Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act	)	GN Docket No. 10-159

COMMENTS of ADTRAN, Inc.

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SUMMARY

ADTRAN welcomes this opportunity to address once again the state of broadband deployment in the United States pursuant to Section 706. ADTRAN also recognizes the necessity for the use of a well designed model as a tool to aide in the analysis of the state of broadband deployment. The model created by the Commission during the development of the National Broadband Plan could be very useful in such efforts, although there exist problems that must be resolved in order to eliminate error, bias or the perception of bias.

The value for Busy Hour Offered Load (BHOL) used to dimension networks throughout the model is severely underestimated. The capacity estimate of 650 fixed users per call used for FWA modeling is unrealistically high. The model assumes paired 20 MHz channels in the 700 MHz band for its baseline analysis, which is inconsistent with the actual allocation of spectrum in the band. Resolving these problems will enhance the accuracy of the Commission's model. Moreover, to the extent the Commission's mapping exercise makes use of the model, a failure to correct these errors would likewise render the maps flawed and unreliable.

In addition, to the extent the Commission is contemplating use of the model in connection with subsidy programs, such as the Connect America Fund, the Commission must include protections to ensure that any such subsidies are based on actual performance, not merely on the model's predictions of capabilities. Consumers will be able to reap the myriad benefits of broadband identified in the National Broadband Plan only if they have actual broadband capabilities – it is not enough that a model predicts they should, since varying real life conditions can make the results differ from the model's forecast.

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COMMENTS of ADTRAN, Inc.

ADTRAN, Inc. ("ADTRAN") respectfully submits the following comments in response to the Commission's Seventh Broadband Deployment Notice of Inquiry, which solicits data and information to help the Commission determine whether broadband is being deployed to all Americans in a reasonable and timely fashion.[1] As a telecommunications equipment manufacturer, ADTRAN has a strong interest in the successful and widespread deployment of broadband to all Americans. These comments are limited to specific topics in the *NOI* for which we have information that can support the Commission's task. We identify the comments below by topic, using paragraph numbering from the *NOI*.

[1] Seventh Broadband Deployment Notice of Inquiry, FCC 10-148, released August 6, 2010 (hereafter referred to as "*NOI*").

Section II.B.1, paragraph 13: Model methodologies

ADTRAN recognizes the necessity for the use of a well designed model as a tool to aide in the analysis of the state of broadband deployment. Further, subject to the issues noted below, we believe that the OBI technical model, as documented in OBI Technical Paper No. 1,[2] provides a good basis for such a tool. However, the model includes several material assumptions that are unsupported, in conflict with generally accepted industry data, and/or internally inconsistent. These issues must be resolved before the model can be used in support of additional analyses. ADTRAN has previously provided comments[3] on these issues:

1. The value for Busy Hour Offered Load (BHOL) used to dimension networks throughout the model is severely underestimated.

The most serious issue with the model regards the assumption that networks can be dimensioned at an average BHOL of only 160 kbps per subscriber for the year 2015. This assumption is in direct conflict with both industry data showing current and projected traffic trends, and with figures in the *Technical Paper* itself.

Two highly regarded sources for Internet traffic data are the Cisco Visual Networking Index[4] and the University of Minnesota Internet Traffic Studies (MINTS) project,[5] which are

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[2] Federal Communications Commission, "The Broadband Availability Gap: OBI Technical Paper No. 1," April 19 2010 (hereafter referred to as "*Technical Paper*").

[3] *See*, ADTRAN ex parte filing, "GN Docket No. 09-51 -- OBI Technical Paper 1," May 28, 2010; ADTRAN ex parte filing, "GN Docket No. 09-51 -- OBI Technical Paper 1," June 16, 2010; ADTRAN filing, "Comments of ADTRAN, Inc.," July 12, 2010.

[4] Cisco, "Cisco Visual Networking Index – Forecast and Methodology, 2009-2014," June 2 2010, http://cisco.biz/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360_ns827_Networking_Solutions_White_Paper.html, last accessed on June 23 2010.

consistent with each other in regard to monthly Internet traffic in the United States as of year end 2009. Per-household data derived from the June 2010 release of Cisco's VNI estimates the Busy Hour Carried Load (which can be lower but not higher than BHOL) at 436 kbps in 2014.[6] Extrapolating the same data to 2015 generates a projected BHOL of 510 to 645 kbps.

The majority of the difference between the OBI estimate and the range provided above comes from the way the OBI figure is artificially truncated, as described in the *Technical Paper*. Summarizing the description which begins on page 111, the authors estimate the BHOL for year 2009 at 111 kbps and estimate that, without "reasonable network management techniques," it will grow to about 444 kbps in year 2015. Then, while briefly discussing examples of reasonable network management techniques, they note that about 65% of the traffic is due to 10% of the heaviest users and state "... if we were to ***exclude the capacity demand of these heaviest users*** [emphasis added], the BHOL of the remaining users would be far lower." The model then does exactly that – it excludes the heaviest 10% of users from the BHOL estimate to arrive at a year 2015 figure of 160 kbps.

There are several fundamental issues with this approach to arbitrarily truncating the offered load:

- Obviously, excluding the heaviest users is incompatible with the goal of providing broadband available to all. A more palatable interpretation of the mathematical manipulation performed is that the average for the top 10% of users is reduced to the same value as that for the bottom 90% of users. In reality, even if usage could be ideally truncated to a defined level – a goal which is impossible in a practical deployment – the

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5 http://www.dtc.umn.edu/mints/home.php, last accessed on June 23 2010.

6 ADTRAN filing, "Comments of ADTRAN, Inc.," July 12, 2010, p. 15.

usage for each of the top 10% of users would be equal to the maximum value associated with the 90th percentile user, which is much higher than the average for the bottom 90% of users. While the resulting reduction in load cannot be calculated without knowing its distribution, it is significantly less than the 65% cited in the paper.

- Again assuming that usage could be ideally truncated to a defined level – which, again, is not possible in a practical deployment – the load from the heaviest 10% of users would form an impulse at the top end of the distribution which would have a disproportionate effect on the network capacity required to meet performance objectives compared to the average load.

- "Offered load," which is defined as the traffic that users try to place on the network, is not affected by network management techniques. Network management techniques only affect "carried load" – that is, the amount and distribution of the traffic that the network carries. In other words, network management only affects what users get, not what they want (unless of course, the heaviest users are actually excluded from the pool!).This is important for two reasons. First, since offered load cannot be measured directly using network traffic monitors, traffic estimates such as Cisco's VNI (as well as the estimate in Exhibit 4-BQ of the Technical Paper) are actually estimates of carried load. By definition, offered load can be higher but not lower than carried load.

  Second, one of the characteristics of a non-congested network is that total offered and carried loads are relatively close to each other. In ADTRAN's internal simulations, total offered and carried loads remain within about 10% of each other in non-congested scenarios. A network in which carried load is only 35% of offered load is severely

congested and would not support the minimum broadband performance goals defined in the National Broadband Plan.

- Finally, in a paper which relies heavily on endnote citations in nearly all other instances, ADTRAN observes that there are no references providing support or rationale for this truncation. No industry or academic data is cited indicating how such an extreme limit on either offered or carried load would be accomplished, or even that it might be possible. This important parameter, which affects required network capacities for all last mile technologies as well as second and middle mile capacities, seems to have been slashed by two thirds based on no more than a speculative and artificial mathematical manipulation.

In discussions on this topic,[7] FCC personnel have noted that the growth rate for users in the 4 Mbps service tier addressed by the OBI technical model cannot be expected to be as high as that for the broadband population as a whole, because the overall growth rate considers both growth within tiers and migration from lower to higher service tiers. ADTRAN agrees, but notes that the non-truncated projection of 444 kbps in 2015 described in the Technical Paper (in Exhibit 4-BS) is already specific to the 4 Mbps service tier. We consider 444 kbps to be a more reasonable projection of carried load for the 4 Mbps service tier in the year 2015 (although probably somewhat understated). Applying the above observation about the approximate equivalence of offered and carried loads in non-congested networks, and taking into account the model's sensitivities, we consider it an acceptable estimate of offered load as well.

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[7] *See*, ADTRAN ex parte filing, "GN Docket No. 09-51 -- OBI Technical Paper 1," June 16 2010.

2. The capacity estimate of 650 fixed users per cell used for FWA modeling is unrealistically high.

The maximum number of fixed subscribers served by a FWA cell in the model is estimated at 650, assuming 2x 20 MHz channels.[8] Even using *arguendo* the value of 160 kbps for BHOL, it is not clear how this number of fixed subscribers was calculated. The model assumes that fixed broadband access will account for 33% of the devices on the wireless network (two mobile users for each fixed user) and generate 73% of the traffic in the areas of interest by the year 2015.[9] Optimizing capacity in the cell for the increased spectral efficiency of fixed directional antennas and for the proportion of traffic generated, the fixed users in a sector would share 30.4 Mbps on average – however, 160 kbps x 217 users (1/3 of 650, allowing for three sectors per cell) results in an average load of 34.7 Mbps, or 114% average utilization. This is clearly not a feasible scenario.

Based on ADTRAN simulations and on discussions with the FCC,[10] it seems that the estimate of 650 fixed users was arrived at assuming a 100% fixed user population on the wireless network, rather than the ratio cited above of two mobile users for each fixed user. This assumption results in 70% average utilization, as well as performance (based on ADTRAN's simulations) consistent with the FCC's minimum requirement of 4 Mbps service. This assumption is inconsistent both with expected 4G deployments and with the rest of the technical model, which allocates cost for wireless networks based on fixed users generating only 73% of

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[8] OBI Technical Paper No. 1, p. 61.

[9] OBI Technical Paper No. 1, pp. 53-54. The percentage figures apply to areas in which FWA provides the only means of mass broadband access. In areas with other options for broadband access, the percentage of FWA users and traffic relative to the mobile percentages would presumably be lower.

[10] *See*, ADTRAN ex parte filing, "GN Docket No. 09-51 -- OBI Technical Paper 1," June 16 2010.

the traffic. Any future use of the model must estimate wireless capacity using the appropriate mix of both fixed and wireless users on the network.

3. The model assumes paired 20 MHz channels in the 700 MHz band for its baseline analysis, which is inconsistent with the actual allocation of spectrum in the band.

The OBI model assumes paired 20 MHz channels (40 MHz total) in the 700 MHz band for the baseline analysis. This is at odds with the actual current allocation of that band – due to its legacy as a series of 6 MHz broadcast TV channels, the band has been auctioned off in blocks from 6 to 12 MHz wide. Within those blocks, the maximum usable channel width is 10 MHz.

As noted in the Technical Paper in Exhibit 4-Q, smaller channel widths are less efficient for providing broadband service. In order for the model to reflect the FCC's own spectral allocations, it must estimate wireless capacity using channel bandwidths consistent with those allocations.

The issues addressed above have varying effects on different network access technologies. The value of BHOL affects network capacity requirements for all types of access networks. The second and third issues are specific to FWA. The cumulative effect of these three issues on FWA capacity is significant – if capacity is estimated using BHOL at 444 kbps, the FCC's recommended mix of fixed and mobile users, and 10 MHz paired channels, then the capacity of a wireless cell (normalized to 40 MHz total spectrum) is approximately 100 to 120 fixed users, less than one-fifth the value of 650 fixed users per cell cited in the Technical Paper.

Section II.B.3, paragraph 21: Maps

The issues noted above with regard to model methodologies throw doubt upon the accuracy of the maps at Broadband.gov. Despite claims that the OBI technical model is relatively insensitive to changes in FWA capacity – Exhibit 4-Z shows little sensitivity to small capacity changes, and in the FCC's webcast presentation on May 6, the presenters noted that cell capacity could be cut by a factor of four with minimal impact on the FWA availability gap – the discrepancies may indeed have a noticeable impact to the results. As noted above, if all three issues are corrected the cumulative impact is a reduction of over 5:1 in cell capacity, greater than the factor of four cited in the webcast.

Even if the overall impact is minimal, the issues above need to be corrected for both purely technical and perceptual reasons. From a technical standpoint, correcting the model may highlight localized issues that are not reflected in the overall availability gap. From a perceptual standpoint, it is vital that the model be seen to be as accurate and technology-neutral as possible. Even if the changes identified have little or no bearing on numerical results, they should be implemented to preclude any possible perception of bias.

Section II.E, paragraph 43: What Actions Can Accelerate Deployment?

Paragraph 43 makes note of a large number of initiatives either planned or currently underway in support of the National Broadband Plan. Among those initiatives is reform of the Universal Service Fund, for which a separate Notice of Inquiry[11] has already been initiated. The *CAF NOI*, among other questions, asks about the use of a model in support of the objectives of a new Connect America Fund (CAF).

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[11] *Connect America Fund, A National Broadband Plan for Our Future, High-Cost Universal Service Support*, 25 FCC Rcd 6657 (2010) (hereafter referred to as "*CAF NOI*").

Although ADTRAN generally supports the use of a model to aid in understanding and evaluating alternatives for accelerating broadband deployment, the model cannot be used as a substitute for a commitment to provide network performance consistent with the goals set in the National Broadband Plan. The CAF process should award subsidies on a schedule and with requirements that make funding dependent on actual network performance, rather than performance predicted by a model, no matter how well designed, transparent, or thoroughly reviewed the model might be.

There are at several reasons to base payments on actual rather than predicted performance. First, assuming the Commission uses a bidding process to determine who will receive CAF subsidies, the understanding that funding will be dependent on actual results will encourage bidders to carefully check model assumptions against their internal projections (in many cases confirmed by actual experience), which should result in more carefully considered bids.

Second, tying awards to performance places the responsibility for appropriate network design, monitoring and upgrading over time on the award recipient. This fosters an evolutionary approach in which changes to the growth rate relative to initial predictions, for example, are detected early and accommodated via updates to the network growth plan. No model, no matter how well designed, can anticipate growth requirements well enough to serve as a substitute for ongoing measurements.

Third, tying awards to performance acknowledges local variability in offered load. Most models, including the OBI technical model, deal with overall populations. Access networks, on the other hand, need to address the needs of localized populations that may consist of no more than a few dozen users served by a specific access node. The localized averages for these

populations will vary significantly around national or regional averages and localized monitoring is required to make sure they have sufficient network capacity to meet the performance requirements.

Tying awards to performance also removes some of the controversy that is sure to accompany any predictive model. No model will satisfy all stakeholders – however, if its use in the bidding process is superseded by performance measurement after deployment, any potential advantage to be gained from model bias is minimized or eliminated in the long term. Stakeholders can then work towards consensus based on technical merit, focusing on accuracy in model parameters rather than temporary advantage.

Finally, subscribers care about actual performance, not what some model predicts they should enjoy. The National Broadband Plan identified myriad benefits that will accrue from the universal availability of broadband. As the National Broadband Plan observed, broadband is "changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge."[12] However, subscribers can only achieve these advancements if they have access to real, not simply theoretical broadband.

Conclusion

Understanding the degree to which broadband is being deployed to all Americans in a reasonable and timely manner is a critical step in achieving ubiquitous deployment. An accurate and unbiased model is one of many tools which aid in that understanding, as well as in supporting acceleration of deployments where necessary. The OBI Technical Model, if

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[12] OMNIBUS BROADBAND INITIATIVE (OBI), FCC, CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, GN Docket No. 09-51, at xi (2010) (NATIONAL BROADBAND PLAN), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296935A1.pdf.

corrected as discussed above, can further those objectives both through its design and through the transparency with which it is documented. However, specific issues with the OBI model must be addressed in order for it to reflect current spectrum allocations, expected deployment models, and accurate projections of future demand. Further, the use of any model to encourage accelerated deployments must be combined with requirements based on actual performance, because actual performance – not just predictions – is what counts for consumers.

Respectfully submitted,

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