Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
2009 Consumer Information and Disclosure	)	CG Docket No. 09-158
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	)	
	)	
Truth-in-Billing and Billing Format	)	CC Docket No. 98-170
	)	
	)	
IP-Enabled Services	)	WC Docket No. 04-36

COMMENTS OF VERIZON WIRELESS
ON MEASUREMENT OF
MOBILE BROADBAND NETWORK PERFORMANCE AND COVERAGE

Verizon Wireless hereby submits its comments on Public Notice DA 10-988[1] regarding the measurement of mobile broadband network performance and coverage. As a provider of nationwide commercial mobile broadband service, Verizon Wireless is familiar with methodologies for measuring mobile broadband network coverage and performance. It continually tests and evaluates its network coverage and performance to build out, maintain and market its mobile broadband service. And, it provides consumers with information as to network coverage and performance. Other competing mobile broadband providers offer similar information so consumers can choose which provider best meets their needs.

Given the current availability of information on mobile broadband coverage and performance, and the incentives providers have to police their competitors' claims in the

[1] "Comment Sought on Measurement of Mobile Broadband Network Performance and Coverage," DA 10-988 (released June 1, 2010).

marketplace, there is no reason for the Commission to involve itself in wireless broadband performance testing or the display of mobile broadband coverage maps. Consumers now can obtain the information they want directly from providers, or through their own "test drive" of a mobile broadband device during the trial period offered by providers. If the Commission were to consider developing its own data collection efforts, then it should do so only under a comprehensive testing program that collects information through a well-designed test drive procedure that measures multiple metrics affecting service reliability, not just speed. Alternatively, it could use available data collected by an authoritative source through such a testing program. "Crowdsourcing," as described in the Public Notice, cannot provide the same reliable and comprehensive data as data collected through a comprehensive test drive program, and it suffers from multiple, inherent flaws due to the unique issues posed by measuring broadband service to and from mobile devices. Crowdsourcing thus should not be used to evaluate mobile broadband performance and coverage. Ultimately, if the Commission wants to develop metrics to examine mobile broadband coverage and performance, it should convene a technical advisory group to assist it in ensuring that testing protocols are valid and produce accurate, useful information.

Measurement metrics for mobile broadband services.

1. *What are the best measurement metrics for mobile broadband services?*
    a. *What performance characteristics should be tracked for mobile broadband networks (e.g., typical data throughput, signal strength, accessibility, retainability, latency, other quality of service parameters)? At what level of temporal and geographic granularity?*
    b. *What parts of the network should be measured? What starting and ending points (e.g., radio access network, middle mile) are most useful and actionable for consumers, regulators and providers?*
    c. *Should measurement processes and standards for mobile broadband services be different than those for fixed broadband connections?*

The typical end user of mobile broadband services is primarily interested in data on geographic coverage and performance, including speed and reliability, that is, whether the user can perform the tasks he desires in the locations where he anticipates using the service. For example, consumers may be interested in data on reliability where they live and work, while business enterprises may have the need for specific coverage data to ensure that service is available for communications between field operations and office bases in specific locations. Currently, mobile broadband providers offer such information on their websites through signal coverage maps and descriptions of throughput speeds, and can also respond to specific requests for information.

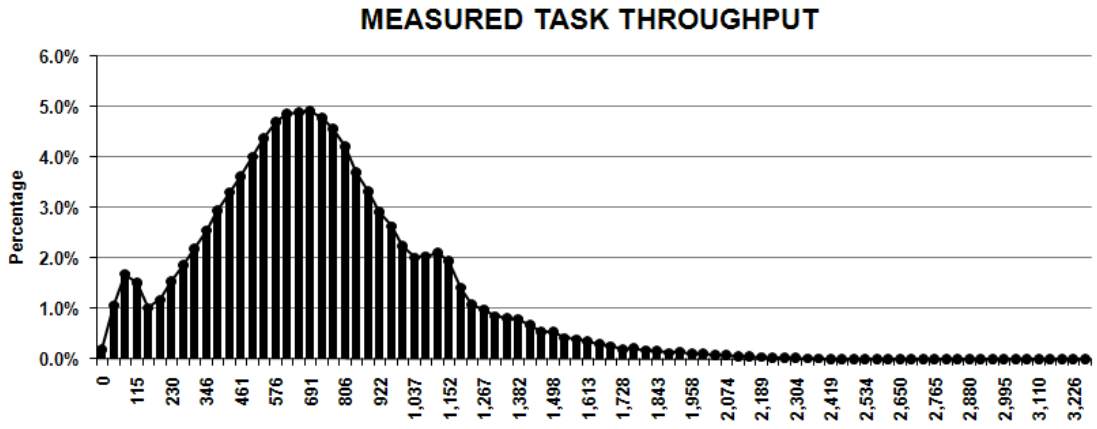
Throughput is usually reported in a range of average or typical speeds; coverage maps are provided as predicted and approximate coverage. Such predictions of coverage and performance remain subject to the variations in RF signal and the presence (or absence) of interference that are inherent in mobile broadband service, both as a result of network and device performance and external factors, discussed in more detail below. For most consumers, the level of detail portrayed in signal coverage maps and a description of the typical throughput range would be sufficient to evaluate the suitability of the network to meet their needs.

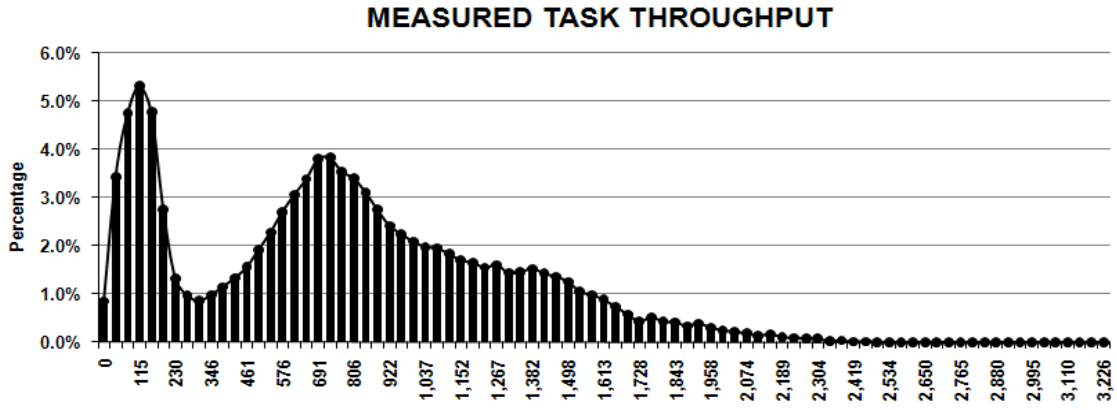
Much more detailed technical assessments of network performance underlie the information that is available to consumers. Mobile broadband network providers use such detailed assessments to maintain their networks and evaluate network improvements and expansions.[2] Tracking the characteristics and performance of mobile broadband

[2] *See* http://aboutus.vzw.com/bestnetwork/network_facts.html ("We use the results of our frequent network tests to maintain and fine-tune our network on a regular basis as part of our ongoing quality maintenance programs.").

networks requires systematic and detailed collection and analysis of data. At this level of detail, Verizon Wireless believes that the proper assessment of mobile broadband networks requires employment of statistically valid methodologies that leverage dense sampling across a wide geographic area that can accurately portray measurements for the area being characterized (*e.g.*, statewide or market-based).

In addition, measurements of specific service qualitative attributes such as throughput speed should describe the mobile broadband network independent of outside/external network influences and be portrayed as a range of experience. Using a "range of experience" metric can provide a more informative description, because simply using the "average" observed across testing throughput in a geographic area can provide a very different depiction of the probable user experience. For example, in the following two depictions of percentage of tasks performed at a specific throughput speed, the average speed for both is similar, although the percentage of instances falling significantly below the average are higher in the second graph. In other words, reporting the average speed does not tell the consumer how frequently that speed may be achieved, so reporting the range of experience would provide better insight into network performance.





Mobile broadband networks are designed to enable service to the mobile user, and service encompasses several discrete metrics. Verizon Wireless tests and collects data on many aspects of service, including the following:

> Radio Network Availability – Is the mobile broadband radio network available? (This is essentially what is measured by a signal coverage map.)
>
> Radio Network Access – Can the user connect to the mobile broadband radio network? (This is a measure of failed connection attempts, that is, how often when the user attempts to connect to the data network, she obtains a connection, as opposed to a blocked connection (network overload), forcing multiple retry attempts.)

Service Access – If connected, can the user authenticate and acquire the requisite credentials to access the mobile broadband system? ("Service access" measures how often the network will be able to locate the site that the user has designated without reporting back an error, *i.e.,* offers the desired service to the user.)

Service Reliability – Can the user reliably maintain mobile broadband radio and system connectivity and complete tasks without disruption (call dropping)?

Service Performance – Did the service experience in terms of throughput, latency, etc., meet user needs and expectations? (Service performance takes into account the speed of delivered service, latency, etc. as the user performs her tasks.)

Verizon Wireless uses these basic metrics, and its network test and measurement program, in a constant, daily effort to improve the wireless experiences for its customers. It recognizes that attracting and retaining customers depends on providing the highest quality, most reliable service to them where they live, work, commute and travel.

All of these metrics should play a role in evaluating mobile system performance. For example, throughput speed has been used by the Commission to define what is broadband service, *e.g.,* for collection of data in Form 477. However, faster data speeds on a mobile broadband network do not necessarily translate to improved performance, and blazing fast throughput speeds are less impressive if setting up a mobile broadband data session on the network fails in 20% of attempts. Or, a reliable network may not be the most attractive network to some consumers where geographic coverage is limited. For that reason, if the Commission were to conduct a measurement program for mobile broadband, then it should include a broad set of metrics, including the following:[3]

Radio Network Availability – The probability that the broadband mobile radio network is not offered or coverage is insufficient to allow radio access. (Percentage of network unavailability.)

[3] These measures are comparable to the layers in the Open System Interconnection ("OSI") model. *See* ITU-T, "Data Networks and Open System Communications," ITU Rec. X.200 (07/94).

Radio Network Access – The probability that a user cannot successfully connect to the mobile broadband radio network (such as a lack of radio coverage or insufficient base station resources). (Percentage of failed connection attempts.)

Service Access – The probability that a user can successfully attach to the mobile broadband system and route user data. (Percentage of failed IP address assignment.)

Service Reliability – The probability that a varied set of tasks can be completed successfully and without disruption on the mobile broadband network. (Percentage of dropped data connections.)

Service Performance – The probability that a varied set of tasks can be completed within the stated performance expectations of the mobile broadband network. (Percentage of task latency above target; percentage of round trip time above target; percentage of throughput speed measured below target).

After the metrics have been decided upon, the next question is how to compile the data. There are multiple temporal and geographic considerations that should be taken into account. Network assessments should be averaged over time (rolling 12-month view as an example) and occur routinely such that both improvements and degradations affecting user experience can be captured, while guarding against allowing isolated incidents to unduly impact current results. Network assessments should incorporate an expansive geographic mobile sampling in order to provide the broadest possible extrapolation of the data (*i.e.,* thousands of individual test locations).

If the measurements were used to compare networks, then there are several factors that could affect the comparability of mobile broadband service measurements for different networks that need to be considered in the test plan:

- Use of different mobile devices and antenna configurations, measurement equipment, software and protocols;

- The locations where measurements are made;
- The time when measurements are made – for example, the performance of the radio access may be affected by time of day, weather conditions, seasons (extent of tree foliage), and recent weather history (wetness of the ground and foliage).

Consequently, any measurements that are intended to compare the quality of multiple networks should use a common measurement procedure, including comparable test devices, and the different networks should be sampled simultaneously from the same locations. The number of different locations should be sufficiently large to provide some statistical averaging to take account of the different locations of base stations.

With regard to the Public Notice's question as to what parts of the network should be measured, the mobile broadband network should be viewed as an extension of the public broadband network and Internet. As such, the need to account for user mobility introduces a series of technical tradeoff considerations each mobile broadband carrier must balance in order to properly meet the needs of its customer base. Competition in the mobile broadband network marketplace and with end user equipment suppliers, along with nomadic consumers' demand for services and advanced capabilities, produces varied networks tailored to the user segments they seek to attract. As a result, comparative assessment of mobile broadband networks should focus only on the individual providers' mobile broadband network and not allow factors beyond the operators' control to unduly influence perception of service and devices. In other words, measurement of performance should ideally test only the edge of the mobile broadband

network, that is, from mobile broadband provider-controlled devices to ISP interconnection.

The Public Notice also asks whether testing of mobile broadband should be different than for fixed broadband. It absolutely must be different, for the simple reason that mobile and fixed devices and networks interact in significantly different ways that require distinct methodologies for measuring performance and coverage. Fixed broadband involves a direct line connection between the end user and the network that is more static in terms of location and performance expectations. The connection between a wireless broadband end user and the network is subject to degrees of variability based upon multiple dimensions – the user is nomadic, and the radiofrequency connection between the user and network is affected by many factors, such as the number of other users in the same geographic area, the frequencies in use, the nature and topography of the location or venue, the season of the year, the characteristics of the device, and the various programs running on the device.

While mobile broadband coverage may be somewhat predictable based on RF propagation characteristics, achieving a reliable connection to the network and the performance of the network vary against all these other factors, making infeasible a summary depiction of mobile broadband network performance equivalent to fixed broadband network performance. The characteristics of the network to be measured (coverage footprint rather than homes served, and primarily using a range of experiences for performance as described above) and the measurement procedure (drive tests) for mobile broadband will be completely different than those for fixed broadband. While

some end result comparisons of speed, throughput and latency may be possible, how one gets to those comparisons will be quite different for fixed and mobile networks.

User-generated and other data gathering methods.

2. *What are the best methods for collecting data on mobile broadband performance and coverage for end-users?*
    a. *What are the best available tools in the market today for measuring mobile broadband performance and service coverage?*
    b. *Are there current data sets already available that could be useful for facilitating better consumer disclosures on mobile broadband performance and coverage?*
    c. *Are there existing technologies that can measure actual end-user experience on mobile broadband networks? If so where could the measurements take place (e.g., on the device, inside the network)?*

Given the mobility enabled by wireless broadband networks, the best means of collecting performance data and confirming coverage data are drive tests, incorporating well-designed and thorough testing routes and test devices that provide a similar experience for each network being tested. Coverage and performance tests conducted by professional organizations such as The Nielsen Company[4] in the United States and P3 Communications GmbH[5] in Europe employ test equipment in a controlled environment to capture as near as possible network coverage and performance that can be compared objectively across networks. Verizon Wireless, AT&T and other mobile providers similarly use drive tests with test equipment in a controlled environment to measure their own and their competitors' networks.

Typically, a drive test for a particular market is conducted over multiple days and covers a significant number of miles within the market. During the course of the test drive, numerous automated test sessions occur, usually of relative short duration, and test the network using the criteria noted above in response to Question 1 (radio network

[4] *See* http://en-us.nielsen.com/.
[5] *See* http://www.p3-group.com/communications/en/home.html.

availability, etc.). For comparative test purposes, test calls are made simultaneously on multiple networks to ensure the same conditions are present. Test equipment, including devices and antennas, and output power are controlled to ensure the accuracy in comparative results for both the same network in different markets and different networks in the same market. Drive routes are selected based on the types of highways within the market and the density of potential subscribers. Similar drive routes are typically used for each market in subsequent tests to ensure the comparability of periodic testing. While each testing organization may use different equipment and different test routes, each follows the same basic procedures for all drive tests.

In Europe, ETSI has published a seven-volume set of technical procedures for testing mobile networks based on the European standard for GSM technology.[6] This publication provides a standardized test procedure, and is used by P3 Communications, for example, for evaluation of mobile broadband networks in Europe. There is no comparable, compiled standard test document in use in the United States, although the drive tests conducted by Nielsen, Verizon Wireless, AT&T and others in the United States follow similar test procedures.

In the United States, mobile broadband network operators have access to independent third party assessments of both mobile broadband coverage and performance. For example, Nielsen offers network assessments on markets throughout the United States. The mobile broadband devices used for drive tests are devices that are maintained in a controlled test environment. They are designed to reflect as closely as possible the experience of a real-life end user.

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[6] *See* ETSI, TS 102-250-1, "Speed Processing, Transmission and Quality Aspects (STQ); QoS Capacity for Popular Services in GSM and 3G Networks," 7 vols. (2004-2009).

There are, however, currently no reliable technologies available for measuring *actual end user* experience on mobile broadband networks. The problem that actual end user test applications encounter is that any in-service, end user device will be supporting various end-user activities, and will, therefore, ultimately reflect a performance trade-off. Background applications, memory allocation, processor capacity and power management are all common *non-network* based end-user environmental factors that impact the consumer experience. Moreover, each consumer device model is built differently, reflecting the manufacturer's decisions about which hardware and software elements to include based on costs, power consumption, and intended market. Two different models operating in exactly the same location under the same conditions may give different readings on an active user's experience on a specific network. Thus, the actual end user will typically have a range of experiences on his or her mobile broadband network – that range of experiences can be reflected in data collected through drive tests. This is one reason why crowdsourcing would be an invalid approach to testing mobile broadband services, as discussed below.

3. *How can user generated data (i.e., 'crowdsourcing') on mobile broadband network performance and coverage be utilized to assist in collecting data and improving transparency?*
    a. *What efforts and technologies currently exist that can enable device level data collection on performance and coverage of mobile broadband networks? What metrics could a device level software application collect that could measure mobile broadband performance and coverage (e.g., signal strength, data throughput rate)? What other data points would be valuable to collect in association with that data (e.g., location, tower ID, handset type)?*
    b. *For collecting device level data, what impact does the type of device (e.g., smartphone, feature phones, laptop, wireless modem) itself have on end-user experienced network performance? How, if at all, could a measurement methodology take variations resulting from device type into consideration?*

c. *How could measurement methodology account for variations in performance due to the location (e.g., basement of house vs. above ground) or movement (e.g., user on a train) of the end-user? How can we account for differences in location determination methods (e.g., GPS) across handsets and providers, if any? How should buildings, topography, weather, continued network build-outs, and other service availability variables be accounted for in the methodology?*
d. *Can a statistically robust sampling method correct for the variables described above, such as the impact on performance and coverage measurements of movement, device and location variability?*
e. *How can we measure performance with minimal impact on the network itself? For example, how can active measurement techniques that generate additional network traffic mitigate potential increases in congestion?*

It is possible for an application on an active, end-user mobile device to report information regarding the broadband network, such as throughput speed, latency, and precise location where the signal is received. It would also be possible for the user to respond to a pop-up questionnaire at the time when such information is captured, which could collect additional subjective details on the user experience such as service reliability and quality of the user experience.

However, such user-generated data[7] cannot provide measurements on performance and coverage that would be as useful as, or as free from defects in the measurement procedure as, those derived from the controlled drive tests described above in response to Question 2.

Given all the variables that the Commission itself identifies in these questions, such user-generated data would not produce statistically acceptable or reliable data on

[7] The Commission uses the term "crowdsourcing" to describe this means of collecting data. However, crowdsourcing originally signified using a crowd population to find solutions to a problem, rather than simply raw data collection. *See* http://www.wikipedia.com/wiki/Crowdsourcing (last visited June 25, 2010). Raw data collection with limited analysis is more akin to "mean opinion scoring"; for example, reporting on the number of users who respond with a specific opinion when polled.

mobile broadband network coverage and performance.[8] Device-specific variability, location determination challenges, and survey point randomness and/or completeness seriously diminish the value of "crowdsourcing" for the purpose of providing reliable metrics on mobile broadband networks.

Device level collection techniques work best when the device is used for that single purpose, that is, in a drive test situation. Indeed the major players in the test and measurement industry have all deployed PDA-based adaptions of their systems. These devices, however, are special purpose devices configured to acquire technology-specific measurements. For example, signal measurements for analog, CDMA, EVDO, GSM, UMTS, HSPA, Wi-Max and LTE must all consider different types of signal characterizations and the availability of higher order-modulation schemes. In older technologies (such as analog or GSM), strong raw radiofrequency power was highly desired while in more recently-developed technologies, especially those based upon spread spectrum or wideband adaptation (such as CDMA, EVDO, HSPA, Wi-Max and LTE), lower power and interference levels are desired to maintain quality and capacity and ultimately to deliver the highest order modulation support. Given these variations in technologies, special purpose testing systems with integrated devices are required to support the full array of technologies.

In contrast, user-generated data is subject to specific and acute limitations related to the devices used for such data collection. Among the most noteworthy are:

- Device power reserve: The crowdsourcing application uses the available power, and is dependent on its operation on the battery power. Some devices may be programmed to shut down background applications to preserve battery life.

[8] The Commission is committed to dissemination of information that meets standards of quality, objectivity, utility and integrity. *Information Quality Guidelines*, 17 FCC Rcd 19890 (2002).

- Antenna design: Does the device provide a primary and secondary antenna? What is the placement of the antenna elements within the structure of the device and how does the handgrip influence the reception performance of the device?

- Available memory: How many applications can be running simultaneously, and will the user's decision to start another cause the measurement application to fail?

- Concurrent application execution: If the device is running multiple applications, the performance of any one may be affected, which may affect the readings that are delivered.

- Privacy concerns: Is the user willing to be tracked 24/7? Or, will privacy concerns cause the user to shut down the application, skewing any readings?

Moreover, with regard to the geospatial association of data points to the area under analysis, a failure to adequately define measurement location seriously undermines the intent of providing mapped results for consumers.

Device design affects the user-generated data approach as well. Equipment manufacturers today build their devices to balance multiple factors: time to market, complexity of the design, costs, and end-user appeal. As a result, the range of "smart" devices upon which the envisioned crowdsourcing application would run will vary greatly in terms of available memory, processor capacity, and operating system configuration. Indeed, attempting to place regulatory importance on collecting crowdsource data could have the effect of incenting manufacturers and service providers to favor high-end devices that perform well on the crowdsourcing application.

There are also application-based limitations to user-generated data. While technology advances have made on-board device tools ever more common, few if any devices are capable of sustaining these activities (that is, reporting back on performance

and coverage) either in the foreground or background without severely affecting the consumer experience. As one example, it is common for consumers and even device operating systems to disable device capabilities such as location determination in order to improve consumer experience (*i.e.*, battery life).

If crowdsourcing were to have any useful function, then the data collected would have to be combined with more reliable data, *e.g.*, reliable coverage maps from Nielsen data or American Roamer.[9] By specifying, for example, the signal-to-noise ratio in the mobile broadband network at certain locations, the data collected from actual users could enrich the coverage data by informing consumers of call successes in various locations, both across the area as well as above (high-rises) and below (basements, subways). But, this could only be useful in conjunction with more reliable data on signal coverage.

4. *What are the benefits and costs of measurement for providers, regulators, customers and others?*
    a. *What are the benefits (e.g., transparency, better data, network and international comparability, benefits for researchers, verification of National Broadband Map grantee data)?*
    b. *What are the costs (e.g., hardware costs, usage of the network, consumer hassle, accurate information already exists)?*
    c. *Are there any legal, security, privacy or data sensitivity issues with collecting device level data? If so, how can these issues be addressed?*

Appropriately collected and analyzed data can help assess network performance and coverage, as well as enable comparative evaluations among networks. However, there are significant costs associated with the kind of test drive data needed to assess the quality of mobile broadband networks. Verizon Wireless alone employs more than 90 test drivers, who annually conduct more than 3.5 million voice call attempts and more

[9] American Roamer collects, compiles and markets wireless signal coverage information. *See* http://www.americanroamer.com/. It announced in March 2010 that it had developed "a new broadband mapping tool. The first of its kind browser-based application illustrates where and how broadband coverage is available throughout the United States." http://www.americanroamer.com/companynews.php (last visited June 25, 2010).

than 19 million data tests on Verizon Wireless' and other national wireless networks, while traveling more than 1 million miles in specially equipped, company-owned quality test vehicles.[10] Verizon Wireless, and other mobile broadband providers, expend such resources because testing the network is an essential part of a mobile broadband providers' business in meeting consumer expectations and planning improvements to the network.

The Commission does not need to expend similar resources, because data on mobile broadband networks' performance and coverage is already being collected in formats that may meet the Commission's goals in this context:

- Nielsen offers to interested parties comprehensive data on mobile broadband networks in U.S. markets.[11]
- Mobile broadband coverage data is available from American Roamer.[12]
- In recent years, several states have been collecting data on broadband coverage, including mobile, through public-private partnerships such as ConnectKentucky, and the results are posted on-line.[13]
- Each state is collecting data on broadband coverage and offered speeds, including mobile broadband, under grants from the National Telecommunications and Information Administration through the Broadband Data Improvement Act ("BDIA"), with the goal that each state will make available to consumers interactive broadband maps.[14] Some of these maps are already available to

[10] *See* http://aboutus.vzw.com/bestnetwork/network_facts.html.
[11] *See* http://en-us.nielsen.com/.
[12] *See* http://www.americanroamer.com/.
[13] *See* http://www.connectkentucky.org/about_us/ (last visited June 25, 2010).
[14] *See* http://www2.ntia.doc.gov/SBDD.

consumers.[15] (Congress allocated $350 million for development of a nationwide broadband inventory mapping program under the BDIA.)

- NTIA and the Commission will compile national broadband coverage maps from the state efforts under the BDIA.[16]

Besides the sheer expense of a valid testing program, Verizon Wireless has noted in response to Question 3 other problems associated with consumer applications that might be used to collect data from end user devices, including privacy concerns from the location data, billing concerns for the data allowance consumption, device performance concerns arising from the impairment of battery life and the functioning of other applications on the device, and potential marketplace limits on developing a range of suitable devices.

Given these and other problems, the Commission should not develop its own unique data collection program. At most, it should use existing data collection efforts, digested for certain metrics, from a testing source that the industry agrees is authoritative.

Publication and communication.

5. *How could information on mobile broadband performance and coverage be better communicated to consumers?*
    a. *What are the current best practices for displaying or communicating mobile broadband performance and coverage to consumers today?*
    b. *Are consumers currently being provided with enough accurate and detailed information about performance and service coverage to make informed choices between different mobile broadband network providers?*

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[15] *See, e.g.,* www.connectedtx.org (last visited June 25, 2010).

[16] *See* Department of Commerce, National Telecommunications and Information Administration, "State Broadband Data and Development Grant Program; Notice of funds availability (Notice) and solicitation of applications," 74 Fed. Reg. 32545, 32546 (July 8, 2009) ("In addition, the awardees will submit all of their collected data to NTIA for use by NTIA and the Federal Communications Commission (FCC) in developing and maintaining the national broadband map, which will be displayed on an NTIA Web page before February 17, 2011.")

Wireless providers use various metrics to provide consumers with information on mobile broadband networks. For example, Verizon Wireless offers consumers an interactive signal coverage map on its website. Customers can enter a street address or any zip code to see the service available at a specific location.[17] The map will depict where Verizon Wireless' 3G, EVDO network (Mobile Broadband) operates vs. where its 1X (Network Access) network operates. Verizon Wireless also offers information on typical throughput speeds for the mobile broadband service.[18] And, it offers consumers information about the network testing program that backs up Verizon Wireless' claim to be the nation's most reliable mobile broadband network.[19]

Providers generally rely on their own test data or third-party data, such as Nielsen reports, to support the information they provide on coverage and performance. Since claims can be validated through the providers' data collection programs for their own and their competitors' networks, or the available Nielsen reports which cover multiple networks, advertising and marketing claims are based on data that uses industry-accepted metrics. If these claims are not factually supportable, then network providers can expect that their competitors will challenge them.

However, a coverage map or information on throughput alone does not necessarily inform the consumer whether the network will meets his or her needs. Mobile broadband service, like mobile voice service, is designed to facilitate nomadic usage. It is a personal, and personalized, service. Consumers vary in the type of device

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[17] *See* http://www.verizonwireless.com/b2c/store/controller?item=planFirst&action=viewPlanDetail&sortOption=priceSort&catId=409.

[18] Verizon Wireless states that users in areas with EVDO Rev. A coverage will experience typical download speeds of 600 to 1.4 Mbps, and typical upload speeds of 500 to 800 Kbps. *See* http://www.verizonwireless.com/b2c/mobilebroadband/?page=coverage.

[19] *See* http://aboutus.vzw.com/bestnetwork/network_facts.html.

they want to carry, the types of applications they want to run, and their traffic patterns. Network connectivity will vary with all the factors identified above. No provider or third-party analyst – nor the Commission – can take into account all the factors that any one consumer may find important in choosing a mobile broadband service.

Given these inherent variations, the best data for individual consumers is their own experience while running devices as they want to use them, where they want to use them. All major carriers, consistent with the CTIA Consumer Code,[20] have a trial period during which customers can try devices and test coverage and performance. The trial period allows customers to do their own "test drive" to determine whether the coverage and performance of the network suits their individual needs. Even a presentation of comparative network data would not necessarily tell individual customers whether their selected device will always perform as they need in the areas where they intend to use it.

Current mobile broadband network performance and coverage disclosures.

6. *What measurements are typically performed by service providers today to track mobile broadband network performance and service availability?*
    a. *What tools are currently available for consumers to check coverage and performance at a specific geographic location by mobile broadband network (e.g., coverage maps), and how accurate are the data for typical outdoor and indoor consumer use?*
    b. *How are data for coverage and service area maps collected, verified and displayed (how compiled, how accurate, how granular)? How are data on mobile broadband performance (i.e., data throughput rates) measured and displayed?*
    c. *What technologies are used to collect such data (e.g., RF modeled coverage, drive tests, network reporting, handset data collections)?*
    d. *Are there any voluntary industry standards that are being used in disclosing mobile broadband network performance and coverage to consumers? How could these be improved (e.g., signal strength or throughput bands to map different levels of service quality)?*

[20] *See* http://www.ctia.org/consumer_info/index.cfm/AID/10352 (last visited June 25, 2010).

As noted above, most mobile broadband providers offer on-line maps for consumers that provide detailed interactive coverage. Moreover, broadband coverage maps are also available through various state efforts, including efforts conducted under the BDIA. These maps are typically based on RF propagation studies, which may be informed by the company's own drive tests and/or drive tests conducted by a third party, such as Nielsen. These maps generally provide a detailed, street-level view that customers can use in an interactive manner. Such level of detail is beneficial to customers when researching various providers' service, as they are able to customize the maps to look at various areas where they may want service and zoom in to see specific coverage at the desired level of detail.

The coverage depicted in these maps will always be based on typical scenarios, because actual availability of the network depends on various external factors that cannot be readily depicted, including the number of users in the geographic area, the type of device any one user has deployed, the weather conditions, and seasonal changes in foliage.[21] Furthermore, producing maps that provide the same level of accuracy for indoor coverage is virtually impossible because the availability of the signal indoors varies with the spectrum in use, the structural materials of the building and the location of the user inside the building.

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[21] Verizon Wireless provides the following statement regarding its on-line maps:

> These Coverage Locator maps are not a guarantee of coverage and may contain areas with no service. The maps reflect a depiction of predicted and approximate wireless coverage. The coverage areas shown do not guarantee service availability, and may include locations with limited or no coverage. Even within a coverage area, there are many factors, including customer's equipment, terrain, proximity to buildings, foliage, and weather that may impact service. An all-digital device will not operate or be able to make 911 calls when digital service is not available. The Extended Enhanced Services Coverage Areas include networks run by other carriers; some of the coverage depicted is based on their information and public sources, and we cannot ensure its accuracy.

Major mobile broadband providers and companies such as Nielsen conduct their drive tests to determine network performance. While each test drive program may rely on different protocols and routes, all use the same basic procedures. Given the variation in technologies and other technical characteristics among mobile networks and mobile devices, and the variable nature of the user experience on mobile broadband networks, following a well-defined and consistent testing protocol for measuring coverage and performance, as set forth above in response to Question 2, is a critical requirement to obtain authoritative results. Without controlling for the variables that affect coverage and performance, the comparisons may not be informative for consumers, and indeed, may misrepresent the relative performance of the networks in the study.

If the Commission desires to develop a standard format or set of metrics for information on mobile broadband performance and coverage, then it should convene a Technical Advisory Group for those specific topics related to mobile broadband. In such a group, the Commission could hear from providers using differing technologies and spectrum bands on the specific issues that such standardization may present. The Commission could also hear why certain metrics may favor one technology or network configuration over another, and then could develop a set of metrics that balances out any such differences. Verizon Wireless is willing to partner with the Commission in these efforts.

Respectfully submitted,

VERIZON WIRELESS

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