February 3, 2010

Via Electronic Filing

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, SW, TW – A325
Washington, DC 20554

Re: Written Ex Parte Presentation in WT Docket Nos. 07-195, 04-356 and GN Docket Nos. 09-51 and 09-157

Dear Ms. Dortch:

M2Z submits this ex parte into the records of the above referenced proceedings in support of the FCC's mandate to enable universal and affordable access to broadband.[1] According to the National Broadband Plan team's findings, approximately 20 million people in the United States do not subscribe to broadband because they cannot afford it.[2] M2Z has advocated that the AWS-3 band should be used to help address this "affordability gap" through the use of public interest obligations.[3]

Based on its review of the AWS-3 and the National Broadband Plan records, M2Z respectfully suggests to the Commission that the public interest obligations outlined in the AWS-3 FNPRM should be modified to better align the use of the AWS-3 spectrum with the national goal of universal and affordable broadband.[4] M2Z recommends the Commission reject the FNPRM's use of a 25% capacity requirement as the licensee's threshold for meeting the free service obligation. A capacity based approach does not promote efficient use of spectrum and, more importantly, is not easily enforceable. Instead, M2Z proposes a more direct test on the build-out of the license using two population based threshold obligations: (i) a network

[1] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 1115, § 6001(k)(2) (to be codified at 47 U.S.C. § 1305) (directing the Commission to "ensure that all people of the United States have access to broadband capability"); News Release, Federal Communications Commission, FCC Chairman Genachowski Commends NCTA's Adoption Plus (A+) Program, 2009 (Dec. 1, 2009) (quoting Chairman Genachowski: "Ensuring that all Americans have access to affordable broadband service is a national priority - one that the Commission is actively working on as part of our National Broadband Plan.").

[2] *See* From the FCC National Broadband Plan – Sept 2009 Commission Meeting at slide 81 citing Pew Internet and American Life Project, Home Broadband Adoption June 2009 which shows that approximately 37% of Americans either have not or cannot access broadband and 19% of those cannot afford broadband.

[3] *See*, e.g. Comments of M2Z Networks, Inc. GN Docket 09-51 (filed Jun. 08, 2009); FNPRM Reply Comments of M2Z Networks, Inc. WT Docket Nos. 07-195 and 04-356, (filed Aug. 12, 2008); FNPRM Comments of M2Z Networks, Inc. WT Docket Nos. 07-195 and 04-356 (filed Jul. 25, 2008); NPRM Reply Comments of M2Z Networks, Inc. WT Docket Nos. 07-195 and 04-356 (filed Jan. 14, 2008); NPRM Comments of M2Z Networks, Inc. WT Docket Nos. 07-195 and 04-356 (filed Dec. 14, 2007).

[4] The Commission's June 2008 FNPRM suggested that the AWS-3 licensee commit to using 25% of its network capacity to support free users. *See Service Rules for Advanced Wireless Services in the 2155-2175 MHz Band; Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz, and 2175-2180 MHz Bands*, WT Docket Nos. 07-195 & 04-356, Further Notice of Proposed Rulemaking, FCC 08-158, at ¶ 3 and proposed rule 27.16 (c)(1) (rel. Jun. 20, 2008) ("AWS-3 FNPRM").

construction requirement on the licensee to build a broadband network that covers 95% of the U.S. population over a 10 year period; and (ii) a requirement on the licensee to construct this network with the capability of providing a free basic broadband service to 20 million subscribers by the end of the same 10 year period.[5] M2Z further recommends that any intermediate milestones regarding the free service component should be consistent with the coverage requirement milestones.[6]

The analysis below demonstrates the key parameters involved in constructing a network that can meet these build-out obligations using currently available Time Division Duplex ("TDD") systems.

I. The AWS-3 Band Can Support A Large Scale Broadband Network

As discussed in greater detail below, the explosion in usage of broadband data on wireless devices and the simultaneous need for effective spectrum utilization makes TDD systems the ideal choice for delivering wireless broadband access. With the advent of standards based wireless protocols such as WiMAX and WCDMA/LTE in the last decade, a robust ecosystem of TDD vendors has also developed providing network operators a wide array of equipment options. This ecosystem has become adept in utilizing innovative techniques to improve cost/quality performance of wireless networks while also helping network operators make efficient use of spectrum.[7]

Using commercially available TDD equipment, our analysis demonstrates the AWS-3 spectrum band can be used to build a national wireless broadband network covering 95% of the U.S. population. This AWS-3 network would have the capacity to support over 36 million subscribers with a basic broadband data service at 768 kbps; alternatively, this network could also support over 18 million subscribers at a higher data rate of 4 Mbps.

II. Overview of TDD Systems and Their Advantages

In the U.S., almost all existing incumbent commercial wireless networks are optimized to deliver mobile voice using Frequency Division Duplex ("FDD") technologies and require paired spectrum. TDD technologies, on the other hand, operate on unpaired spectrum like the AWS-3 spectrum band.[8] TDD technologies offer significant advantages over FDD technologies for delivering packetized data services like streaming media and/or web access.[9] In particular,

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[5] The Obama Administration holds the view that "the public airwaves should be operated with the public interest in mind." According to a recent letter sent to Representative Anna Eshoo, the Department of Commerce's NTIA stated that the FCC is obligated to consider "both market factors and public interest concerns in prescribing license conditions" including "build-out requirements for licensees." *See* Letter from Assistant Secretary of Commerce Larry Strickling to Representative Anna G. Eshoo, stamped Nov. 3, 2009.

[6] In order to achieve the national goal, the free service requirement should be linked ratably to the coverage requirement. For example, using the AWS-3 FNPRM intermediate milestone of 50% of population covered at the end of 4 years, the free service requirement would be adjusted ratably to be the capability to support 10 million free subscribers at the end of 4 years. *See* Appendix A.

[7] *See infra* n. 11

[8] "All current cellular systems use FDD and more than 90% of the worlds available mobile frequencies are in un-paired bands," Ericsson Whitepaper: LTE an introduction, Technical Merits. Page 11 available at: http://www.ericsson.com/technology/whitepapers/lte_overview.pdf (visited Feb. 2, 2010).

[9] *See* https://www.cisco.com/en/US/solutions/ns341/ns524/ns811/beamforming_whitepaper_fujitsu.pdf (visited Feb. 2, 2010). *See* http://ezine.motorola.com/serviceprovider?c=19&a=456 ("Motorola EZine")(visited Feb. 2, 2010). Motorola explains that "TDD spectrum is increasingly being viewed as ideal spectrum for heavy data consumption as operators can allocate more capacity to either the downlink or uplink, depending on the applications. Frequency division duplex (FDD), used by voice networks today, have uplink and downlink allocations that are balanced, which isn't the most efficient way to transmit data." Motorola further adds that "Mobile WiMAX is a TDD-based technology, and

because TDD systems use the same frequency band for both uplink and downlink transmissions, the spectrum allocated for uplink and downlink can be modified to reflect changes in user behavior thereby making TDD networks ideal for the variable and highly asymmetric nature of the Internet. [10] There is also a strong current of innovation in TDD technologies especially with the integration of techniques like Orthogonal Frequency Division Multiple Access ("OFDMA"), smart antenna systems, beamforming, Multiple-Input and Multiple Output ("MIMO"), Space Time Coding ("STC") and Space-Division Multiple Access ("SDMA") that increase spectral efficiency and link budget, which in turn improves the capital and operating economics for service providers.[11] Our survey of publicly available technical specifications of various WiMAX and TD-CDMA vendors shows a number of them use these techniques to deliver systems with spectral efficiency in the range of 3 bps/Hz/cell.[12] Recent reports of trials of the LTSI/SAE consortium have indicated TD-LTE systems can deliver spectral efficiency rates of 5 to7.3 bps/Hz highlighting the potential for greater improvements in the near future.[13]

According to the WiMAX Forum, total system link budgets of 140-160 db are possible using OFDMA based TDD systems (the range due to different operating and service level assumptions).[14] As Cisco and Fujitsu point out, each 3dB of additional gain in link budget equates to 37 percent higher coverage for the wireless network and ultimately reduces the number of cell sites required for a nationwide build.[15]

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several operators, including China Mobile, are keen on deploying TD-LTE because of their spectrum allocations." *See also* Comments of ArrayComm, LLC WT Docket Nos. 07-195 and 04-356, at 2-5 (filed Jul. 25 2008) ("ArrayComm Comments").

[10] *See* Motorola EZine; *See also* ArrayComm Comments at 2-5.

[11] *See e.g.* Terrapinn publications in association with Motorola, WiMax Guide: "Joined up mobile – WiMAX extends the broadband picture" (Oct. 2007); Intel, "Understanding WiMAX and 3G for Portable/Mobile Broadband Wireless, (Dec 2004); Cisco "Adaptive Beamforming Whitepaper, (2008).

[12] *See e.g.* Alvarion Presentation. Slide 10; available at: www.spy.co.uk/Consultancy/RockMedia/WiFiSummit/ Presentations/PeledAlvarionWi-FiSummit.ppt; Compares an Alvarion BreezeMAX system at 3.24b/s/Hz vs. other Wimax systems at 3.0 b/s/Hz/sector.; ArrayComm White Paper. Pg 12; available at: http://www.arraycomm.com/docs/ ArrayCommonMBWAecons.pdf; This chart shows a spectral efficiency of 4b/s/Hz/sector; Motorola Paper – The Promise of WiMAX. Pg 5; available at: http://www.motorola.com/networkoperators/pdfs/Wi4-the-promise-article.pdf; This shows a range of spectral efficiencies, not using the highest modulation, that averages ~3bps/Hz; WiMAX Forum presentation. Pg 13; available at: http://www.wimaxforum.org/files/wimax_lte/wimax_and_lte_feb2009.pdf; Chart shows average spectral efficiencies for 3 different releases of Mobile WiMAX which range from 1.9 to 3.7 bps/Hz (for the 2.O release); HSPA to LTE-Advanced White Paper. Pg 53 available at: http://www.rysavy.com/Articles/2009_09_3G_Americas_RysavyResearch_HSPA-LTE_Advanced.pdf; There is a chart of "Achievable Efficiencies" on the top of the page which compares Mobile WiMAX (and several other technologies) to the theoretical limits.; IPWireless TD-CDMA *See* Letter from Joe Hanna, on behalf of IPWireless, to Marlene H. Dortch, Secretary, FCC, WT Docket 07-195 and PS Docket 06-229 (filed Jan. 17, 2010). Spectral efficiency is defined as bits per second per Hertz per cell (Bps/Hz/cell) and represents the aggregate data capacity per a fixed amount of spectrum available per cell site. This parameter normalizes different vendor solutions regarding cell sectors and frequency re-use. Some of these figures are spectral efficiency per sector; in those cases, for the purposes of comparison we assume one sector = one cell, though in practice, a cell may use multiple sectors.

[13] *See* http://lstiforum.com/media/press.html?listNum=175 (last visited on Feb. 2, 2010). The LTE/SAE Trial Initiative (LSTI includes a number of vendors including Nokia, Ericsson, Alcatel-Lucent) is a global collaboration between vendors and operators which recently announced the industry's peak spectral efficiency target of 5 bps/Hz downlink and 2.5 bps/Hz uplink can be achieved in a live air test and that MIMO technology working in realistic conditions, with rates of over 40 Mbps (spectral efficiency: 7.3 bps/Hz) measured in the field with a 2x2 antenna configuration.

[14] *See* http://www.wimaxforum.org/technology/downloads/Mobile_WiMAX_Part1_Overview_and_Performance.pdf (last visited on Feb. 2, 2010) at 32-34.

[15] *See supra* n. 9.

III. The Potential of a Nationwide Network on AWS-3

There are many different technical implementations for how AWS-3 can be configured to build a national network that delivers a broadband data service. Rather than specify a single implementation, the purpose of this analysis is to illustrate the basic technical parameters that enable such a network. In practice, different service providers will make different technology and network design choices to suit their own business requirements.

To simplify the discussion, we perform the analysis for two different classes of service: a basic broadband service at 768 kbps and a higher speed 4 Mbps broadband service. Further, we assume that the operator only provides a single service at a time in order to set a boundary on the analysis. We conduct our analysis across a range in numbers of required cell sites for a national build to show how many subscribers can be supported by the network for a particular class of service. This range reflects the flexibility that an operator can have in designing its network to its desired operating parameters.

The key technical parameters of the analysis are as follows:

a. TDD Operation in AWS-3 Spectrum

This analysis assumes a TDD waveform utilizing an OFDMA architecture, such as IEEE 802.16e Mobile WiMAX standard or the 3GPP compatible generation of protocols including TD-LTE, TD-CDMA, and TD-SCDMA. The AWS-3 band is assumed to be a single national spectrum license with rules that allow for technical flexibility and at least 20 MHz of usable spectrum to the licensee.[16]

b. Spectral Efficiency

The analysis assumes commercially available TDD equipment delivering average spectral efficiency of 3bps/Hz/cell.[17]

c. Service Specifications and End-User Load Models

There are two service specifications in this analysis. The first is a 768 kbps basic broadband service and the second is a 4 Mbps broadband service. The 768 kbps and 4 Mbps respectively reflect sustained downlink speeds as opposed to burst rate figures commonly used in the wireless specifications.

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[16] Our analysis assumes the AWS-3 band to be 2155-2180 MHz with OOBE limits of 60+10log(P) resulting in 20 MHz of useable broadband spectrum pursuant to the AWS-3 FNPRM. *See* AWS-3 NPRM at 2. The FNPRM sought comment on expanding this allocation by 5 MHz from the original allocation of 2155-2175 in order to address co-existence issues with neighboring bands and adjustments to OOBE limits to from the FCC standard of 43+10log(P). OET noted that "OOBE measurement data with a WiMAX interfering signal were not collected. We present results for the tests we did conduct with a WiMAX interferer in Table 4 below. These tests generally show that a WiMAX signal has less potential for causing interference than a UMTS signal. Based on these observations, we can reasonably expect that WiMAX in the AWS-3 band would have less impact on an AWS-1 receiver than UMTS." *See* Advanced Wireless Service Interference Test Results and Analysis, WT Docket. Nos. 07-195 & 04-356, at 9 (rel. Oct. 10, 2008).

[17] *See supra*. n. 9.

For the purpose of this analysis, we are basing the end-user load model on a publicly available cable broadband user traffic model. For a cable service delivering approximately 6-10 Mbps downlink service today, the typical average throughput per broadband subscriber is 50 kbps.[18] For the 768 kbps service analysis, we adjust the cable load number down to 25 kbps per subscriber using a simple logarithmic curve to reflect a less intensive use of the network.[19] To simplify the analysis, in the case of the 4 Mbps service, we conservatively assumed the full 50 kbps average data usage per subscriber, similar to what is found on cable broadband networks.

d. National Build

Many factors impact the actual number of cell towers required for a U.S. national build. These factors include, among other things, the RF link budget and propagation characteristics, cell tower locations, the topology and coverage areas, specific end-user locations, and service definitions (including mobile vs. fixed nomadic use). As a general matter, mobile services require more hand-offs and greater coverage and therefore require more base stations than do fixed/nomadic deployments.

For a typical mobile WiMAX or TD-CDMA system, estimates put a national build at between 20,000-30,000 cell towers for an initial coverage build.[20]

e. Analysis and Results

A TDD system using 20 MHz of useable unpaired spectrum and operating with a spectral efficiency of 3bps/Hz/cell would deliver 60 Mbps in aggregate capacity at each individual base station. At a downlink to uplink ratio of 3:1, each cell site would therefore support a total downlink capacity of 45 Mbps. Based on the load model assumptions, each cell site could therefore support approximately 1,800 subscribers at 768 kbps or 900 subscribers at the 4 Mbps service.

Extrapolated out to a national footprint, this network would support between 36 million and 54 million subscribers with a basic broadband service at 768 kbps.[21] Alternatively,

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[18] *See* Rysavy Research Paper "Mobile Broadband Spectrum Demand" (page 18, section 3.6, ¶ 3) available at: http://www.rysavy.com/Articles/2008_12_Rysavy_Spectrum_Demand_.pdf; *See also* Communications Technology, Nov. 1, 2007, DOCSIS Migration Methodology, From A to B to "3", By Saifur Rahman, available at: http://www.cable360.net/ct/operations/bestpractices/26403.html. Article states that cable load model of average of 40kbps per subscriber downstream and 20kbps upstream. *See also* Adtran White Paper: Defining Broadband Speeds: Deriving Required Capacity in Access Networks, submitted to the FCC's National Broadband Plan, GN Docket 09-51, at 18-19 (filed Jan. 26, 2010,) (stating that Internet traffic long term average traffic per household to be 61 kbps in 2008) available at: http://fjallfoss.fcc.gov/ecfs/document/view?id=7020383547.

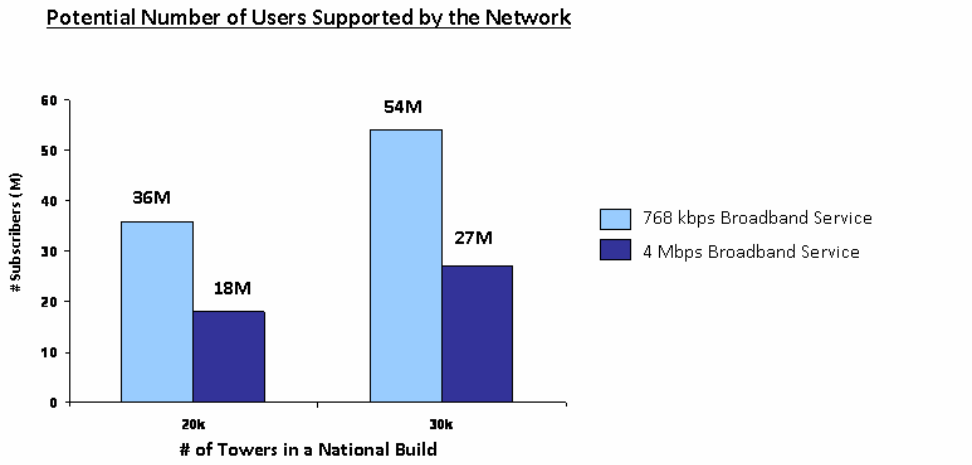
[19] Service speeds and user load are related on a logarithmic scale and we calculate that a service speed at 1/6th the cable speed (i.e <1 Mbps vs. 6+Mbps) would have ½ the user load.

[20] Assumes an average cell size of between 4.5 -5.5mi after averaging across the entire coverage area. 95% of U.S. population, according to the 2000 census data (available at census.gov) is located in ~57% of the U.S. total landmass or 2.1M square miles. Assuming a 5mi cell radius across the entire coverage area, this would require approximately 27k base stations. *See* Wimax Forum Whitepaper available at: http://www.wimaxforum.org/sites/wimaxforum.org/files/document_library/wimaxforumnlosgeneral-versionaug04.pdf, which references a 4-9km typical cell radii under NLOS conditions. An analysis of an mobile network (which requires many more sites than a fixed nomadic service) performed by Jeffrey Eisenach estimated that 32.6.k towers required to reach 95% of the U.S. population; the analysis used an estimated cell radius of 2.9mi for the first 75% of the US population and 8mi cell radius for the next 20% of U.S. population. *See* Eisenach, Jeffrey A., Due Diligence: Risk Factors in the Frontline Proposal (Jun. 28, 2007). Available at SSRN: http://ssrn.com/abstract=1260397

[21] *See infra* Figure 1.

the same network would support between 18 million and 27 million subscribers with a higher speed 4 Mbps service.[22]

Figure 1



IV. Conclusion

The AWS-3 band, with 20MHz of usable spectrum, can be constructed to support millions of broadband consumers. In light of the national goal to achieve universal and affordable broadband access and the overwhelming support in the record calling for the AWS-3 licensee to provide free basic broadband, the FCC should move quickly to assign the AWS-3 band in a way that meaningfully contributes to achieving this national objective.

In doing so, the Commission should establish population based build-out requirements on the license to provide universal coverage for 95% of the U.S. population and affordable access in the form of free basic broadband to 20 million subscribers by the end of the first term of the license.

Sincerely,

Uzoma C. Onyeije

cc: Ruth Milkman, John Leibovitz, Peter Daronco, Paul Malmud, Stephen Zak, Julius Knapp, Blaise Scinto, Gary Michaels, Brian Wondrack, Ira Keltz, Margaret Weiner, Kevin Holmes, Martha Stancill

[22] *Id.*

Appendix A: M2Z's Proposed Changes to the FNPRM: Sections 27.14(q) and 27.1191

§ 27.14 Construction requirements; Criteria for renewal.

(a) AWS and WCS licensees, with the exception of WCS licensees holding authorizations for Block A in the 698–704 MHz and 728–734 MHz bands, Block B in the 704–710 MHz and 734–740 MHz bands, Block E in the 722–728 MHz band, Block C, C1, or C2 in the 746–757 MHz and 776–787 MHz bands, or Block D in the 758–763 MHz and 788–793 MHz bands, and with the exception of AWS licensees holding authorizations in the 1915-1920 MHz, 1995-2000 MHz, and 2155-2180 MHz bands, must, as a performance requirement, make a showing of "substantial service" in their license area within the prescribed license term set forth in §27.13. "Substantial service" is defined as service which is sound, favorable and substantially above a level of mediocre service which just might minimally warrant renewal. Failure by any licensee to meet this requirement will result in forfeiture of the license and the licensee will be ineligible to regain it.

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(q) Any AWS licensee holding an authorization in the 2155-2180 MHz band shall provide signal coverage and offer service to at least 50 percent of the total U.S. population within four years of the date on which the original license was issued and at least 95 percent of the total U.S. population at the end of the license term. If any licensee in this band elects not to meet its performance requirements based on the percent of the U.S. population served, it shall provide signal coverage and offer service to at least 35 percent of the population in each Cellular Market Area (CMA) or Economic Area (EA) in its licensed area within four years and at least 70 percent of the population in each CMA or EA in its licensed area at the end of the license term.

(1) If any AWS licensee holding an authorization in the 2155-2180 MHz band fails to establish that it meets the applicable performance requirement within four years of the date on which the original license was issued, the term of that license authorization will be reduced by two years and such licensee may be subject to enforcement action, including forfeitures. In addition, the licensee may lose authority to operate in part of the remaining unserved areas of the license.

(2) If any AWS licensee holding an authorization in the 2155-2180 MHz band fails to establish that it meets the applicable performance requirement at the end of the license term, that licensee's authorization will terminate automatically without Commission action for those geographic portions of its license in which the licensee is not providing service, and those unserved areas will become available for reassignment by the Commission. Such licensee may also be subject to enforcement action, including forfeitures. In addition, a licensee that provides signal coverage and offers service at a level that is below the end-of-term benchmark may be subject to license termination. In the event that a licensee's authority to operate in a license area terminates automatically without Commission action, such areas will become available for reassignment pursuant to the procedures in paragraph (j) of this subsection.

(3) *Provision of free broadband service*. A licensee (including lessees) offering any service on spectrum subject to this section must have the capability to provide free broadband service to 20 million free broadband subscribers by the end of the build-out period and any such capability shall be adjusted ratably to match the level of network build-out construction at any of the intermediate milestones established in sections q(1) and q(2). The licensee shall not have the additional obligation to provide service to free broadband subscribers beyond the limits defined in this section.

~~**§ 27.1191 Free wireless broadband service requirement in the 2155-2180 MHz band.**~~

~~(a) *Applicability*. This section shall apply only to an authorization in the 2155-2180 MHz "AWS-3" band.~~

~~(b) *Provision of free broadband service*. A licensee (including lessees) offering any service on spectrum subject to this section must utilize up to twenty-five percent of its AWS-3 wireless network capacity to provide free two-way wireless broadband Internet service ("free broadband service") at a minimum engineered data rate of 768 kbps downstream per user.~~

~~(1) To the extent that a licensee meets all demand for the free broadband service and is providing such service at a minimum engineered data rate of 768 kbps downstream per user, such licensee can utilize more than seventy-five percent of its wireless network capacity for any other service authorized to operate in this band.~~

~~(2) On a per base station or per market basis, a 2155-2180 MHz licensee will not be required to maintain the minimum data rate when and where meeting additional demand for the free broadband service would require more than twenty-five percent of wireless network capacity. Once demand reaches twenty-five percent of wireless network capacity, a 2155-2180 MHz licensee has the discretion to manage any additional demand for free service using any lawful network management protocol.~~