BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Measurement of Mobile Broadband	)	CG Docket No. 09-158
	)	
Network Performance and Coverage	)	CC Docket No. 98-170
	)	
	)	WC Docket No. 04-36

COMMENTS OF AT&T, INC.

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On June 1, 2010, the Commission released a public notice (the "Notice") seeking comment on "whether and how" to pursue a measurement program for mobile broadband services, as well as on how mobile broadband providers report network performance and coverage, and whether such voluntary self-reporting could be improved.[1] In particular, the Commission seeks comment on the metrics that might best be used to measure mobile broadband network performance and coverage, the best methods for gathering data relating to such metrics, the potential costs and benefits of such data gathering, and the best methods for communicating information regarding mobile broadband network performance and coverage to consumers. AT&T, Inc. ("AT&T") submits the following comments.

Introduction and Summary

AT&T and other mobile broadband providers operate in a very competitive environment. They have every incentive to invest in improving their coverage and network performance, and in informing consumers of the relative advantages they offer over their competitors. Accordingly, we share the Commission's interest in developing better ways to measure cover-

[1] DA 10-988, Released June 1, 2010.

age and performance, and providing consumers with more and better information about the services we offer.

Consumers are armed today with more information about network coverage and performance than ever before. Carriers provide information to consumers in their marketing materials regarding coverage and network quality. There are device based applications that measure throughput. There is an ever-growing body of information available to consumers regarding network coverage and performance from third parties based on surveys, limited drive tests and "crowd-sourcing" methodologies. While these evaluations may not be as accurate or reliable as expert third party drive tests and coverage tools like AT&T's coverage viewer, we believe that they may be useful to consumers.

AT&T agrees that it is important for consumers of mobile broadband services to have access to reliable, accurate information in order to make informed decisions. Accurately measuring network performance and coverage is difficult due to the inherent variability of mobile radio communications and the need to account for non-network variables that can affect the results. Methodologies such as "crowd sourcing" can introduce biases that also may skew the data. If the Commission's goal is to measure mobile broadband network performance and coverage accurately and reliably, we believe that the Commission should employ drive testing rather than "crowd-sourcing" methods.

I. Mobile Broadband Network Performance Measurement

The Commission seeks comment on both the most useful mobile broadband network performance measurement metrics available and the best methodologies for tracking and reporting such measurements. In the related context of fixed broadband, the Commission has contracted with a third party, SamKnows, to undertake a similar initiative and has sought comment

on the metrics and methodologies SamKnows has proposed.[2] AT&T provided comments on the SamKnows initiative that pointed out the many challenges such an effort presents, given the many ways in which networks, content providers, applications, user behavior, operating systems, devices and other factors can influence the performance experienced by an end user, making it difficult to isolate and measure the performance of an individual broadband internet access service by itself.[3]

Attempting to measure mobile broadband network performance is an even more daunting task because, as compared to fixed networks, mobility introduces a greater range of factors that affect performance and those factors are subject to greater variability across different customers. In particular, radio frequency signal strength and interference, topography, weather conditions, device capabilities (e.g., battery strength, processing power) and the nomadicity of end users within or between cell sites all present unique challenges in identifyining relevant performance metrics and constructing a testing regimen that is capable of producing results that are comparable among different wireless providers.

Today, the most reliable and insightful means for measuring mobile broadband network performance across different providers is "drive testing," a process by which independent expert firms such as Nielsen and GWS perform various performance tests using devices connected to multiple networks at the same times and locations. This ability to measure multiple networks simultaneously helps control for many of the variables that make network-to-network comparisons difficult in the mobile environment. Still, the devices and applications used for such testing introduce some differences that cannot be eliminated using current technology, and the data

[2] *Comment Sought on ResidentialFixed Broadband Services Testing and MeasurementSolution,* Public Notice, DA 10-670 (April 20, 2010).
[3] Comments of AT&T Inc.—Consumer Information and Disclosure PN, DA 10-670, CG Docket No. 09-158 (May 4, 2010).

represent only snapshots in time.[4] Further, comprehensive drive testing is a technically sophisticated, labor-intensive undertaking and, thus, it is not an inexpensive proposition. But it represents the state of the art in mobile broadband performance measurement.

By contrast, "crowd-sourced" mobile network performance measurement using device-based tools (such as the Commission's performance measurement applications for the Apple iPhone and Android mobile smartphones, and similar applications produced by private firms like Root Wireless) are inherently far less effective and reliable than drive testing for purposes of measuring typical throughput, for example. Such crowd-sourced tools are subject to self-selection bias – they measure performance only for users who actively choose to obtain the tools and who run them at times and places of their choosing. Further, the efficacy of the tools are dependent on the capabilities and performance of the devices on which they happen to be installed by a given self-selecting user. As a result of these and other methodological deficiencies discussed below, AT&T is aware of no device-based application available today that will yield accurate, reliable and unbiased information on typical mobile broadband network performance.

In short, to the extent the Commission believes it needs more information about mobile broadband network performance than is already available today, AT&T believes the Commission should focus on the metrics discussed below and should consider drive testing, rather than crowd-sourcing, as a means to gather those metrics.

A. Metrics

In the Notice, the Commission suggests a number of potential metrics that should be considered for purposes of measuring mobile broadband performance and coverage, including typical data throughput, signal strength, accessibility, retainability, latency, location, tower ID, and

[4] Some popular technology oriented publicatons, such as PC World, have relied on drive testing analyses of mobile broadband performance. This testing is often limited in geographic scope and duration, however, and may not be particularly useful for the Commission's purposes.

device type. While all of these metrics are likely relevant to mobile broadband network providers for purposes of evaluating their own networks as they constantly strive to improve coverage and performance, AT&T believes that some of these might be less important to consumers.[5] In AT&T's experience, consumers consider a number of factors when choosing a provider, not the least of which is price. They also consider the coverage and quality of the network, as well as the selection of devices offered by the provider and the features and applications supported by those devices. When considering the network coverage and quality issues, data customers generally are most concerned with accessibility and retainability—whether the network has reliable coverage where they want it. For applications like web browsing and email downloads, they are also concerned with typical data transfer or page completion delay—which is how long does it take from the time data is requested until it is received.

However, before considering whether there are metrics that could provide consumers with better information on the comparative performance of various mobile broadband networks, it is important to take a couple of facts into account. First, according to the Commission's own data, most mobile broadband customers are quite satisfied with their mobile broadband service.[6] Moreover, more and more consumers are obtaining mobile broadband-capable devices and subscribing to and using mobile broadband services. Accordingly, it would appear that mobile broadband carriers are providing high quality services that consumers value highly. Second,

[5] In addition, handset manufacturers have differing policies with respect to whether they make public APIs an application developer would need to access this sort of information. As a result, some of the metrics noted in the Notice, such as location and tower ID, might not be able to be measured with device-based tools from all devices.

[6] See *Americans' Perspectives on Online Connection Speeds for Home and Mobile Devices*, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-298516A1.doc. (June 1, 2010). According to the Commission's survey results, 92 % of respondents reported that they were very or somewhat satisfied with their wireless service overall, and 71 % of respondents reported that they were very or somewhat satisfied with the speed of internet access on their smartphones, while only 13 % reported that they were dissatisfied with their internet access speeds.

mobile broadband providers compete vigorously for customers, using comparative advertising. Each of the four largest providers, AT&T, Sprint, T-Mobile and Verizon Wireless, advertise the attributes of their mobile broadband networks, with some claiming to have the fastest mobile broadband, the broadest coverage or the most reliable network.[7] Regional mobile broadband providers such as U.S. Cellular, Cellular South and Leap (Cricket) also trumpet the capabilities of their mobile broadband services in their advertising. And new mobile broadband entrants, such as Clearwire, have begun to offer and advertise "4G" service. These marketing and advertising claims are based on network performance data gathered by the carriers and by third party analysts, and are often further tested through carrier complaints to the National Advertising Division of the Better Business Bureau. Thus, carriers have every incentive to provide as much reliable, comparative data on network performance as they can in order to win customers in this wildly competitive market, and they also have the incentive to police the veracity of claims made by their competitors. All of this ensures that consumers get as much accurate, actionable information as carriers are able to provide in this young but burgeoning market.

With these marketplace realities in mind, we next disucss particular performance metrics.

Throughput. Carriers have invested billions in deploying technologies designed to provide more robust, higher throughput data services, from 2G technologies like GPRS/EDGE and 1xRTT, to 3G technologies like UMTS and EV-DO, and on to even more capable networks based on HSPA, WiMAX and soon, LTE.[8] Consumers have driven this investment, as they have moved from SMS and ringtone downloads to email, web-browsing, streaming video and even more robust and data-hungry applications. To compete, carriers must build networks that

[7] Wireless service providers, as an industry spent more on advertising in 2009 than all but three other industries. *14th CMRS Competition Report at Para. 129.*
[8] *14th CMRS Competition Report at Para. 11-117.*

give customers the ability to use the data applications they choose with the high quality customer experience they expect.

While "typical data throughput" might, at first blush, sound like a useful data point, it is unlikely to be a good predictor of the consumer experience in all cases as the actual throughput on a given network can vary widely, and because the throughput needed to deliver a good customer experience will vary widely depending on how the customer uses the network. For example, throughput at 100 Kbps may be more than sufficient for a high quality user experience for email and various machine-to-machine applications, but less than satisfactory for a consumer attempting to stream live video. Similarly, a customer's ability to achieve the networks "typical" data throughput may vary dramatically from cellsite to cellsite -- a single user on a cellsite is likely to experience higher throughput than a user sharing access to a cellsite with multiple users simultaneously streaming video. In fact, none of these hypothetical users may experience "typical data throughput."

More importantly, accurately measuring "typical data throughput" is a difficult endeavor, particularly if measured from the standpoint of the end user with a metering application on his or her device. If the purpose is to provide data that would allow comparisons between the performance of mobile broadband networks, one would have to consider how to account for a number of variables outside the mobile broadband network that will affect throughput. These variables arise from factors from the party with whom the customer is seeking to send or receive data, the networks between that party and the customer's mobile broadband network, the customer's device, the other applications that the customer might be using, and the metering application itself. In addition, variables in the customer's mobile broadband network, such as location, other users, weather, topography, time of day, and other factors can affect throughput.

First, the server that a data user might be trying to access could affect the perceived throughput. We have all experienced times when multiple users try to access the same website and understand how speeds can be affected by this phenomenon. The location of the content/application servers with which a customer wishes to communicate and the network topology (peering and/or transit links, the capacity and location of such links, the internet access network and backbone network) between such servers and the customer's mobile broadband network also will affect throughput on an end to end basis.

The way the content/application provider packages the data also will affect the customer's experience. Throughput measures are sensitive to file sizes, the protocol used, parameter settings for the protocol and so forth.

In addition, the customer's device will affect throughput. Feature phones generally cannot achieve the throughput rates that smartphones can deliver, and laptop cards are likely to be more capable than smartphones. Different models of the same device may have different capabilities (such as the iPhone, iPhone 3G and iPhone 3GS). Even devices of the same make and model might behave differently based on variance in the sources of supply for chipsets or other components.

Device software also will affect throughput. Operating systems have differing characteristics that can affect perceived and actual speeds. Whether a customer is multitasking (using more than one application at the same time) is also likely to affect throughput measurement. In fact, the operation of the metering application itself will affect throughput, both due to the activity on the device itself, and potentially, in a "crowdsourcing" effort, by contributing to network congestion.

Thus, if the objective is to provide data that a consumer could use to inform a choice between mobile network providers, all of these non-network variables would have to be taken into account. To be useful (and not misleading) any attempt to gather and disclose end to end data on throughput to come up a comparative measure of typical throughput for mobile broadband networks would have to either develop a statistical model capable of accounting for all of these non-network variables, or an effective means of disclosing the amount by which such variables might affect the user's experience, or, perhaps, both.[9]

Even if the non-network variables were taken into account,[10] the amount of variability between the throughput experienced by the a email user on an otherwise vacant cell and a streaming video user on a different cell during a weather emergency is likely to be striking, and neither number is likely to resemble a "typical" throughput number. Indeed, the range of variability in throughput for a mobile broadband network could be expected to be quite wide, wider, by orders of magnitude, than that which might apply to a fixed broadband access network. Accordingly, to the extent that measures of "typical throughput" could be derived, even through state of the art drive testing, the utility of such a measure may be limited. While it might provide some directional guidance on the relative performance of competing networks, it is unlikely to be a reliable predictor of a consumer's likely experience in any given data session.

[9] Throughput is also likely to be affected by a number of factors that are variables inherent in mobile radio communications. Whether the user is outside or indoors, whether the trees have leaves, whether it is raining, all of these are variables that could affect the radio communication between the customer's device and the network, and therefore, throughput. Throughput also will vary based on the numbers of customers on the network and how they behave. For example, the number of simultaneous users on the cellsite used by the customer who is attempting to measure throughput, and whether those other users are using voice, video or less data-intensive applications like email or SMS. While carriers can affect these variables (by deploying in-building coverage in some cases, splitting cells in high traffic areas, through traffic management by and adding capacity at data gateways), such variables also will depend on the choices made by users and to a large extent on physics.

[10] For the reasons described in the methodology section below, AT&T believes that drive testing can better account for such non-netowrk variables than device-based applications.

Accessibility, Retainability, Signal Strength, Latency and other measures.

Obviously, whether a customer can access a network, and whether the call or data session will continue without being "dropped" are important factors to consumers. Carriers spend huge amounts of money on network improvements and internal testing to achieve high rates of reliability, and they spend huge amounts advertising that they are "the most reliable" or have "the fewest dropped calls.[11] AT&T believes that accessibility and retainability are useful metrics to evaluate relative network performance. For the reasons described in the methodology section below, we believe that drive testing is the most reliable method to measure accessibility and retainability.

While sophisticated drive testing models track metrics like signal strength and latency, these metrics are likely not as important to consumers. Signal strength would be diffcult to measure accurately using a device-based application, and even with sophisticated measurement technology such as that used by drive testing firms and carriers, is likely to be of limited use to consumers. The signal strength varies constantly in any communication between a device and the radio access network, depending on the movement of the device through the network, in and out of doors, and the presence or absence of other users. AT&T believes that measures like accessibility and retainability are more likely to provide information that consumers would be able to use.

Similarly, sophisticated drive testing methodologies typically measure latency. Drive testing firms like Nielsen and GWS would use such measurements in conjunction with other metrics to measure the performance and responsiveness of a mobile broadband network—e.g.

[11] For purposes of analyzing mobile data networks, "accessibility" refers to the ability of a customer to access the network to initiate a data session, and "retainablilty" refers to the ability of a customer in a data session to continue the data session without any interruption in service on the mobile data network. Typically these measures are expressed on a percentage basis based on attempts.

the time it takes to download a website or perform other tasks during a data session. As discussed below, however, any attempt to measure latency in a deviced-based "crowd-sourcing" approach is unlikely to be able to account for non-network factors that could affect the results. As a result, we think the Commission's efforts would be better spent trying to determine whether it can develop a relevant, accurate and usable way to measure other aspects of network performance.

B. Methodologies

Drive Testing. As noted above, the most reliable methods available today to measure network performance involve drive testing. Mobile broadband network providers often perform their own testing, and hire independent third parties, like GWS and Nielsen, to perform testing. While the exact methodologies are proprietary and may differ from firm to firm, drive testing typically involves a common set of principles. Multiple carrier networks are tested simultaneously from the same location using devices with similar capabilities (i.e. Provider A's laptop card vs. Provider B's laptop card; Provider C's smartphone vs. Provider D's smartphone). The locations and times are chosen to test urban, suburban, and rural locations, including city streets, interstates and "blue highways," on fully-loaded, live networks at times calculated to include both typical peak and non-peak congestion scenarios, and the consumer devices are integrated with more sophisticated proprietary measurement tools to account for some non-network variables.

While drive testing is the current state of the art methodology for measuring network performance, it does require sophisticated equipment and testing protocols that make it unsuited for a do-it-yourself consumer test. Further, due to the sophisticated equipment and labor-

intensive testing protocols developed by independent testers, drive testing is not inexpensive.[12] Nonetheless, drive testing is far more accurate and reliable than would be a "crowd-sourcing" approach, as discussed below.

Crowd-sourcing and other device-based testing. As discussed above, there are many non-network and network variables that would affect an end-user's perception of throughput, accessibility, retainability or other possible measures of network performance. Although there are a number of device-based applications available that provide "throughput" measurements, we are not aware of any that could accurately and reliably account for the non-network variables in a way that would allow one to conclude that what was being measured was mobile broadband network performance. There are also a number of other potential methodological issues that would have to be considered before a "crowd-sourcing" approach using a device-based application could be relied upon to accurately estimate comparative mobile broadband network performance.

First, one would have to identify the devices that would participate in any "crowd-sourcing" approach, and take into account the manner in which individual devices ran the tests. To be representative, the sample of users should be diverse, in terms of the types of devices used, the behavioral characteristics of the users and in terms of geography and mobility. Accordingly, running a test using a panel of volunteers may be unlikely to yield a representative sample.

Second, the manner in which each participant ran the testing application would be important. To be reliable, the testing would likely need to be conducted passively. That is, the testing would likely need to be done continuously in the background during a continuous data

[12] Some firms that perform drive testing consider the results of those tests to be proprietary information and place limits on their customers' ability to publicly disclose the test results.

session. Just as self-selection in the sample of users may skew the sample, allowing participants to run the application proactively is likely to skew results as they may tend, for example, to run the test more often at particular times or places than others.[13]

Third, the measurements would have to take into account the capabilities of the end user's device, the other applications in use during the testing, the differences in operating system capabilities and other variables introduced at the consumer device end. This likely would involve some device testing, and might counsel in favor of selecting the user sample based in part on whether it could be limited to users of devices the capabilities of which were well known.

Fourth, the measurements should attempt to take into account non-network variables from the mobile broadband network to the content/application server with which the end user wishes to communicate. Perhaps this could be done to a limited extent by having all tests be performed in the same manner (attempting to download an identical file from the same server each time) but one still would have to control for the location of the remote server, caching, and other factors that could affect throughput, in addition to the end user device/usage variables.

The measurements also would have to account for variables in the location information associated with the data. Differences in the GPS capabilities of devices (as well as other factors, such as whether a user is out of doors or not) will impact the accuracy of location information in ways that would need to be accounted for in any model to the extent possible.

Moreover, the need to account for all of the non-network variables would counsel in favor of a larger data set, likely involving hundreds of thousands of users distributed nationally and continuous testing. To develop and conduct a representative and reliable testing program

[13] Indeed, a panel of volunteers, however large, running a device-based application at times and places of their own choosing would provide no reliable basis for making any general characterization of any carriers "typical" throughput or coverage.

using "crowd-sourcing" is therefore likely to involve significant costs.[14] Moreover, the very process of uploading the test results to a common set of servers is an activity that will affect the results and would have to be taken into account. The costs of such testing also would be felt by the participants, as the testing would likely generate data usage that would count against their plans, potentially slow down other applications they are running and affect battery life.

To the extent that a "crowd-sourcing" approach is used, the Commission also would have to develop an approach to resolve potential privacy and security concerns. Such testing likely would require the collection of huge amounts of potentially sensitive subscriber and network data, involving the user's device type, the user's location, what applications she has run, where she has been on the web, and other information. While it might be possible to extract such data in a way that would neither be connected with any particular customer account, nor disclose any provider's sensitive network data, we believe that any initiative of this sort would present serious and privacy concerns. Approaches would have to be developed to handle these challenges appropriately in order to make any such initiative possible. Potential participants and network providers should be offered sufficient disclosures about any proposed data collection that would inform them of the measures that would be taken to protect the security of the data, to protect their privacy and to require them to expressly consent to opt in to participation in any such intiative.

Finally, to the extent that the Commission was to publish comparative measures of mobile broadband network performance, such measures should be accompanied by disclosures designed to help consumers and other interested parties evaluate the measurements. For example, the methodology used to should be fully disclosed, including the specific techniques the com-

[14] Of course, commissioning expert drive testing to evaluate mobile broadband network performance also may be costly.

mission intends to use to account for non-network variables and, if crowd-sourcing is used, to eliminate the biases that such an approach might introduce. Second, the mean value, standard error and confidence interval of each measure should be published so that interested parties can evaluate the statistical soundness of the results. Third, to the extent that end-to-end testing is performed, the Commission should inform consumers about the likely differences between end-to-end performance across the internet, and performance on an individual provider's network, and how non-network factors are likely to affect the results. Moreover, the Commission likely should inform consumers of any limitations on how the metrics should be used. For example, a network wide measure of "typical throughput" might be useful (together with other information) for comparison among mobile broadband networks, but given the inherent variability in mobile broadband communications, it likely should not be taken as a means to predict the user experience in any particular case.

II. Mobile Broadband Network Coverage

The Notice also seeks comment on ways to measure and report mobile broadband network coverage. The most common and reliable way to gather information mobile broadband coverage is from the carriers' consumer disclosures. AT&T provides a coverage viewer on its website that allows consumers to view its network coverage, including areas where HSPA is available in addition to voice and its high speed EDGE data service. Users can zero in on where they live, work and travel from day to day, and evaluate whether they are likely to have reliable coverage in those areas.

Like most carriers, AT&T's coverage viewer is based on predicted propagation using network information such as cell site location, antenna configuration and power levels, taking into account know topographical information such as mountains, valleys and other physical fea-

tures. AT&T supplements this information with information on coverage provided by its roaming partners, based on similar propagation analysis, supplied through American Roamer. Finally, AT&T uses data from its drive testing to ensure that its coverage maps are as accurate as possible. We believe that AT&T's coverage viewer is the best way for consumers to get information about AT&T's coverage, and we understand that other carriers offer similar tools to evaluate their coverage as well.[15]

Using "crowd-sourcing" or other user generated data can be useful to some degree. For example, AT&T uses an application called "Mark the Spot," which allows users to generate a report to AT&T whenever they have difficulty gaining or maintaining access to the network. Such data helps AT&T analyze, manage, and improve its network, adding coverage where it is needed and adjusting existing coverage to manage potential congestion more efficiently.

Still, using "crowd-sourcing" or other user generated data to attempt to measure mobile broadband network coverage will involve challenges similar to those one would encounter in attempting to measure network quality, as explained above. Non-network variables, primarily involving the user's device and location, might skew the data considerably. For example, a user living in a basement apartment might return data that would indicate a coverage hole where for most users, sufficient coverage is available. Moreover, "dropped" data sessions are likely to be over-reported due to the inability to eliminate those drops that result from a loss of connectivity on the remote server's side.

[15] Because a consumer's experience may vary depending on the radio characteristics of the device they choose, the time of year, the construction of their home or office and where they might choose to use the service, it is possible that a consumer's individual experience might vary. Accordingly, AT&T offers customers a 30 day return policy--the opportunity to use the service for 30 days to evaluate coverage and network performance directly to see if it meets their needs. If for any reason, including coverage, they decide that the service does not meet their needs, they can return the device for a full refund (less a restocking fee), pay only for the service actually used during the 30 days, and cancel any contract with no ETF or further obligation.

Still we understand that independent firms such as Root Wireless have employed "crowd sourcing" to produce information for consumers regarding wireless network coverage.[16] The "Root Coverage" service invites consumers to search for network coverage and performance information in many major metro areas, including reports on a number of metrics such as average signal strength and number of signal bars for the selected carrier in a specified area, 2G and 3G data network coverage and measured data speeds for the selected carrier, and specific network problems such as no signal/dead zones, failure to establish a data connection or areas likely to have hand off errors between phones and cell towers. [17] While we believe that predicted propagation and drive testing are likely to be more reliable ways to measure coverage, we recognize that consumers are also likely to find information provided by services like Root Coverage to be useful.

III. Mobile Broadband Network Provider Disclosures

As noted above, mobile network providers offer a wealth of information regarding network coverage. Most offer coverage maps that indicate where reliable mobile broadband service can be found. These maps, which are based on predicted propagation bolstered by drive testing data, offer the best available information regarding coverage today. Most providers also offer return policies similar to AT&T's 30 day return policy, to allow consumers to evaluate the service to see if they have coverage in the places they live, work and travel most often and cancel if they are dissatisfied without incurring any early termination fee.

As previously discussed, however, measuring other network performance capabilities is quite complex and there are many variables that affect an individual user's experience. Due to the variability of measures like throughput, and the myriad potential causes for this variability,

[16] CNET, http://reviews.cnet.com/cell-phone-coverage-map/?mode=voice&carrier=att&zoom=3&lon=-97.558594&lat=37.509726&maptype=map&overlay=1 (last visited July 8, 2010)
[17] *Id*,

AT&T does not advertise peak throughput claims, or even typical throughput claims, as an individual user's experience may vary widely depending on the device, operating system and applications she chooses, the her location during a given data session, and multiple other factors beyond her choice of mobile broadband network, as described above.

We recognize, however, that there are a number of sources of information available to consumers (in addition to carrier-provided information) to evaluate mobile broadband network performance. As mentioned, firms like Root Wireless provide information on network performance based on "crowd-sourcing" methods. Others, like JD Power, Consumer Reports and PC World publish comparative evaluations based on consumer surveys and limited drive tests. While these evaluations might not be as reliable as the results of a sophisticated drive test program, they are likely to be informative to consumers in evaluating mobile broadband networks.

Should the Commission decide to pursue a measurement program for mobile broadband services, AT&T would, of course look forward to participating in further dialogue with the Commission to explore in more detail the issues raised in these comments.

Respectfully submitted,

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