoS



Global benchmarking of performance on LTE (Feb 2014)

- Examined both LTE speed and coverage experience.
- 16 Countries included.
- 41 LTE Networks surveyed.
- Wide variation in the stage of LTE rollout between MNOs.
- Useful to put performance in international context.

Case Study: Device Impact on QoS



MNO experiencing high latency compared to market

MNO's network was showing higher latency than market average.

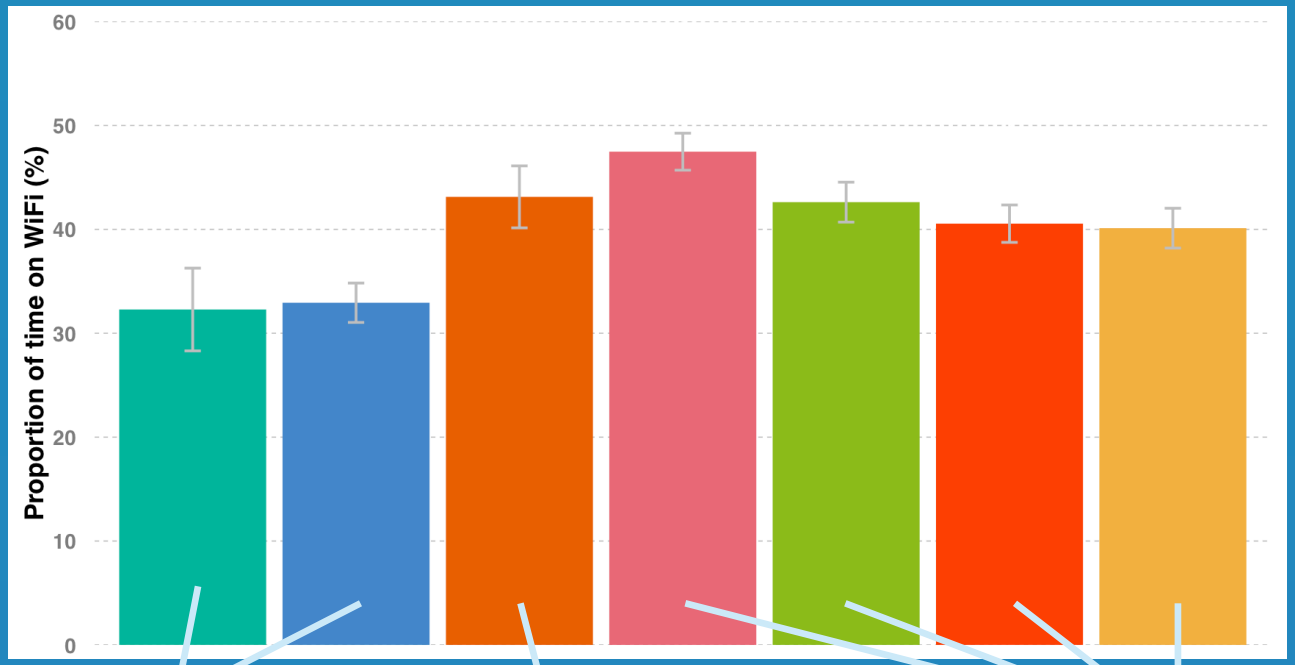
MNO's internal testing indicated this was not the case.

Latency was being raised by performance of lower end devices.

Internal testing only used a limited number of high end models.

Able to fix issue in core network within 10 days or receipt of report.

Case Study: Policy Impact on WiFi Usage

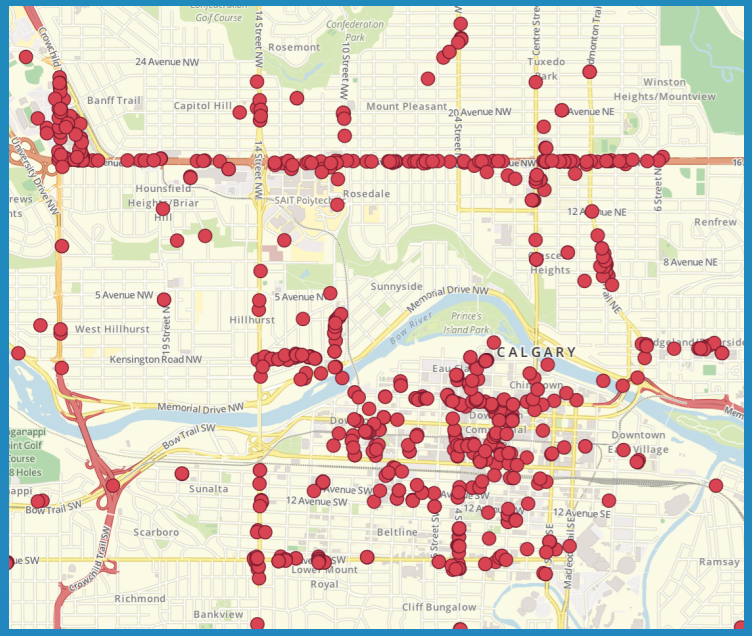


Operators offer unlimited data plans and see reduced WiFi usage

Unlimited data also offered but at severely throttled speed so increased WiFi usage

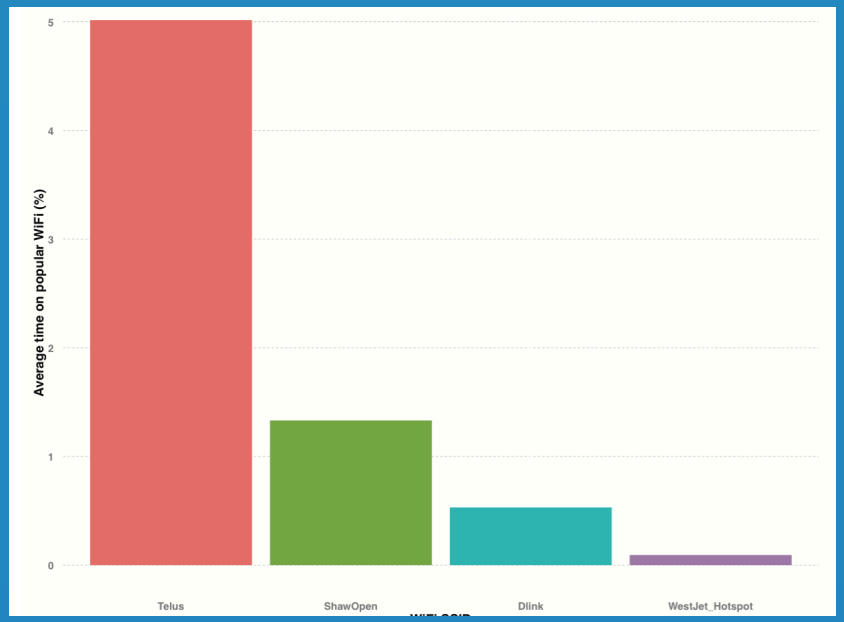
Other operators in market place show smaller fluctuations

Case Study: WiFi network intelligence

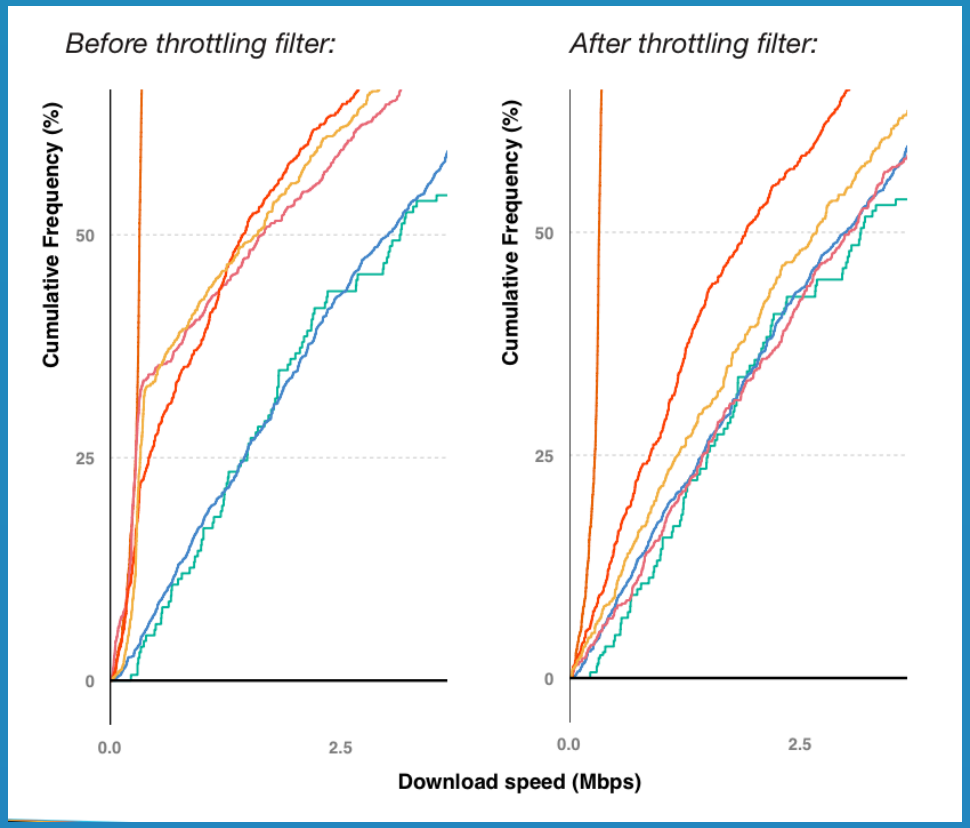


- Maps of hotspot locations
- Optionally filtered to specific networks
- Over 380 million hotspots mapped globally

- WiFi usage behavior segmented by WiFi network
- Overall WiFi usage trends also available, or segmented by location



Case Study: Throttling Analysis



Examining the CDF of network speed reveals throttling policies.

Stats can be calculated on number of users being throttled or number or requests experiencing it.

Network speeds can be remodeled with throttled data removed from distribution.

Summary

- Real world data directly from consumer devices.
- Crowdsourced data leads to large sample size and removes the time and resources required to build a panel.
- Our independence leads to transparency in the market place.
- Increases competition leading to increased focus on performance by MNOs.
- Global reach makes international benchmarking possible.
- Provides insight into WiFi usage/performance
- Quantifies the impact of device model on QoE

Thank you

Brendan Gill, CEO – OpenSignal

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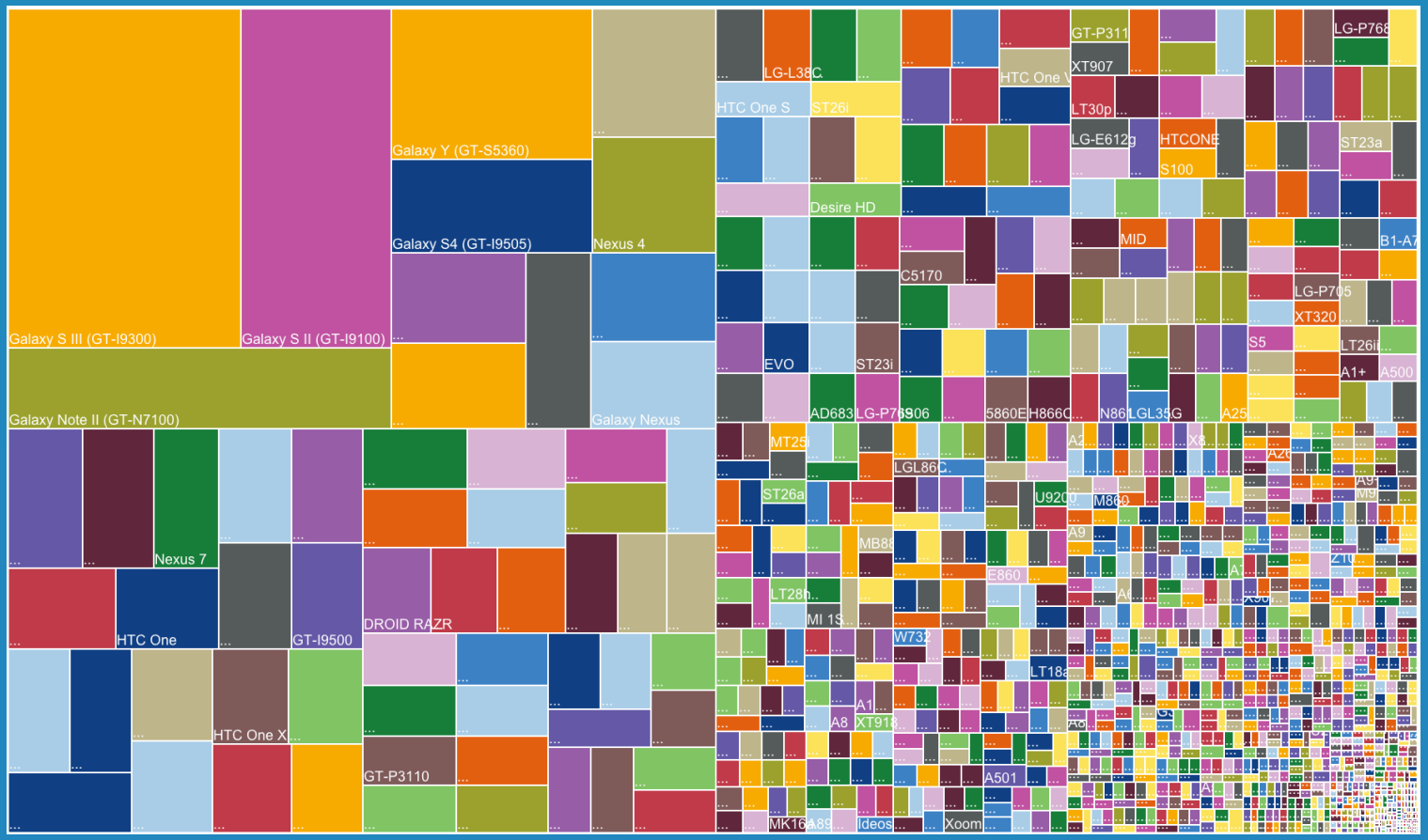
User Centric Coverage Metrics

- Measuring the 'Time Spent on …' {2G/3G/4G/WiFi/No Network}
  - Each user records their RF connection every 15mins
  - We average over units of user-location-hour
  - Then we take a global average across the user base
  - We believe this is most accurate way of quantifying 'coverage'

OpenSignal Vs The Competition

	OpenSignal	Root Metrics	Sensorly
About	Specialize in Crowdsourcing only. Market leader with largest user base and strong network effects.	Background in wireless testing. Hybrid approach of drive testing and crowdsourcing.	Crowdsourcing only
App downloads	**11+ million**	**< 500,000**	**< 1,000,000**
Number of reviews of app	162, 760	1,820	14,160
Average rating	4.2	4.1	4.2

Report: Device Fragmentation



Over 18k device models found in our last annual survey.
More information: http://opensignal.com/reports