Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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

COMMENTS OF AT&T INC. – CONSUMER INFORMATION AND DISCLOSURE PN, DA 10-670

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I. INTRODUCTION AND SUMMARY

AT&T Inc. and its affiliated companies (collectively, AT&T) respectfully submit the following comments in response to the Commission's *Notice* regarding a testing and measurement project for residential fixed broadband services to be conducted by SamKnows Limited (SamKnows).[1] As we have previously explained, AT&T supports the Commission's efforts to ensure that it has sufficient information to make well-reasoned decisions on broadband policy and that consumers have the information they need to make educated choices in the broadband marketplace.[2] We believe that the proposed SamKnows project, if implemented with appropriate modifications and clarifications, could constitute a valuable "proof of concept" and could show that this kind of measurement program is capable of yielding useful results. In these comments, we provide a series of observations and recommendations intended to improve the efficacy of this project.

First, the Commission and SamKnows are correct to recognize the key distinction between end-to-end performance across the Internet and performance on an individual broadband provider's network. To ensure that SamKnows measures performance properly in the end-to-end context, we would encourage SamKnows to publish additional details about the M-Labs infrastructure that is being used for those measurements so that interested parties can evaluate it. Although the SamKnows' methodology for measuring individual network performance appears to have limitations that will inherently understate such performance, we believe the proposed measurements can still provide useful information if those limitations are fully disclosed in any subsequent data reports.

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[1] *Comment Sought on Residential Fixed Broadband Services Testing and Measurement Solution*, Public Notice, DA 10-670 (April 20, 2010) (*Notice*).

[2] AT&T Comments on NBP Public Notice #24, GN Docket No. 09-51 (Dec. 14, 2009).

Second, while SamKnows' plan to use self-selected individuals who volunteer for the measurement project may introduce certain biases into the data, those biases likely can be mitigated through appropriate statistical analysis techniques. We would encourage SamKnows to disclose the specific techniques it intends to use so they can be properly vetted by interested parties. Similarly, to prevent performance measurements from being skewed due to panelists inaccurately identifying the speed of their broadband service plans, SamKnows should develop and publish the methods it will use for pre- and/or post-measurement validation of panelists' service plans.

Third, when reporting the results of its measurements, we would encourage SamKnows to publish, at a minimum, the mean value, the standard error and the confidence interval associated with each measurement so that interested parties can evaluate the statistical soundness of the results. In addition, when performing any analysis of advertised speeds vs. measured speeds, SamKnows should be particularly careful to indentify the speeds that are actually being advertised by the relevant broadband provider, as not all providers represent their advertised speeds to consumers in the same manner. For example, unlike most other ISPs, AT&T offers service in tiers with both an expected maximum *and* minimum speed. We would therefore encourage SamKnows to work with individual ISPs to ensure it fully understands any pertinent differences in the way they advertise their broadband speeds.

Finally, as an overarching matter, we are encouraged by the apparent willingness of SamKnows to work collaboratively with ISPs and other stakeholders to design an accurate and reliable performance measurement project. We look forward to a continuing dialog with both SamKnows and the Commission to further explore the issues raised in these comments.

II. DISCUSSION

A. Data Collection and Tests

In the *Notice* and the Commission's related Request for Quotation (*RFQ*)[3] seeking a vendor to conduct broadband measurements, the Commission articulated two basic objectives for its broadband measurement project. First, the Commission seeks measurements of "actual speeds and performance over the broadband service provider's network."[4] Second, the Commission seeks measurements of actual speeds and performance "across the end-to-end consumer experience"[5] over the Internet during "web browsing and other typical Internet activities."[6] The Commission has provided a visual depiction of the facilities associated with both individual provider networks and end-to-end transmissions using the following diagram, in which individual networks are shown as encompassing points 2 through 5 and end-to-end transmissions are shown as encompassing points 1 through 6.[7]

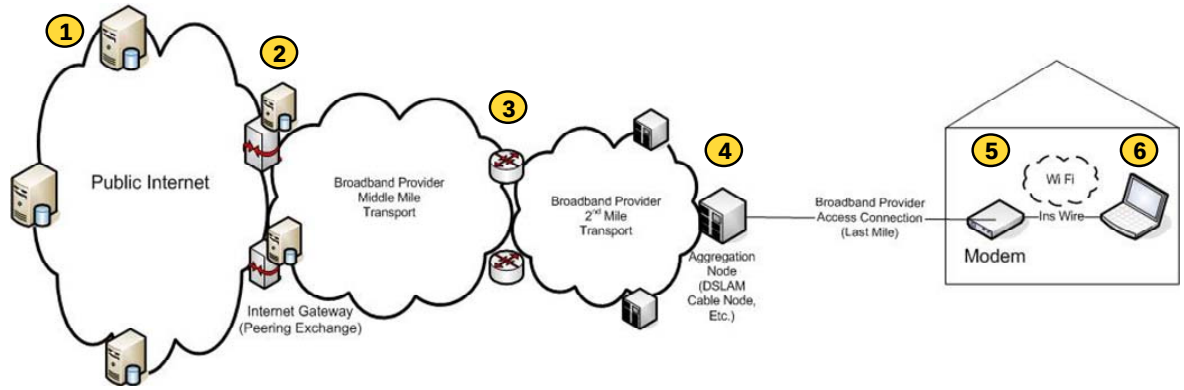
[3] Federal Communications Commission Request for Quotation for Residential Fixed Broadband Services Testing and Measurement Solution, RFQ-10-000013 (March 12, 2010).

[4] *RFQ* at 2.

[5] *Id.* at 2

[6] *Notice* at 3

[7] *RFQ* at 2. As discussed below, the facilities covered between points 2 and 5 in the Commission's diagram actually encompass some facilities that are *not* part of a broadband provider's network.



DEFINITIONS

1. **Public internet content:** public internet content that is hosted by multiple service providers, content providers and other entities in a geographically diverse (worldwide) manner
2. **Internet gateway:** closest peering point between broadband provider and public internet for a given consumer connection
3. **Link between 2nd Mile and Middle mile:** broadband provider managed interconnection between middle and last mile
4. **Aggregation node:** First aggregation point for broadband provider (e.g. DSLAM, cable node, satellite, etc.)
5. **Modem:** CPE (customer premise equipment) typically managed by a broadband provider as the last connection point to the managed network (e.g. DSL modem, cable modem, satellite modem, ONT, etc.)
6. **Consumer device:** consumer device connected to modem through internal wire or Wifi (home networking), including hardware and software used to access the internet and process content (customer managed)

As a general matter, the Commission is correct to recognize the important distinction between performance on an end-to-end basis across the Internet and the performance of an individual broadband provider's network. Although the Commission's understanding of the facilities that encompass a provider's network (and, by implication, the extent of the broadband service the provider actually offers to its customers) does not appear to be entirely correct (see below section II.A.2.), we are pleased that the Commission has sought comment on these issues before launching the SamKnows project. We encourage the Commission and SamKnows to take the following issues into account as they further refine the parameters of their broadband measurement project.

1. End-to-End Performance (Points 1 to 6)

From the perspective of typical consumers, end-to-end performance is the key criterion by which they evaluate the quality of their overall Internet experience.[8] In particular, the perceived "speed" at which they can load web pages, send email, transfer files and perform other common tasks strongly influences their view of the quality and value of the Internet access services they use. But it is not the only factor; latency, jitter, packet loss, network availability and other issues affect the end-to-end experience. Moreover, there are also numerous factors that are not strictly part of the end-to-end *transmission* path that can still significantly affect the overall end-to-end Internet experience perceived by the customer, such as the capabilities of the customer's computer, the applications running on that computer, and the capabilities of the content/application servers with which the customer communicates.

The *Notice* and RFQ appear to recognize many of these factors and the measurement project generally appears designed to account for (or could be modified to account for) most of them.[9] There are some key ambiguities in the *Notice*, however, and the Commission and/or SamKnows should address and, if possible, publicly clarify these issues before initiating the measurement project:

- Measurement Labs (M-Labs) Infrastructure. The *Notice* (at 4) states that SamKnows "will use the M-Labs infrastructure as destinations for our remote tests during this project." However, the *Notice* provides no information about the nature of this infrastructure. The M-Labs website states that M-Labs "deploys many test servers all around the world," but it does not identify the geographic location of the servers to be used by SamKnows, nor does it disclose the capabilities of those servers or the topology

[8] *See, e.g.*, James Staten and Mike Gualtieri, Forrester Research, *Best Practices: Blazing Fast Web Site Infrastructure*, at 2 (Aug. 15, 2008) ("Customers judge the responsiveness of a Web site based on how quickly the home page finishes loading or is ready to be interacted with by users.").

[9] Given the measurement architecture chosen by SamKnows, it does not appear that the panelists' computers or the applications running on them will be factored into measurements of the "end-to-end" consumer experience (Points 1-6). *See Notice* at 3 (describing "Whiteboxes"). Of course, AT&T recognizes that including these computer-related items would cause significant additional complications and, while they may be worthy of further study, we are not advocating that they be included in this particular project.

and manner in which those servers are connected to the Internet (e.g., peering and/or transit links, capacity and location of such links, identity of serving Internet access and backbone providers).[10] In order to enable interested parties to evaluate the appropriateness of the measurements to be performed using the M-Labs infrastructure, the preceding information should be publicly disclosed.[11]

- Other Internet Infrastructure. The *Notice* (at 3) and the *RFQ* (at 2) suggest that SamKnows also intends to perform measurements using Internet endpoints *not* situated on the M-Labs infrastructure, including "typical websites," "Hulu," "YouTube" and other real-world destinations. The Commission and/or SamKnows should identify these endpoints, their geographic locations, the capabilities of the relevant servers or other equipment at the endpoints, and the topology and manner in which those servers and equipment are connected to the Internet (e.g., peering and/or transit links, capacity and location of such links, identity of serving Internet access and backbone providers, and use (if any) of self-provided or third-party Content Delivery Networks). For example, it would be useful to know whether the entities operating any such servers impose limits or caps on the amount of bandwidth that can be allocated to any particular transmission (e.g., in order to ensure a sufficient amount of bandwidth remains available for all customers accessing the server) or otherwise adjust the transmission speed of the server in response to different factors (type of customer, time of day, etc.).

- "Public Internet." In using the term "public Internet," the *Notice* (at 3) appears to assume that Internet access service providers primarily interconnect with other providers at so-called "public" Internet exchanges.[12] Unlike in many other countries, however, a very substantial amount of Internet traffic in the U.S. is exchanged between networks pursuant to bi-lateral arrangements at privately operated facilities, particularly among the larger providers. Thus, to the extent SamKnows' measurement architecture is premised on measuring performance at or near public Internet exchanges, that architecture may need to be adjusted to reflect the predominance of private arrangements for the exchange of U.S. Internet traffic.

- Video Download (Peer-to-Peer) Measurement. The *Notice* (at 3) states that SamKnows intends to perform tests of peer-to-peer video downloads of a "TV show or movie from a

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[10] *See* M-Labs, *Good data is better than no data: M-Lab is built to continually improve data collection efforts, available at* http://www.measurementlab.net/news/2010/apr/01/good-data-better-no-data-m-lab-built-continually-improve-data-collection-efforts. In other sections of its website, M-Labs identifies a handful of U.S. and European cities where it has servers that are used for specific test programs that it hosts, as well as links to servers operated by third-parties. It is not clear whether some or all of these servers will be used by SamKnows.

[11] The *Notice* (at 2) indicates that SamKnows will take steps to ensure there are "no conflicts of interest" for panelists participating in the study, which would presumably include employment by an ISP that is subject to the study. But the *Notice* does not address what steps, if any, will be taken to deal with the apparent conflicts of interest that arise from the use of M-Labs, the Steering Committee of which includes senior personnel from Google and the New America Foundation. Both of these entities have actively lobbied the Commission on broadband data gathering, which is the focus of the SamKnows project.

[12] *See also RFQ* at 2 (identifying "Peering Exchange" as place of interconnection "between broadband provider and public internet").

legal P2P site." As its name signifies, however, "peer-to-peer" communications do not involve downloading files from a website, but rather the transmission of files directly between two or more end users. Thus, to the extent SamKnows plans to measure the performance of peer-to-peer transmissions, it should identify how (if at all) it intends to establish a "test peer" (i.e., the entity or entities with whom the panelists will exchange traffic) in a manner that will produce reliable and comparable results among different panelists.

- Short Duration Transfer Tests. The *Notice* (at 3) suggests that most of the measurements will be conducted using applications that typically consume large amounts of bandwidth (e.g., streaming video) and/or require relatively stringent network performance in terms or latency or jitter (e.g., VoIP). Given the immense popularity and everyday usage of numerous applications involving short data transfers (e.g., email, instant messaging, Twitter), it would be useful to include at least one such application in the measurement regimen in order to properly assess "typical Internet use," as the Commission intends. *Notice* at 3.[13]

- Technical Parameters. The *Notice* (at 4) states that the "SamKnows architecture is based around the Linux operating system," but does not identify which of the many different versions of Linux is being used. Likewise, a significant number of the measurements will presumably be carried out on traffic that uses the transmission control protocol (TCP), but the *Notice* does specify which of the many versions of TCP (e.g., Tahoe, Reno, New Reno, Vegas) are used in the SamKnows infrastructure. Differences in the various versions of Linux and TCP may respond to network conditions (and affect the performance of various applications) in different ways. The Commission and/or SamKnows should thus identify the versions of Linux and TCP to be used in the project.[14]

2. Network Performance (Points 2 to 5)

Scope of the Network. In depicting the scope of a broadband Internet access provider's network via a diagram (*RFQ* at 2), which is reproduced above, the Commission identifies both (i) the connection running between the network interface device (NID) on the side of the customer's premise and the customer's modem inside the premise, and (ii) the modem itself, as

[13] The *Notice* states that SamKnows intends to test "web surfing," including "typical web sites containing . . . small rich media objections [sic] . . . ." *Notice* at 3. Assuming the *Notice* actually intended to refer to small "objects," AT&T agrees that measuring performance using web sites with numerous small objects would better represent the typical experience of an Internet user, as opposed to web sites consisting of primarily large objects.

[14] AT&T assumes that SamKnows will conduct measurements on applications in a sequential fashion (rather than in multiple sessions simultaneously) in order to isolate and accurately measure performance for each application. If that is not the case, SamKnows should explain the nature of, and rationale for, any non-sequential approach.

being part of the provider's network.[15] From AT&T's perspective (and presumably from the perspective of other wireline broadband providers), the connection from the NID to the modem is considered inside wiring and the modem is considered customer premises equipment (CPE), neither of which is treated as part of the network.[16] For example, in the case of DSL service, the connection may consist of aged copper wiring that was neither installed nor maintained by the broadband service provider. Similarly, some DSL customers may choose to use modems acquired from third parties, rather than their broadband service provider. Thus, including the performance of such inside wiring and/or modems in any measurements attributed to AT&T's network (and the networks of other similarly situated providers) would be inappropriate and would likely understate the actual performance of that network.

Indeed, AT&T's Terms of Service expressly notify customers that the speed tiers it advertises (the "Service Capability Speeds") are for the portion of its network "between the network interface device at your home, office or apartment building" and "the first piece of routing equipment in AT&T's network." [17] AT&T also cautions customers that "Service Capability Speeds should not be confused with Throughput Speed, which is the speed at which your modem receives and sends Internet access data," and which may be affected by "wiring inside your home, office or apartment" and "the capacity or performance of your computer or modem," among other factors.[18]

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[15] *RFQ* at 2 (describing "modem" as "typically managed by a broadband provider as the last connection point to the managed network").

[16] In many cases, a consumer's "modem" is combined with a wired or wireless router in a single piece of CPE, to which multiple devices in a home network are connected. Accordingly, SamKnows will need to ensure that traffic from other devices connected to such CPE does not interfere with the integrity of the measurements performed by the SamKnows "Whitebox," which will also be connected to the same CPE. SamKnows should publicly clarify how it will address this issue.

[17] *See* AT&T High Speed Internet Terms of Service / my.att.net Terms of Use, Section 2, *available at* http://www.att.net/csbellsouth/s/s.dll?spage=cg/legal/att.htm&leg=tos.

[18] *Id*.

All of that said, AT&T recognizes that the Commission and SamKnows may not have sufficient technical or economic resources to construct a testing regimen that excludes inside wiring and modems from measurements of the broadband provider's network, and that deploying SamKnows' "Whiteboxes" behind the modem is the only practicable option at this point in time. Provided that the Commission and SamKnows fully and accurately acknowledge the overinclusiveness of this aspect of the testing regimen – and particularly that it will understate the speeds actually achievable through a broadband provider's network – the results of these measurements could still provide generally useful information to both the Commission and consumers.[19]

Line Length to the Relevant Exchange. In the *Notice* (at 5), the Commission states that SamKnows will derive "[a]n accurate estimate of length of line from the panelist's premises to the relevant exchange," which will presumably be used to analyze potential correlations between line length and various performance metrics (e.g., speed, latency, jitter). The *Notice* does not explain how this derivation will occur or, for that matter, how SamKnows will identify "the relevant exchange" to which the panelist is connected. To the extent the term "exchange" is intended to mean the DSLAM in the context of xDSL, subscribers in the same neighborhood (or even on the same street) may be connected to different exchanges depending on the location of their premise and/or the specific type of service to which they subscribe. For example, AT&T offers xDSL-based broadband services via DSLAMs based in both central offices and remote terminals, as well as in serving area interfaces (SAIs) in our Fiber-to-the-Node U-verse

[19] Although the *Notice* is not entirely clear, we assume that neither the M-Labs infrastructure nor the infrastructure of other Internet end points (both of which would appear to be represented by Point 1 in the Commission's diagram) will be used to measure the performance of an individual broadband provider's network (Points 2-5). If that assumption is incorrect, SamKnows should explain the rationale for the use of such infrastructure.

architecture. Thus, estimating line length based on general presumptions about the correlation between a panelist's street address and the assumed location of the xDSL provider's "exchange" is unlikely to produce accurate results. We would therefore encourage SamKnows to explore this issue in greater detail when it "engage[s] with ISPs" (*Notice* at 4) to further refine its measurement project.

B. Development and Recruitment of Panelists

Selection Bias. Under ideal circumstances, in order to obtain an objective and representative sample that will produce statistically meaningful test results, the panelists for the measurement project would consist of a probability sample from the overall population of broadband subscribers in the U.S.[20] Here, however, SamKnows intends to induce members of the broadband population to "self-select," i.e., volunteer for the project. As the *Notice* explains (at 2), SamKnows plans to develop a panel of test subjects by "solicit[ing] volunteers through a media campaign using social and traditional media, such as consumer and technology press, alongside Twitter and independent bloggers and opinion formers." The *Notice* (at 2) appears to recognize, however, that recruiting panelists in this fashion is likely to produce sampling biases,[21] and it then briefly describes some of the steps that SamKnows' statisticians will take to address such biases.

While a probability-sample approach would be preferable, the self-selection approach described in the *Notice* can still produce useful results, provided that SamKnows employs statistically sound methods and procedures for recruiting and screening panelists; analyzing the

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[20] *See, e.g.*, L. Kish, *Statistical Design for Research*, John Wiley & Sons, at 23 (1987).

[21] For example, the recruitment process may attract a disproportionate numbers of volunteers who have experienced trouble with their broadband service and are thus not representative of the overall population. *See, e.g.*, Office of Management and Budget, *Questions and Answers when Designing Surveys for Information Collections*, at 29-30 (January 2006) (discussing "convenience samples"), *available at* http://www.whitehouse.gov/omb/inforeg/pmc_survey_guidance_2006.pdf.

performance measurements; and presenting the results in a fashion that addresses the biases inherent in its chosen approach. In particular, we would encourage SamKnows to provide a more explicit description of the statistical methods it plans to use. We would also strongly encourage SamKnows to include mean values, standard errors and confidence intervals in its published results so that interested parties can evaluate the statistical soundness of those results. Doing so will be critically important for assessing whether the performance measurements can be validly compared among different technologies or providers. For example, measurements showing that one technology or provider has higher latency than another would not be probative of an actual difference between them if the observed difference is not statistically significant.

Sample Size. The *RFQ* states (at 3) that the measurement project is intended to include performance measurements from "at least" fifteen of the twenty largest ISPs in the U.S. and will use a total sample population of approximately 10,000 households that should be "geographically representative" and should enable a "national analysis." Although 10,000 households may, at first blush, appear to be a substantial sample size, it may not be large enough to produce statistically meaningful results for all of the categories of panelists the Commission may be interested in measuring. For example, most broadband providers offer multiple speed tiers (AT&T, for example, offers about a half-dozen); many providers use multiple technologies in various parts of their service territories (e.g., ADSL, VDSL, and/or FTTH; DOCSIS 1.1, DOCSIS 2.0 and/or DOCSIS 3.0); and many providers serve different types of geographic areas in their territories (e.g., urban, suburban and rural). Using a population of 10,000 households to obtain results with high statistical precision in each of these categories across at least fifteen different ISPs may ultimately prove unworkable. Thus, to avoid such a problem at the tail-end of the project, we would encourage the Commission and/or SamKnows to identify the specific

categories for which it intends to seek measurements before it proceeds with those measurements.

Validation of Service Plan. In order to evaluate the measured speed of a panelist's broadband service relative to the advertised speed of that service, SamKnows will need to know which service plan the panelist has actually purchased. It may often be the case that panelists either do not know, or are mistaken about, the service plan to which they subscribe. Thus, SamKnows will need a rigorous and reliable means of validating each panelist's service plan information. Indeed, any errors in this area could significantly skew the results of the measurement project because they would distort the speeds actually advertised by the broadband provider. The *Notice*, however, does not describe the mechanisms that SamKnows will use for this critically important task. We would encourage SamKnows to explore this issue further with the ISPs and to publicly disclose whatever pre- and/or post-measurement mechanisms it ultimately adopts to validate panelists' service plans.[22]

C. Data Analysis and Presentation

To ensure that policymakers and consumers fully understand the data reports produced from the SamKnows project – and draw appropriate conclusions from those reports – SamKnows should take particular care in accurately and comprehensively describing the precise scope of the measurements it performs; any limits on the statistical validity of those measurements; and the mean value, standard error and confidence interval of the measurements. For example, as

[22] Some DSL Internet access providers (including AT&T) offer their customers the option of self-installing their own DSL service, rather than having a technician install it for them. The DSL provider will typically send the customer an installation kit, consisting of a modem; "DSL filters" that protect against potential interference between the high-frequency portion of the loop (used for Internet access) and the low frequency portion of the loop (used for telephone service); and detailed instructions for completing the installation. Customers occasionally install the DSL filters incorrectly (or not at all), which may significantly decrease the speed a particular customer is able to achieve. To ensure such "user-error" does not adversely affect the integrity of the measurement project, SamKnows may want to track which panelists self-installed their DSL service.

previously discussed, the proposed methodology for measuring the performance of a wireline broadband provider's network includes facilities that are not actually part of that network. This and any other similar idiosyncrasies or limitations in the data should be prominently disclosed.

Likewise, any analysis of advertised vs. measured speeds should properly reflect the speeds actually being advertised by a given broadband provider. Thus, we would encourage SamKnows to review the relevant materials from each provider that publishes their advertised speeds (e.g., the provider's Terms of Service) to ensure such information is presented accurately in any data report stemming from the measurement project.

III. CONCLUSION

For all of the forgoing reasons, AT&T supports the Commission's goal of developing a reliable and accurate broadband measurement project in conjunction with SamKnows.

Respectfully Submitted,

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