



Measuring Broadband America:

Fixed & Mobile Broadband
Performance Measurement

7th Workshop on Internet Economics (WIE 2016)

James.Miller@FCC.Gov

202-418-7351

Senior Attorney Advisor EMCD/OET/FCC

Disclaimer

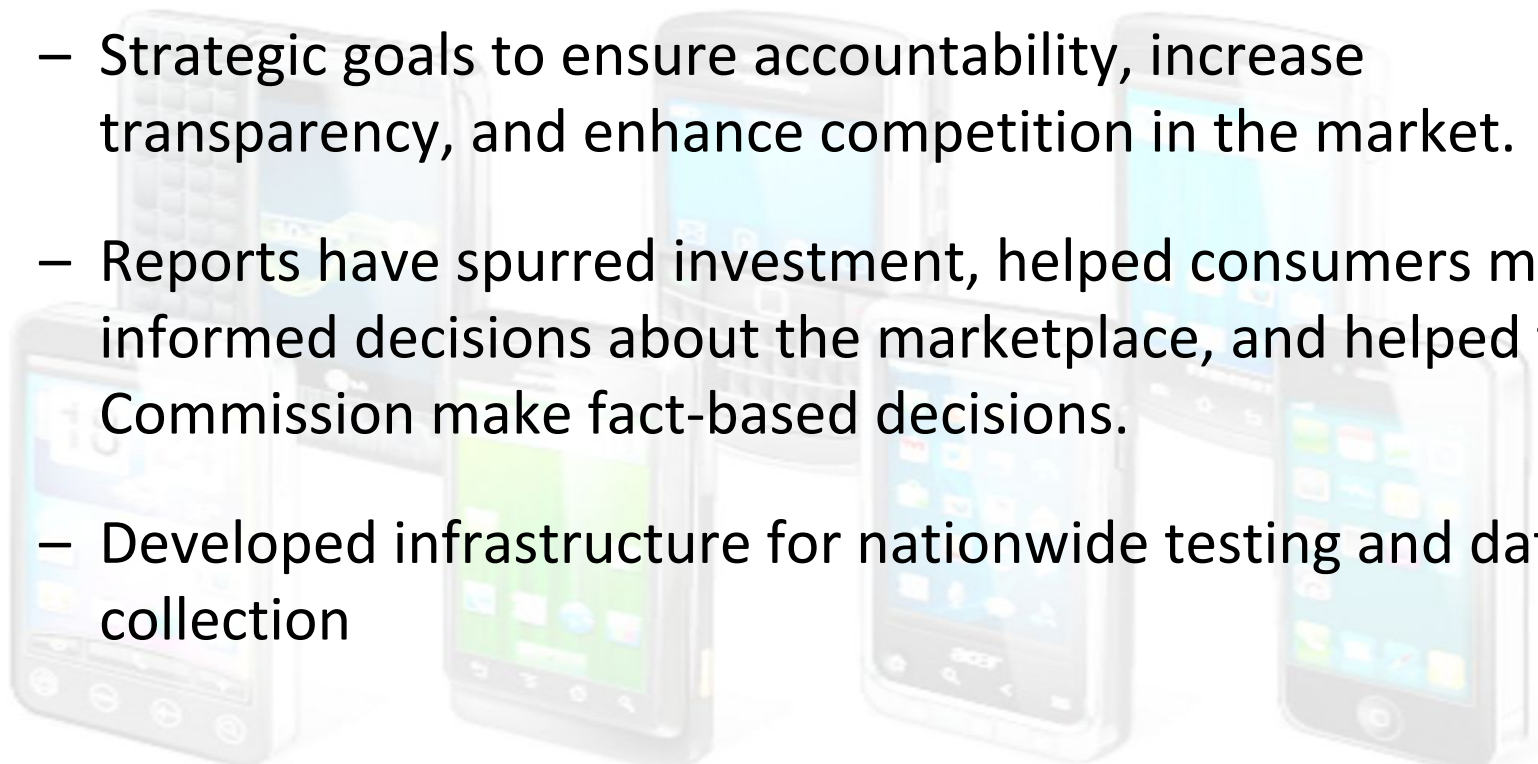
The opinions expressed are those of the author and do not necessarily represent the views of the Federal Communications Commission or the United States Government; The Maureen and Mike Mansfield Foundation; or any Japanese Ministry or the Government of Japan.

本人の見解によるものであり、アメリカ合衆国その他の代弁ではないことをご承知下さい



• Fixed Broadband

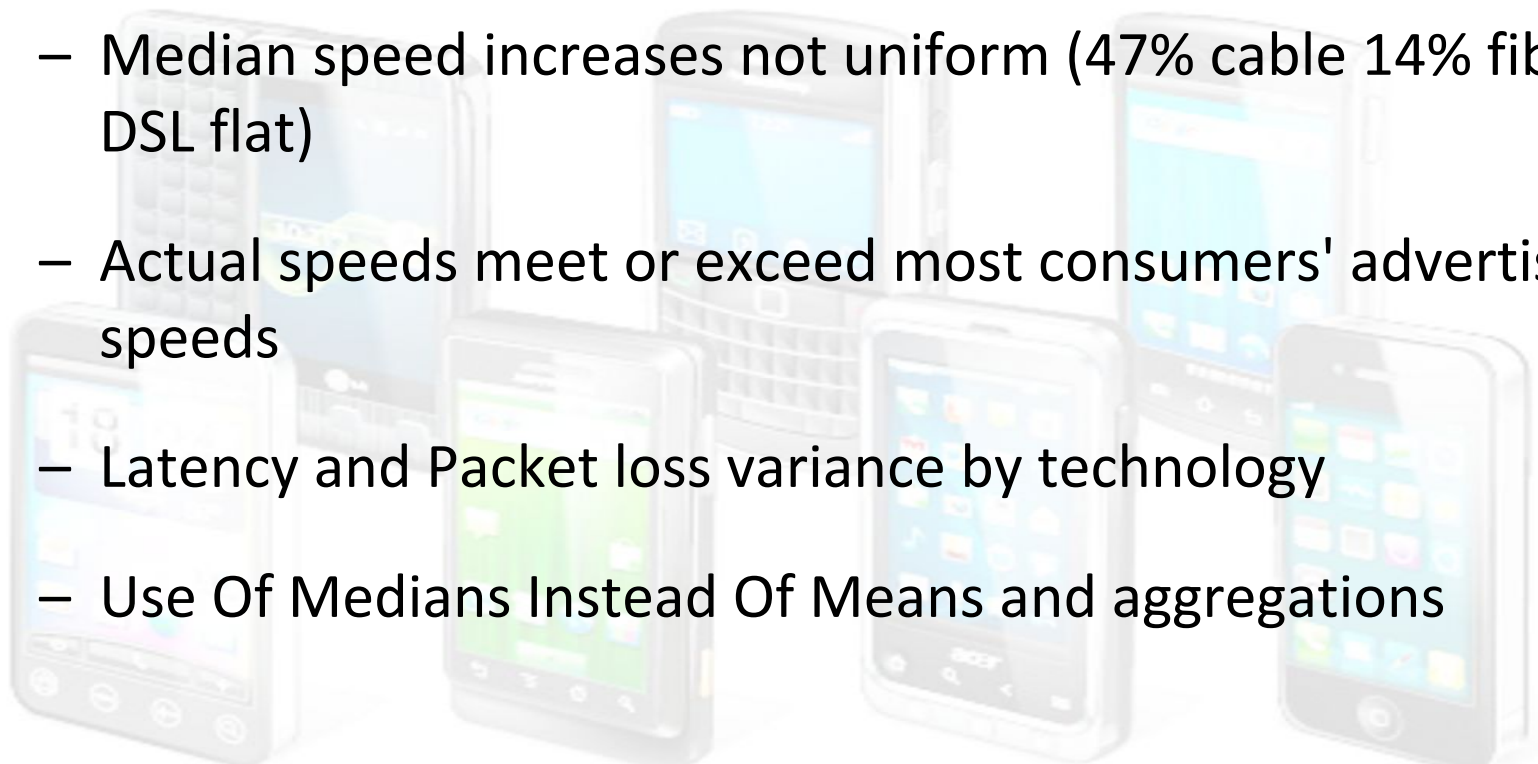
- Commission began gathering data in 2011 and has released six reports on *fixed* broadband performance.
- Strategic goals to ensure accountability, increase transparency, and enhance competition in the market.
- Reports have spurred investment, helped consumers make informed decisions about the marketplace, and helped the Commission make fact-based decisions.
- Developed infrastructure for nationwide testing and data collection





• 2016 Fixed Report Highpoints

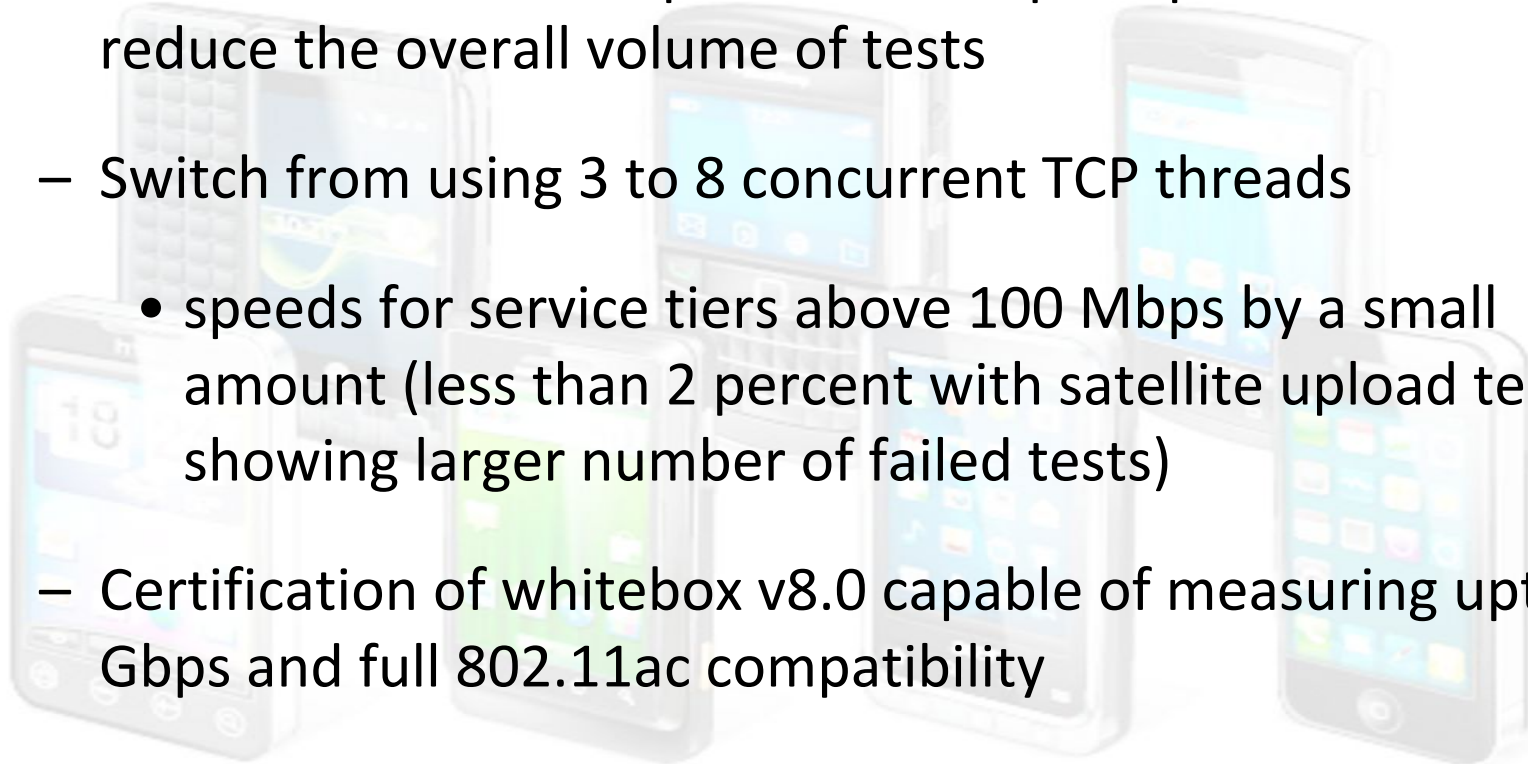
- Continued growth in advertised speeds (10Mbps 2011 -> 39 2015)
- Median speed increases not uniform (47% cable 14% fiber DSL flat)
- Actual speeds meet or exceed most consumers' advertised speeds
- Latency and Packet loss variance by technology
- Use Of Medians Instead Of Means and aggregations





• 2016 Fixed Methodology Changes

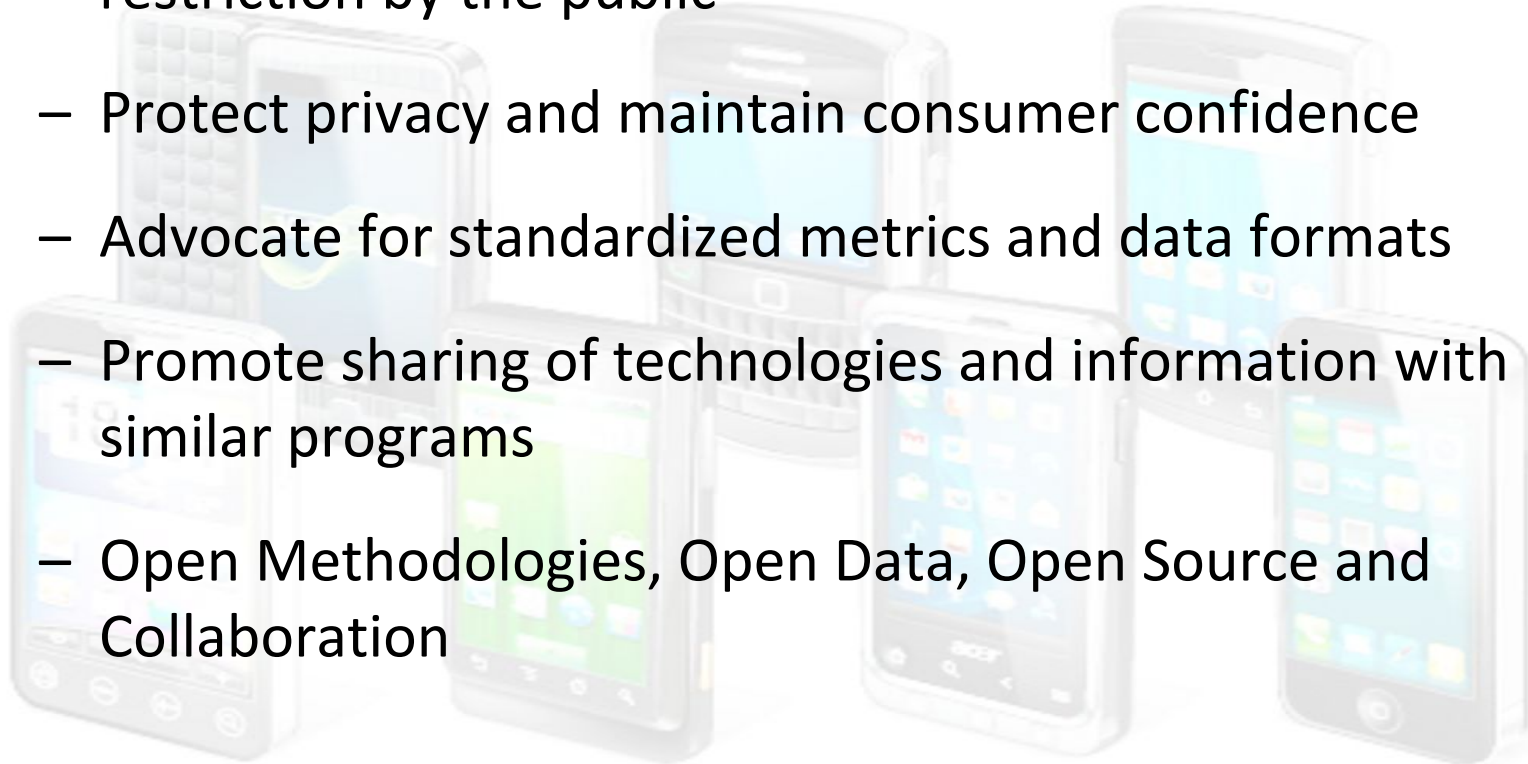
- Weighting of tiers using carrier supplied and 477 info
- New test schedule to provide more peak period data and reduce the overall volume of tests
- Switch from using 3 to 8 concurrent TCP threads
 - speeds for service tiers above 100 Mbps by a small amount (less than 2 percent with satellite upload tests showing larger number of failed tests)
- Certification of whitebox v8.0 capable of measuring upto 1 Gbps and full 802.11ac compatibility





• Program Goals

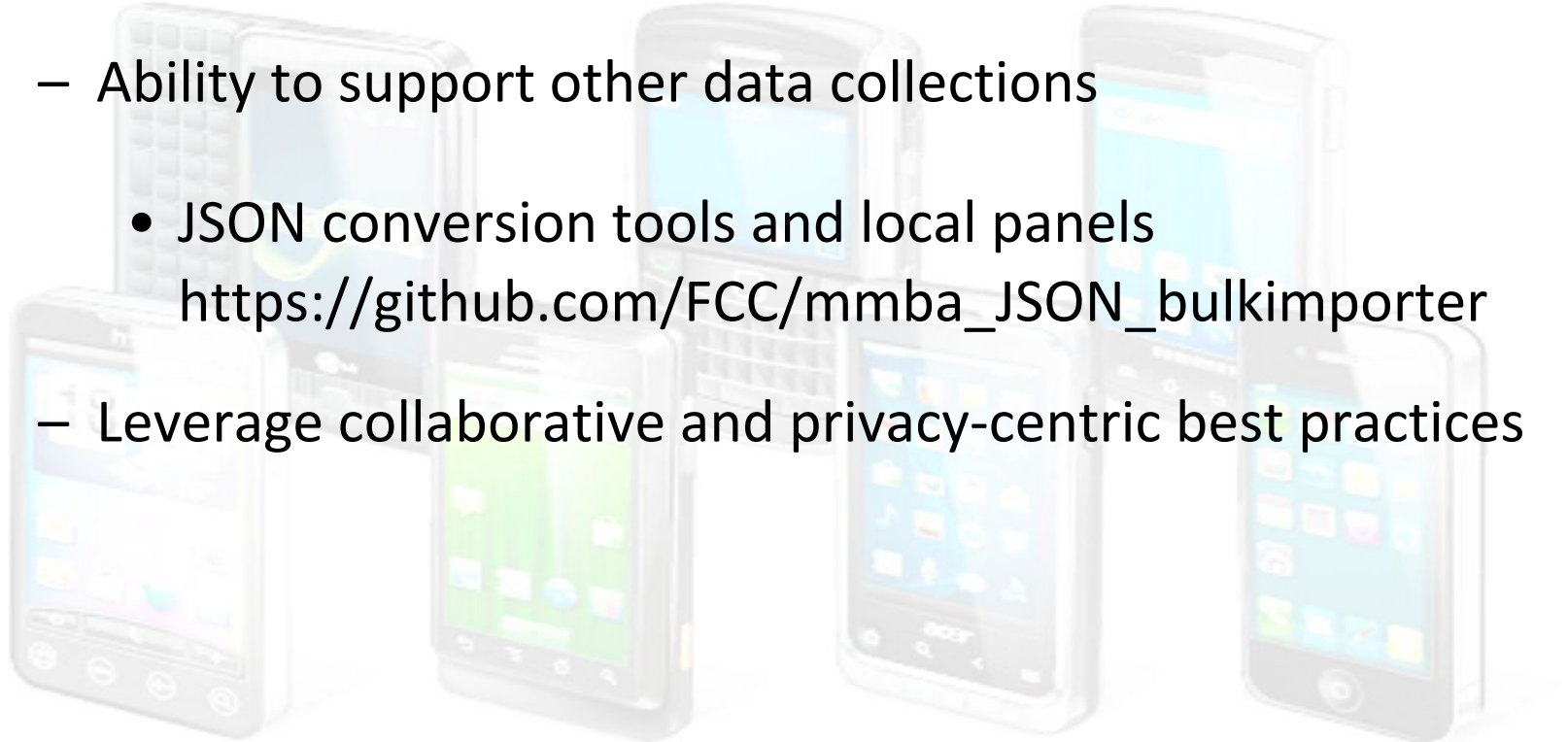
- Create national database on mobile broadband performance and characteristics accessible without restriction by the public
- Protect privacy and maintain consumer confidence
- Advocate for standardized metrics and data formats
- Promote sharing of technologies and information with similar programs
- Open Methodologies, Open Data, Open Source and Collaboration





• Opportunities for Collaboration

- Use of shared datasets
- FCC App source code available
- Ability to support other data collections
 - JSON conversion tools and local panels
https://github.com/FCC/mmba_JSON_bulkimporter
- Leverage collaborative and privacy-centric best practices

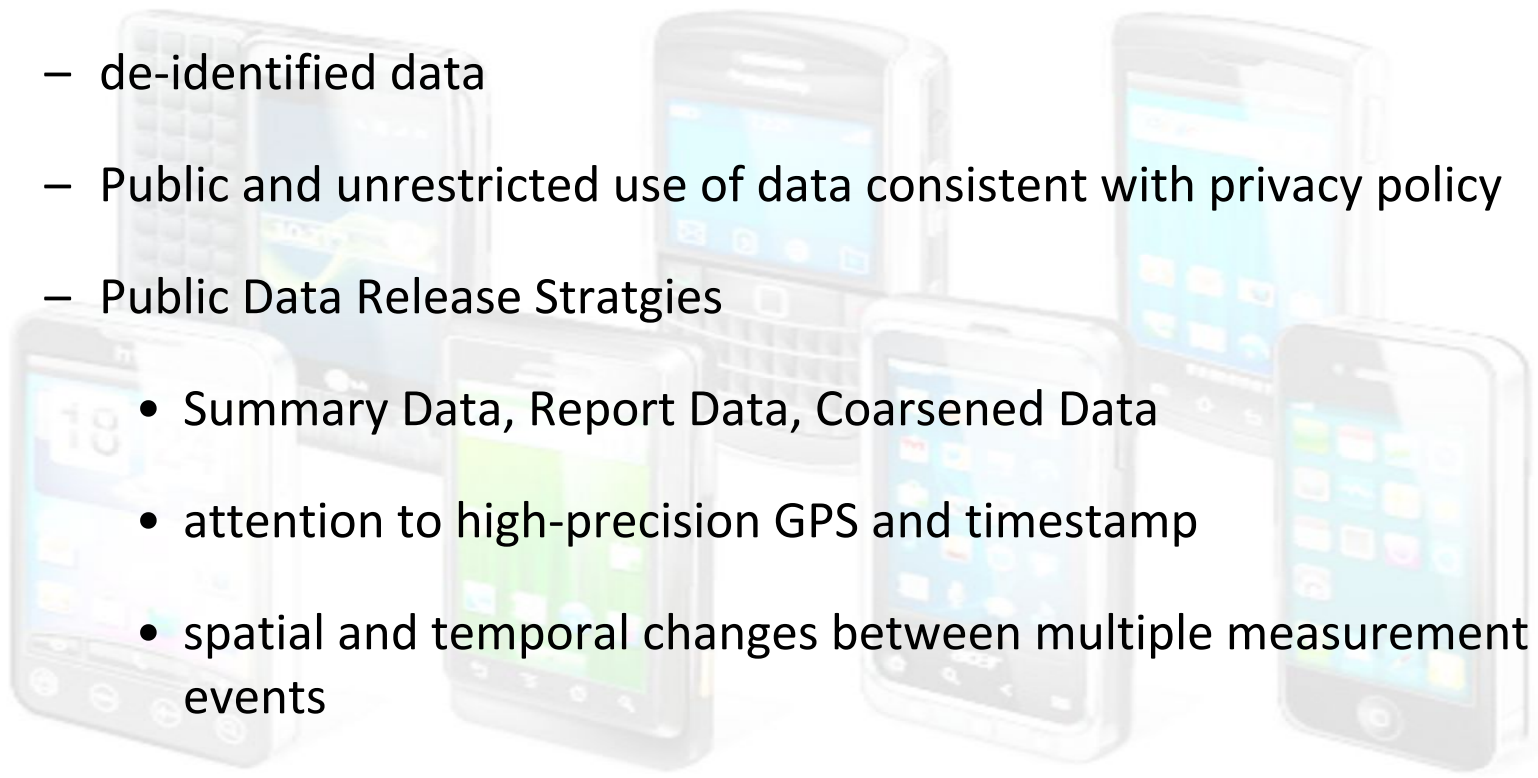




• Shareable Collaborative Datasets

- Openly documented methodology and data dictionary
- Structured export capability
- de-identified data
- Public and unrestricted use of data consistent with privacy policy
- Public Data Release Strategies

- Summary Data, Report Data, Coarsened Data
- attention to high-precision GPS and timestamp
- spatial and temporal changes between multiple measurement events





- **JSON Native Files**

- Active Tests
- Wireless Cellular
- Handset APIs
- Test Conditions & Error Conditions

Measurement

- **Tests**

- JHTTPGETMT
- JHTTPPOSTMT
- JUDPLATENCY
- CLOSESTTARGET

- **Metrics**

- phone_identity
- network_data
- gsm_cell_location
- cdma_cell_location
- cell_neighbour_tower_data
- location

- **Conditions**

- PARAM_EXPIRED
- NETACTIVITY
- CPUACTIVITY





- **JSON Native Files**

- Active Tests
- Wireless Cellular
- Handset APIs
- Test Conditions & Error Conditions

Measurement Reference

Property	Type	Description	Explanation
<code>_received</code>	Integer	unix_timestamp of reception	The timestamp recoded at server side at the moment the result file is being received.
<code>_sourceip</code>	String	source ip address	The Internet Protocol (IP) address of the handset submitting the results to the collecting infrastructure as seen by the collecting infrastructure.
<code>enterprise_id</code>	String	FCC_Public	The code for different panel programs.
<code>sim_operator_code</code>	String	<code>android.telephony.TelephonyManager</code> <code>.getSimOperator()</code>	The field holds string from the Android method that identifies the MCC+MNC (mobile country code + mobile network code) of the provider of the SIM.



JHTTPGETMT Reference

Property	Type	Description	Explanation
type	String	JHTTPGETMT	The active metric type 'JHTTPGETMT' describes measurement results of the active test for download performance.
bytes_sec	Integer	154716	The field represents the throughput experienced during the transfer period of the test, the value is obtained dividing the total amount of bytes transferred during the "transfer_period" by the time they have been transferred. This represents hence the download speed.
datetime	String (Android dtime format)	Fri Jan 25 15:35:22 GMT 2013	The field represents the time the test finished in UTC represented as a Android dtime datatype.
number_of_threads	Integer	3	The number of concurrent TCP connections used in the test.

● JSON Native Files

– Active Tests

- JHTTPGETMT
- JHTTPPOSTMT
- JUDPLATENCY
- CLOSESTTARGET

– Wireless Cellular

– Handset APIs

– Test Conditions & Error Conditions



- **JSON Native Files**

- Active Tests

- Wireless Cellular

- network_data
- gsm_cell_location
- cdma_cell_location
- cell_neighbour_tower_data
- location

- Handset APIs

- Test Conditions & Error Conditions

network_data Reference

Property	Type	Description	Explanation
----------	------	-------------	-------------

[..]

active_network_type	String		
	android.net.ConnectivityManager		

.getActiveNetworkInfo()

.getTypeName() The field holds an integer from the Android method that identifies the type of wireless network that provides Internet connectivity at the time of the observation.

[...]

network_operator_code	String		
	android.telephony.TelephonyManager		

.getNetworkOperator() The field holds string from the Android method that identifies the numeric name (MCC+MNC) of the current registered operator of the Internet connectivity at the time of the observation.

network_operator_name	String		
	android.telephony.TelephonyManager		



● JSON Native Files

- Active Tests
- Wireless Cellular
- Handset APIs
 - handset type
 - OS
- Test Conditions & Error Conditions

phone_identity Reference

Property	Type	Description	Explanation
----------	------	-------------	-------------

type	String	phone_identity	The passive metric type 'phone_identity' describes features of the handset and installed operating system.
------	--------	----------------	--

datetime	String	Fri Jan 25 15:35:07 GMT 2013	The unix time and date of the handset performing the measurement at the beginning of the observations.
----------	--------	------------------------------	--

manufacturer	String	api android.os.Build.MANUFACTURER	The field holds a string from the Android method that identifies the handset manufacturer.
--------------	--------	-----------------------------------	--

model	String	api android.os.Build.MODEL	The field holds a string from the Android method that identifies the handset model.
-------	--------	----------------------------	---

os_type	String	android	The field holds a string for the Operating System of the handset. This value is set by the application logic.
---------	--------	---------	---

os_version	Integer	api android.os.Build.VERSION.SDK_INT	
------------	---------	--------------------------------------	--



- **Continuing Research Areas**

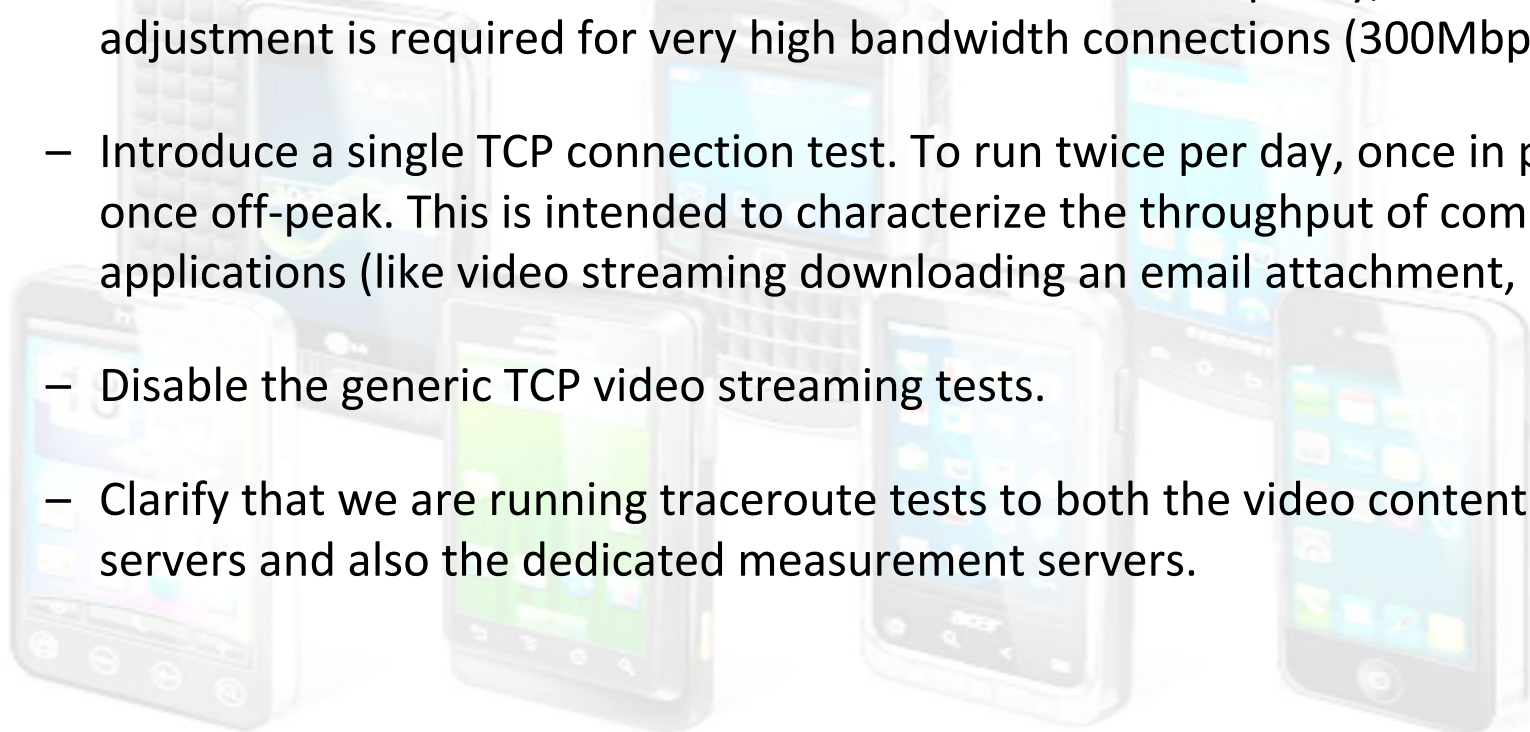
- Sample Variance and Sample Sizes
- Crowdsourcing, Outreach, and Collaborative Synergies
- Standards and Data Quality from OS API Derived Sources
- Validation of Networks and Whitebox Subscriber Corollaries
- Integration of Fixed and Mobile Panel Support Features





• 2016 Fixed Methodology Other Change

- Adjust multi-TCP speed tests from 30 seconds to 10 seconds.
- Adjust multi-TCP speed tests to use a higher number of parallel TCP connections. This test is intended to characterize line capacity, and the adjustment is required for very high bandwidth connections (300Mbps+).
- Introduce a single TCP connection test. To run twice per day, once in peak, once off-peak. This is intended to characterize the throughput of common applications (like video streaming downloading an email attachment, etc.).
- Disable the generic TCP video streaming tests.
- Clarify that we are running traceroute tests to both the video content servers and also the dedicated measurement servers.





• 2016 Fixed Methodology Other Changes

- Add in Hulu as a video provider being tested.
- Introduce a new CDN test. This captures IP address, TCP connection time, time-to-first byte, and transfer time and speed for a small object hosted on the following CDNs: Apple, Akamai, Microsoft, Google, Cloudflare, Amazon.
- Change the speed tests to focus on peak hours. Currently we run once every 2 hours (12 times per day), giving us 2 samples in peak hours. We propose to change this to: once in midnight-6am, once in 6am-midday, once in midday-6pm, once every hour thereafter. This drops to 9 samples per day (thus further reducing data usage), but increases the peak hour samples to 4.
- Add in reverse path traceroute for the dedicated servers. This is minimal overhead and may be useful to researchers.

Existing FCC Measurement History and Evolving Rules

- FCC has an evolved schema in place to acquire and analyze data on legacy PSTN
 - PSTN resiliency: Part 4, ARMIS
 - Section 706 of Telecommunications Act, 1996, required annual report on availability of advanced telecommunications services to all Americans
 - Resulted in information on deployment of broadband technology but not its performance
- Proposed performance measurements of broadband services delivered to consumer household
- Open Internet Rulemaking
Expanded Scope of Disclosures
Required by Carriers in
December 23, 2010 to
Include Performance Information

1. Transparency [47 C.F.R. § 8.3]

A person engaged in the provision of broadband Internet access service **shall publicly disclose accurate information regarding the** network management practices, **performance**, and commercial terms of its broadband Internet access services sufficient for consumers to make informed choices regarding use of such services and for content, application, service, and device providers to develop, market, and maintain Internet offerings. This rule applies to both fixed and mobile broadband Internet access providers. [emphasis added].

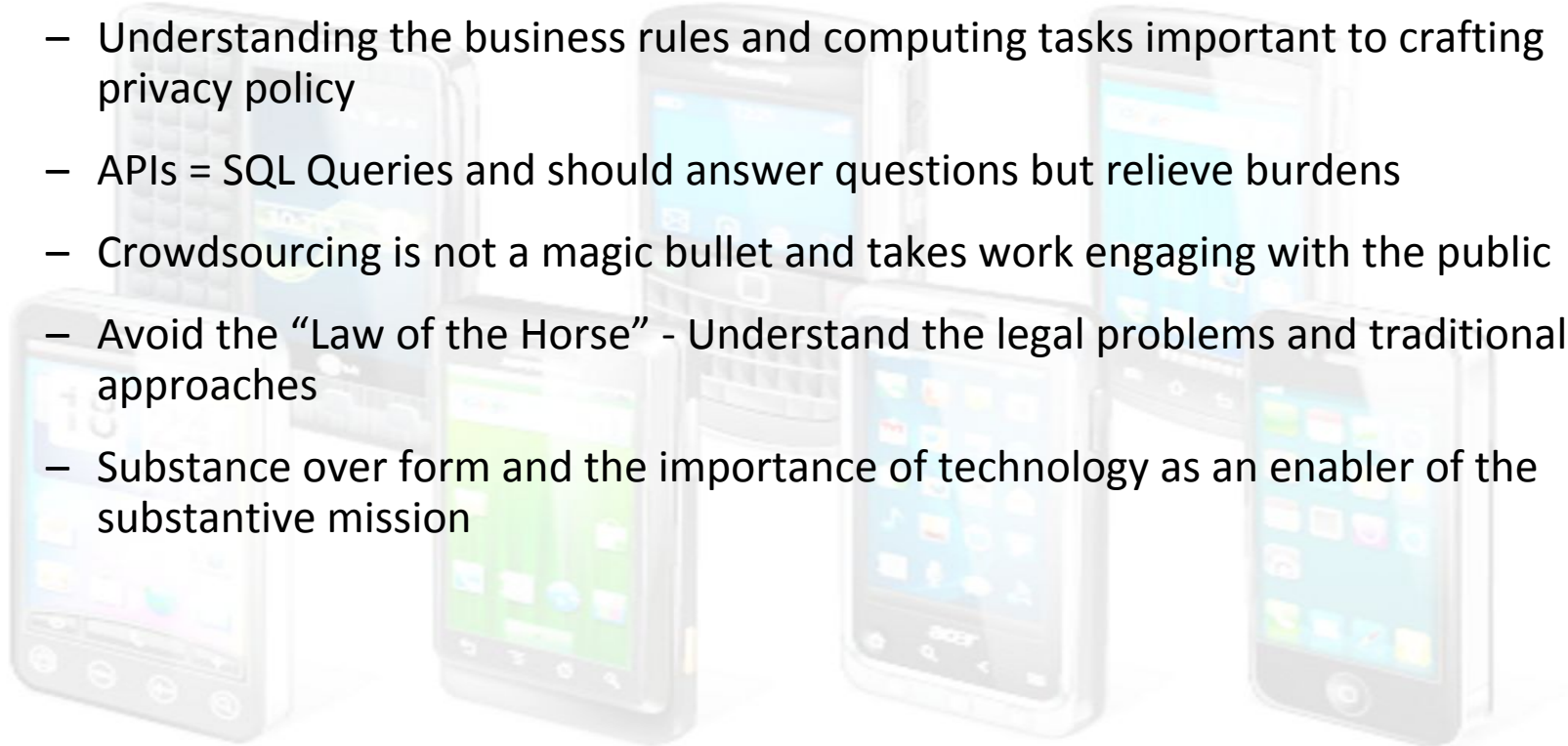
FCC data sets and reports of (Internet) interest

- Measuring Broadband America (Internet performance measurements)
- Broadband Progress Report (“706 report”)
- Broadband deployment data (“Form 477”)
- International Broadband Data Report
- Mobile Wireless Competition Report
- Universal Service Monitoring Report (telephone service)
- Telephone Subscribership in the United States
- Report on Cable Industry Prices
- Trends in Telephony Service
- Not available:
 - detailed price & subscription data
 - outage and reliability information



• Crowdsourcing Open Data

- Engage the stakeholders
- Value of Open technologies and approaches for internal stakeholders, contractors, industry stakeholder and the public
- Understanding the business rules and computing tasks important to crafting privacy policy
- APIs = SQL Queries and should answer questions but relieve burdens
- Crowdsourcing is not a magic bullet and takes work engaging with the public
- Avoid the “Law of the Horse” - Understand the legal problems and traditional approaches
- Substance over form and the importance of technology as an enabler of the substantive mission





NETACTIVITY Reference

- **JSON Native Files**

- Active Tests
- Wireless Cellular
- Handset APIs
- Test Conditions & Error Conditions

- NETACTIVITY
- PARAM_EXPIRED
- CPUACTIVITY

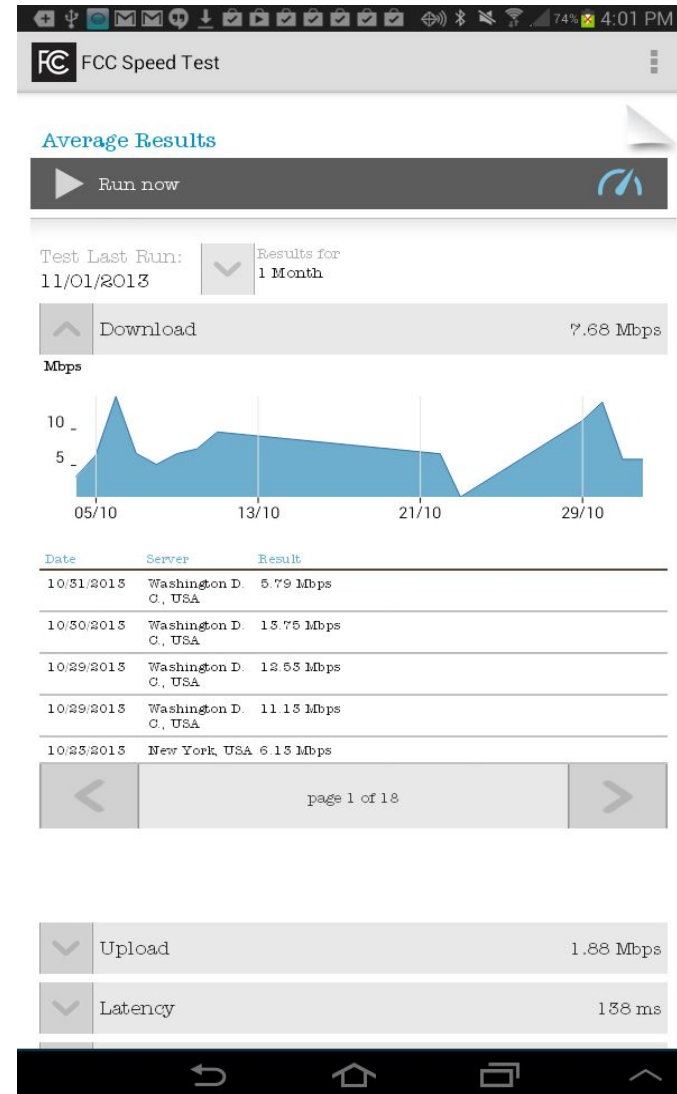
Property	Type	Description	Explanation
type	String	NETACTIVITY	The passive metric type 'NETACTIVITY' describes the traffic sent and received by the handset during a test condition period.
bytesin	Integer	0	The field holds an integer value that identifies the number of bytes received by the handset during the test condition period.
bytesout	Integer	0	The field holds an integer value that identifies the number of bytes sent by the handset during the test condition period.
datetime	String	Fri Jan 25 10:23:21 EST 2013	The unix time and date of the handset performing the measurement at the beginning of the observations.
maxbytesin	Integer	10000	The field holds an integer value that identifies the maximum limit of bytes to be received by the handset during the test condition period.
maxbytesout	Integer	5000	The field holds an integer value that identifies the maximum limit of bytes to be sent by the handset during the test condition period.



- **Handset Retains Personalized Performance History**

- Average and individual test result history displays changes in mobile broadband network performance over time.

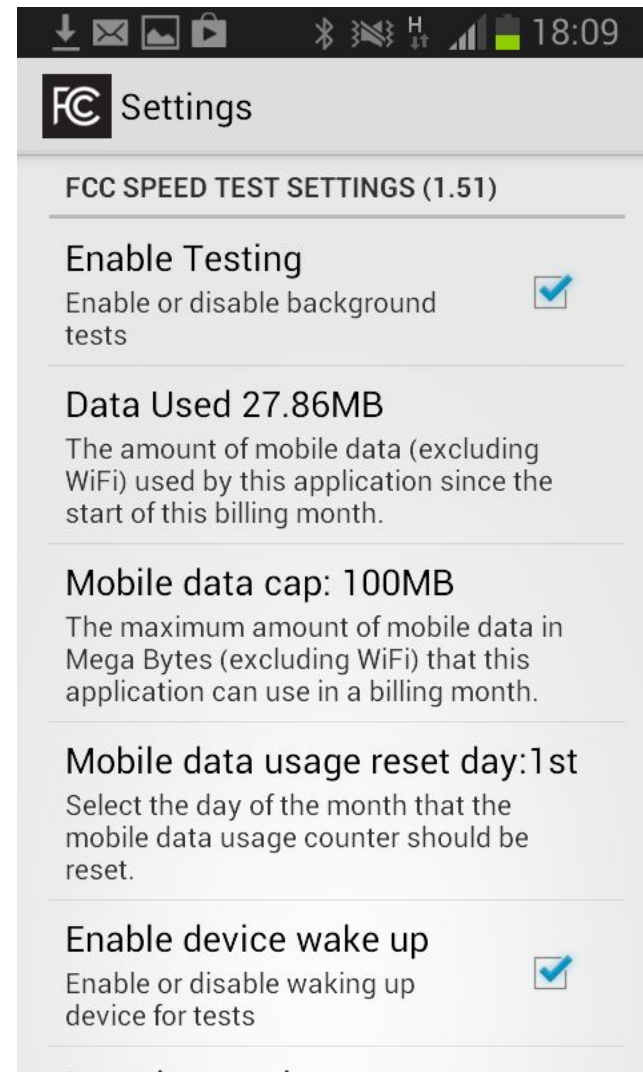
- Removes need for personalized data on backend





• App Functionality

- Available to download from Google Play.
- Tests run as requested by the user (manually), and on a random centrally-scheduled background basis.
 - Measures speed, latency, and packet loss.
 - Structural data including RSSI, Bearer, Carrier, CellTowerID, etc.
 - Data cap defaults and other consumer protections





- **Software and Data Tools Supporting Big Data Applications**

- Native JSON file formats and noSQL approaches
- Conversion tools for CSV, SQL and other structured data
- Documented Data Dictionaries and Schemas

