

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

In the Matter of)	
)	
Amendment of Parts 2 and 90 of the)	RM-11715
Commission's Rules To Create a New)	
Frequency Allocation for Wireless)	
Broadband Services)	
)	
Petition of Mimosa Networks, Inc., for a)	
Rulemaking To Create a New Frequency)	
Allocation for Wireless Broadband)	
Services)	

REPLY of MIMOSA NETWORKS, INC.

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SUMMARY

The 10 GHz band presents significant opportunities for the growth of wireless broadband, and the record submitted in response to the Petition for Rulemaking filed by Mimosa Networks, Inc., supports Mimosa's proposals for utilizing the band to pursue these opportunities. Radio amateurs opposing use of the band for wireless broadband offer various arguments that in the end do not add up to a sound basis for excluding broadband and foregoing the far greater public benefit to be realized from opening up the band for wireless broadband use.

Benefits of Using the 10 GHz Band for Broadband

The record supporting Mimosa's Petition demonstrates that existing spectrum capacity is overtaxed by substantial increases in the use of broadband services, and this strain on capacity is impeding broadband service providers' efforts to meet their customers' service demands. Many commenters agree that making the 10 GHz band available for fixed operations would aid in reducing these pressures.

A key consideration in making the 10 GHz band available for wireless broadband is the opportunity to use the band to serve rural communities. Opening up the spectrum to pursue this goal is a principal objective of Mimosa's Petition, and this approach has been endorsed by numerous commenters who explain that access to 500 megahertz of spectrum in the band would facilitate their efforts to serve consumers in rural areas.

The record also shows that, as Mimosa argues in its Petition, the Commission's pro-competitive policies would be advanced by permitting broadband use of the 10 GHz band. Taking this action, for example, would give wireless Internet service providers an opportunity to deploy overlay networks in urban and suburban areas currently served only by large incumbent providers. This

competitive entry would help address a serious problem: A recent survey shows that only 54 percent of households with annual incomes of less than \$30,000 have broadband at home. Competition, by making broadband services more affordable, could help address this problem.

Arguments Against the Petition Do Not Warrant a Denial of the Petition

Parties opposing the Petition—virtually all of whom are radio amateurs—assert that the Commission is precluded from granting the Petition, and also express concern that incumbents’ use of the 10 GHz band would be adversely affected if the Commission were to make the band available for broadband services.

Arguments that the Commission is barred from granting the Petition are unavailing, and strong reasons exist for concluding that shared use of the band by incumbents and broadband service providers would not cause harmful interference. Opposition to the Petition should therefore not stand in the way of the Commission’s initiating a rulemaking proceeding to pursue the opportunities to be realized by enabling broadband use of the band.

Scope of the Commission’s Authority.—One party claims that the Commission cannot act favorably on Mimosa’s Petition because an existing U.S. footnote to the Domestic Table of Allocations bars all non-Federal services in the 10 GHz band other than amateur service, the amateur-satellite service, and the non-Federal radiolocation service. This argument is not persuasive because the Commission has the authority and discretion to revise the referenced footnote, in a rulemaking proceeding, to expand the footnote’s scope to include broadband operations on a shared basis in the 10 GHz band.

Signal Strength Issues.—Opponents of the Petition argue that broadband service providers’ transmissions in the 10 GHz band would overwhelm the weak-signal activities of radio amateurs. In fact, engineering analysis and other factors demonstrate that this concern is overstated.

Given the fact that radio amateurs typically operate on a sporadic basis, using 5 to 10 kilohertz within a broad swath of 10 GHz spectrum, radio amateurs have the ability to utilize the band for transmissions that steer clear of stronger broadband signals and thus avoid any harmful interference.

Mimosa’s Proposed EIRP Limit.—Radio amateurs argue that the Equivalent Isotropically Radiated Power limit proposed by Mimosa would imperil access to any portion of the 10 GHz band by amateur radio operators. Contrary to concerns expressed in the record, however, this scenario would not likely be the case. A sector antenna typically used for point-to-multipoint operations in the band would not likely result in harmful interference because the antenna gain for such an antenna would necessarily be sufficiently low so that the EIRP level of the transmission would be limited.

Contention-Based Protocol; Band Plan.—Parties opposing the Petition have stated that Mimosa’s proposed contention-based protocol would not be effective in guarding against harmful interference. The spectacular success of Wi-Fi devices, however, which are based upon a contention-based protocol, demonstrates the effectiveness of this protocol when operating in a band with similar devices employing a “clear channel assessment” mechanism.

For the typical amateur radio case of narrowband voice communications, where an automated contention-based protocol is not employed, it is quite straightforward for the operator to simply pick a channel not occupied by a persistent broadband transceiver. For the past 100 years, scanning for a clear channel has been the primary way that radio amateurs have selected their frequency of operation. This simple practice will work effectively in the 10 GHz band, as it has in lower frequency Part 97 bands with much more congestion.

In addition, the band plan proposed by Mimosa would provide further insurance against harmful interference to radio amateurs' use of the 10 GHz band by using a guard band and non-mandatory channelization arrangements for amateur radio operators.

Enforcement.—Radio amateurs fail to support their claims that it will be difficult for the Commission to enforce requirements and restrictions intended to prevent interference between broadband operations and amateur radio operations in the 10 GHz band. In addition to the fact that instances of interference are likely to be infrequent, the coordination rules and equipment certification requirements proposed by Mimosa in the band will effectively enforce non-interference obligations.

Radiolocation Operations.—Little concern is expressed in the record regarding possible interference by broadband providers with incumbent radar operations in the 10 GHz band. In Mimosa's view, Dynamic Frequency Selection restrictions will be effective in preventing such interference, especially in light of actions recently taken by the Commission in the *Part 15 U-NII Devices Order* to augment DFS requirements. Mimosa believes the Commission should propose that these revised DFS restrictions be applied to broadband operations in the 10 GHz band.

Suitability of the 10 GHz Band.—A few commenters contend that the 10 GHz band is not suitable for high-capacity backhaul applications covering long distances. These arguments are not persuasive, as the 11 GHz band, which has propagation characteristics similar to those found in the 10 GHz band, is being used extensively for long-haul operations at very high transmission rates.

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Petition of Mimosa Networks, Inc., for a Rulemaking To Create a New Frequency Allocation for Wireless Broadband Services)	

REPLY of MIMOSA NETWORKS, INC.

Pursuant to Section 1.405(b) of the Commission’s Rules,¹ Mimosa Networks, Inc. (“Mimosa”),² by its attorneys, hereby respectfully submits this Reply to comments filed in response to its Petition for Rulemaking (“Petition”) to create a new domestic spectrum allocation, and new and revised service rules, for wireless broadband services.³

¹ 47 C.F.R. § 1.405(b).

² Mimosa, which is headquartered in Campbell, California, is a manufacturer of wireless broadband products. See <http://mimosa.co/>. The CEO of Mimosa is Brian L. Hinman, formerly the CEO and co-founder of 2Wire (acquired by Pace plc in 2010) and Polycom (NASDAQ: PLCM). He was also a co-founder and VP Engineering of PictureTel, an early pioneer in digital video communications. Hinman holds a B.S.E.E. *summa cum laude* from the University of Maryland, an S.M.E.E. from Massachusetts Institute of Technology, and an honorary Sc.D. from Rochester Institute of Technology.

³ Mimosa filed its Petition for Rulemaking on May 1, 2013. On March 11, 2014, the Commission issued a Public Notice instructing parties interested in commenting on the Petition to do so within 30 days pursuant to Sections 1.4 and 1.405 of the Commission’s Rules. *Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed*, Public Notice, Report No. 3002 (CGB rel. Mar. 11, 2014) (“*Public Notice*”). On March 18, 2014, Mimosa filed a Motion for Extension of Time, seeking clarification that replies to all statements filed in the rulemaking proceeding (including statements filed in advance of the 30-day period specified in the *Public Notice*) are due not later than April 25, 2014. On March 27, 2014, the Broadband Division of the Wireless Telecommunications Bureau (“WTB”) adopted an Order in response to Mimosa’s Motion, clarifying that all replies may be filed not later than April 25, 2014.

I. INTRODUCTION.

Mimosa’s Petition proposes actions the Commission should take to address a significant national problem: the lack of access to high-speed broadband services for over 19 million Americans.⁴ These proposals find strong support in the record. Objections filed by amateur radio operators opposing the Petition ultimately lack merit and will make national efforts to bring broadband to underserved areas across the country even more difficult, especially in rural areas. To deny the Petition on the basis of those objections would be particularly regrettable in light of the fact that Mimosa’s proposal for shared use of spectrum in the band provides a unique opportunity to make available 500 megahertz of spectrum without any need to displace or relocate those incumbent users.

Given the increasingly ubiquitous presence of the Internet as part of the fabric of the Nation’s governmental, commercial, social, and educational activities, the lack of access to the Internet can have crippling consequences. As Lawrence Strickling, Assistant Secretary of Commerce for Communications and Information, recently observed, “Americans who don’t have access to

Amendment of Parts 2 and 90 of the Commission’s Rules To Create a New Frequency Allocation for Wireless Broadband Services, RM-11715, Order, DA 14-413 (WTB rel. Mar. 27, 2014), at para. 3.

⁴ *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. 11-121, Eighth Broadband Progress Report, 27 FCC Rcd 10342, 10369 (para. 44) (2012) (“*Eighth Broadband Progress Report*”), cited in Petition at 6. According to the National Telecommunications and Information Administration (“NTIA”), 7 percent of Americans (approximately 22.1 million people) lack access to wireline broadband at speeds of at least 3 Mbps/768 kbps. NTIA, U.S. BROADBAND AVAILABILITY: JUNE 2010-JUNE 2012 (May 2013) at 4, accessed at http://www.ntia.doc.gov/files/ntia/publications/usbb_avail_report_05102013.pdf.

the Internet are increasingly cut off from job opportunities, educational resources, health-care information, social networks, even government services.”⁵

Moreover, the lack of access to advanced broadband services is particularly acute in rural America. Approximately 24 percent of Americans living in rural areas—14.5 million people—do not have any access to high-speed broadband.⁶ As the Commission has observed, “too many rural Americans are being left behind. Rural governments and businesses are missing opportunities to function more efficiently and effectively.”⁷ The Commission has concluded that, although progress has been made in deploying broadband in rural areas, “additional efforts and new policies . . . are still required to ensure that rural America fully shares in the benefits of the emerging broadband economy.”⁸

Mimosa’s Petition initiated a flood of supportive comments. Most commenters agree that the Commission should continue to pursue opportunities for shared spectrum arrangements to meet the growing demand for advanced broadband services and to expand the reach of broadband to all Americans. They also share Mimosa’s belief that the 10 GHz band affords a promising opportunity to advance these objectives.

⁵ Andrea Peterson, *Gap between those who use Internet and those who don’t is widening*, WASH. POST, Nov. 13, 2013, accessed at http://www.washingtonpost.com/business/technology/gap-between-those-who-use-internet-and-those-who-dont-is-widening/2013/11/12/d9d8d002-4726-11e3-a196-3544a03c2351_story.html (quoting Lawrence Strickling).

⁶ *Eighth Broadband Progress Report*, 27 FCC Rcd at 10370 (para. 47).

⁷ Acting Chmn. Michael J. Copps, FCC, BRINGING BROADBAND TO RURAL AMERICA: REPORT ON A RURAL BROADBAND STRATEGY (2009), *attached to Rural Broadband Report Published in FCC Record*, GN Docket No. 09-29, Public Notice, 24 FCC Rcd 12791, 12795 (2009), *quoted in* Petition at 6 n.20.

⁸ BRINGING BROADBAND TO RURAL AMERICA: UPDATE TO REPORT ON A RURAL BROADBAND STRATEGY, GN Docket No. 11-16 (June 17, 2011), at para. 1, *accessed at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-320924A1.pdf.

Opposition to Mimosa's proposals comes virtually exclusively from radio amateurs. To put this opposition in perspective, compared to the 19 million Americans currently lacking access to broadband, there are approximately 700,000 licensed radio amateurs in the United States,⁹ comprising 0.22 percent of the U.S. population. Of that total, approximately 161,000 radio amateurs are current members of ARRL, comprising just 0.05 percent of the U.S. population. While Mimosa appreciates the determination of these radio amateurs to vigorously protect their pastime, the concerns expressed by amateur radio operators are ultimately overstated and misplaced. As Mimosa demonstrates in the sections that follow, the presence of new Internet infrastructure in the 10 GHz band poses no substantial risk to continued activities by radio amateurs in the band, which often consist of radio communications contests by amateur hobbyists.

Based on numbers alone, expanding the 10 GHz band for wireless broadband promises a far greater public benefit than can be realized by restricting the band solely for radiolocation and amateur radio use. In addition, public benefit is further enhanced by broadband providers' sharing the band, avoiding any need to displace or relocate incumbents. This public benefit, and the Commission's related mandate to expand the availability of broadband for all Americans, make a compelling case for the initiation of a rulemaking proceeding in accordance with Mimosa's Petition.

II. BACKGROUND.

Mimosa's Petition for Rulemaking seeks the initiation of a rulemaking proceeding for the purpose of making additional spectrum available for wireless broadband. Mimosa explains in its Petition that freeing up spectrum in the 10.0-10.5 GHz band advances the Commission's spectrum

⁹ ARRL, "US Amateurs Now 700,000 Strong!" (Oct. 12, 2011), *accessed at* <http://www.arrl.org/news/us-amateurs-now-700-000-strong>. ARRL, formerly known as the American Radio Relay League, is the national association for amateur radio. ARRL Comments at 1.

policies by enhancing access to broadband services for all Americans, especially those 19 million Americans currently without viable high-speed Internet access. Finding innovative ways to advance these policies is additionally important because of the escalating demand for broadband services across the entire U.S. population.

Although recent steps taken by the Commission to make more spectrum available for broadband have been constructive, Mimosa argues in its Petition that the Commission should explore additional options for making spectrum available for broadband, specifically by authorizing wireless broadband services in the 10 GHz band pursuant to Part 90, Subpart Z, of the Commission's Rules.¹⁰

The 10 GHz band possesses a variety of desirable characteristics for expanding broadband services, including the fact that, unlike spectrum in higher frequencies, the band is only moderately affected by attenuation due to rain-fade effects. Mimosa acknowledges in its Petition, however, that sharing spectrum in the 10 GHz band inherently requires effective mechanisms to address interference issues, in light of the band's current allocation for radiolocation and amateur radio use. To guard against interference with government and civilian radar operations, Mimosa proposes that the Commission's rules apply Dynamic Frequency Selection ("DFS") restrictions to wireless broadband operations in the band.

Mimosa suggests further steps to protect amateur radio operations in the band. *First*, authorizing wireless broadband services in the 10 GHz band pursuant to Part 90Z uses the Part 90Z coordination procedures and requirements to guard against disruption of amateur radio operations.

¹⁰ 47 C.F.R. Part 90, Subpart Z ("Part 90Z").

And, *second*, Mimosa's proposed band plan will protect frequencies most often used by amateur radio operators.

The proposals made by Mimosa in its Petition have sparked considerable public interest, with more than 240 parties filing formal or informal comments in response to the *Public Notice*. Numerous individuals, trade associations, and corporations agree with Mimosa that making spectrum in the 10 GHz band available for wireless broadband will benefit consumers, bring broadband services to underserved rural areas, promote competition in markets served by cable and DSL providers, assist in meeting the growing demand for wireless broadband services, and benefit the national economy.

While some commenters have expressed concerns regarding harmful interference between broadband providers and incumbents in the 10 GHz band, the overwhelming evidence, as set forth herein, shows that these concerns do not warrant denial of Mimosa's Petition. Instead, the evidence lends support for the Commission to promptly initiate a rulemaking proceeding to consider Mimosa's proposals.

III. THERE IS WIDESPREAD SUPPORT IN THE RECORD FOR THE COMMISSION TO INITIATE A RULEMAKING TO IMPLEMENT MIMOSA'S PROPOSALS FOR MAKING SPECTRUM IN THE 10 GHZ BAND AVAILABLE FOR BROADBAND SERVICES.

The record reflects substantial support for Mimosa's position that three central factors provide a compelling basis for the Commission to start a rulemaking proceeding to implement proposals made in Mimosa's Petition. *First*, numerous parties agree with Mimosa that the enormous

growth in demand for broadband services is overtaxing the spectrum that is currently available for wireless broadband services.¹¹

Second, commenters argue that Mimosa’s proposal, by enabling wireless Internet service providers (“WISPs”) to utilize spectrum in the 10 GHz band,¹² will benefit consumers, promote competition, and further the Commission’s goals for the deployment of advanced broadband services in rural areas.¹³ And, third, numerous parties advise that Mimosa’s proposals for utilization of the 10 GHz band should be examined and implemented in a rulemaking proceeding because these proposals will be effective in allocating additional spectrum for broadband use while also providing sufficient protection for incumbent operations in the band.¹⁴

A. Adopting Mimosa’s Proposal Will Assist in Meeting the Growing Demand for Broadband Services.

As Mimosa notes in its Petition, the Commission stated in its Order transforming its universal service support mechanisms that “[f]ixed and mobile broadband have become crucial to our

¹¹ See, e.g., Comments filed by Thomas Anderson; Mary Lou Catacutan; Don Davis; Paul Eberhardt; Michael Esquivel; Wade Gartin; Dick Hardt; Gagan Hothi; Sriniva Kandala; Julie O’Brien; Alexander Perez; Josh Reynolds; Cameron Sellers; Rob Strechay; Sean Taylor; Brough Turner; Steven Utick; Sergej Vasiljev; Raymond Wice; Scott Wierstra.

¹² “WISPs use unlicensed spectrum in the 900 MHz, 2.4 GHz and 5 GHz bands and ‘lightly licensed’ spectrum in the 3650-3700 MHz band to provide high-quality and affordable service in unserved, underserved and competitive areas.” Wireless Internet Service Providers Association (“WISPA”) Comments at 1. WISPs currently serve approximately 3 million consumers. *Id.* at 2.

¹³ See, e.g., Comments filed by Regina Aquino; Michelle Conrad; Brian Coyne; Cyber Broadcasting, LLC; Ethoplex, LLC; Ty Featherling; LeRoy Fitzgerald; William Fowler; Dennis Hauge; Chris Hudson; Innovative Air, LLC; In the Stix Broadband; Sharad Mehta; Thomas Pedersen; Lee Peterson; Razzolink, Inc. (Anthony Iacopi) (“Razzolink”); Shelby Broadband; Frank Spiteri; Tina Stout; Wavelinc.

¹⁴ See, e.g., Comments filed by Tom Allmand; Bruce Bateman; Michael Black; Lona Dallessandro; Ruth Gravitt; Tim Hildabrand; Matt Hopkins; Jay Kreshel; Tzu-Jung Lee; Scott LePere; Brian Madl; James Martin; Graham McIntire; Sudhanshu Mehta; Gursel Mutlu; Connor Peck; Carlos Ramos; Mustafa Rangwala; Travis Szeto.

nation's economic growth, global competitiveness, and civic life.”¹⁵ The emergence of this crucial role played by broadband services is reflected in the growing demand for these services.¹⁶ As Commissioner Pai recently observed, “[c]onsumer demand for high-speed, wireless broadband is expected to increase nine-fold over the next four years That means our Wi-Fi routers will have to handle about 4.8 exabytes of data every month in 2018.”¹⁷

The record in this proceeding amply documents the fact that the pressures being exerted on existing spectrum capacity by the dramatic and ongoing rise in the utilization of broadband services are making it increasingly difficult for broadband carriers to accommodate their customers' service demands. WISPA explains that “[a]s unlicensed wireless services become more ubiquitous and the capacity needs of consumers continue to expand, WISPs are facing congestion and increased ‘noise’ and interference in unlicensed bands”¹⁸

Unwired, Ltd., a wireless broadband service provider operating in the San Francisco area, explains that:

[W]e are increasingly having difficulty coordinating licensed backhaul in the tradition[al] 6 GHz, 11 GHz, and 18 GHz bands due to complete congestion in these

¹⁵ *Connect America Fund*, WC Docket No. 10-90, *A National Broadband Plan for Our Future*, GN Docket No. 09-51, *Establishing Just and Reasonable Rates for Local Exchange Carriers*, WC Docket No. 07-135, *High-Cost Universal Service Support*, WC Docket No. 05-337, *Developing an Unified Inter-carrier Compensation Regime*, CC Docket No. 01-92, *Federal-State Joint Board on Universal Service*, CC Docket No. 96-45, *Lifeline and Link-Up*, WC Docket No. 03-109, *Universal Service Reform – Mobility Fund*, WT Docket No. 10-208, Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, 17667 (para. 3) (2011) (footnote omitted), *pets. for review pending sub nom. In re: FCC 11-161*, No. 11-9900 (10th Cir., oral argument held Nov. 19, 2013) (and consolidated cases)), *quoted in* Petition at 4.

¹⁶ See Petition at 7.

¹⁷ *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49, First Report and Order, FCC 14-30 (rel. Apr. 1, 2014) (“*Part 15 U-NII Devices Order*”) (Statement of Commissioner Ajit Pai).

¹⁸ WISPA Comments at 2.

bands. Additional bands are required to meet our backhaul needs so we can continue to provide services to the underserved areas in the region via wireless.¹⁹

A carrier providing service in rural Minnesota notes that “we would very much benefit from having access to more spectrum in the 10 GHz range for our backhauls so we can free up 5 GHz spectrum for our customer Access Points.”²⁰ A WISP providing wireless broadband service in California for more than 10 years indicates that the base usage of bandwidth on its network has increased “from 50 Mbps in 2006 to over 500 Mbps in 2014 and of this over 100 Mbps was added on within the last year. In order to continue to provide the necessary bandwidth that customers demand and need we are in need of additional spectrum.”²¹

Moreover, while the Commission acted earlier this month in the *Part 15 U-NII Devices Order* to allow greater unlicensed use of the 5 GHz band, the fact is that, as Commissioner Pai points out, “we need more 5 GHz Wi-Fi spectrum, not just better use of existing 5 GHz Wi-Fi spectrum.”²² As one commenter in this proceeding has explained, “[t]he unlicensed Part 15 U-NII bands have become increasingly popular for both . . . mobile offloading and fixed Internet access, creating heavy congestion that will only intensify going forward.”²³ In addition, spectrum in the 6 GHz, 11 GHz, and 18 GHz bands, made available pursuant to Part 101 of the Commission’s Rules,

¹⁹ Unwired, Ltd. (Peter Kranz) Comments at 1 (emphasis added).

²⁰ Minnesota WiFi (Darin Steffl) Comments at 1.

²¹ Razzolink Comments at 1.

²² *Part 15 U-NII Devices Order* (Statement of Commissioner Ajit Pai) (emphasis in original). Authorizing use of the 10 GHz band for wireless broadband backhaul would help to ease pressures on use of the 5 GHz band, which, in turn, would enable WISPs to better utilize the 5 GHz band for the provision of service to end-user customers. See Laurence Brett Glass, d/b/a LARIAT, Comments at 1 (observing that unlicensed bands have become increasingly crowded and plagued by interference, and explaining that “[e]ven point-to-point links with high gain, highly directional antennas have been disrupted due to the limited amount of spectrum available and an ever-increasing demand for bandwidth”).

²³ Alexander Gostrer Comments at 1.

is experiencing rising levels of demand, and the limited channel widths in these bands make it difficult to provide sufficient capacity for advanced point-to-multipoint equipment.²⁴

Many commenters agree with Mimosa that opening up the 10 GHz band for wireless broadband services would be an important step toward meeting the surging demand for greater broadband capacity.²⁵ One commenter, for example, observes that “[a]pplying the light-licensing process to the 10-10.5 GHz frequency band, in a manner which does not interfere with existing spectrum users, will provide the regulatory framework within which innovative companies can develop new technologies to leverage this under-utilized portion of the spectrum.”²⁶

The record in this proceeding further illustrates the fact that “the spectrum currently allocated to wireless *is not sufficient* to handle the projected growth in demand, even with technological improvements allowing for more efficient use of existing spectrum and significant investment in new facilities.”²⁷ Mimosa’s Petition proposes practical steps the Commission can take to address

²⁴ Amplex Internet (Mark Radabaugh) (“Amplex”) Comments at 1.

²⁵ Open Technology Institute and Public Knowledge (“OTI & PK”) point out that initiating a rulemaking proceeding based on Mimosa’s proposals would be consistent with the recommendation in the National Broadband Plan “to identify additional candidate federal and non-federal spectrum that can be made accessible for both mobile and fixed wireless broadband use, on an exclusive, shared, licensed and/or unlicensed basis.” OTI & PK Comments at 3 (quoting Omnibus Broadband Initiative, FCC, CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, GN Docket No. 09-51, at 3 (2010)).

²⁶ Pierre Pellissier (“Pellissier”) Comments at 1. *See* Virginia Broadband Comments at 1 (noting that “[t]he congestion in the existing U-NII bands is becoming very disruptive to our network and to our customers, and is a major constraint on continued growth. The fully-licensed options are very expensive and the delays involved make new deployment a much slower process. Employing a light-license scheme in the 10-10.5 band would alleviate most of these problems and allow us to improve service to customers and bring broadband to customers we were unable to reach before.”).

²⁷ Council of Economic Advisors, *The Economic Benefits of New Spectrum for Wireless Broadband* at 5 (Feb. 21, 2012), *quoted in Amendment of the Commission’s Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands*, GN Docket No. 13-185, Report and Order, FCC 14-31 (rel. Mar. 31, 2014) (“AWS-3 Order”), at para. 3 n.10 (emphasis added).

this problem, and the record shows considerable support for the initiation of a rulemaking to examine and implement Mimosa’s proposed utilization of spectrum in the 10 GHz band.

B. Opening Up the 10 GHz Band for Broadband Services Will Further Efforts To Bring Broadband to Rural Areas.

Millions of Americans residing in rural areas across the country lack access to fixed broadband meeting the speed benchmark of 4 Mbps/1 Mbps,²⁸ and, as Mimosa explains in its Petition, allocating the 10 GHz band on a shared basis for wireless broadband services “would facilitate access to higher capacity backhaul that would provide a path for WISPs to offer better services in rural areas”²⁹

Commenters agree that the Petition proposes an effective means of advancing the Commission’s goal of bringing advanced broadband services to consumers in underserved rural areas. One commenter, for example, explains that “[t]here [are] still large territories in the USA that are outside of the reach of Internet connectivity. It is critical for the progress of the country to bring information to every corner of the nation.”³⁰

David Jones, who operates a small WISP that focuses on serving rural areas in Wyoming, advises the Commission that “[i]f you are serious about getting faster speeds to rural places this

²⁸ Petition at 6.

²⁹ *Id.* at 23. OTI and PK observe that, “[a]s the Commission is well aware, backhaul remains a critical problem for competitive carriers and providers in rural communities.” OTI & PK Comments at 5.

³⁰ Dimitar Bojantchev Comments at 1. *See* Shared Spectrum Company (“SSC”) Comments at 5 (indicating that wireless broadband services will help provide rural residents with remote healthcare services); Sherri Moseley Comments at 1 (arguing that all American households, including those in small rural communities, “should have the option of Internet service [because it] is such an integral part of our everyday lives”); WISPA Comments at 2 (noting that “WISPs in rural and remote areas often lack access to affordable backhaul and connectivity”).

[i.e., Mimosa’s proposal] is a good step.”³¹ Mr. Jones explains that “[h]aving 500mhz in the 10ghz spectrum opened up for Broadband will allow more bandwidth to rural [A]merica.”³² Richard Quattrocchi supports Mimosa’s proposal because “[p]roviding high speed, wireless access is essential so as not [to] leave behind those in rural areas in the digital divide. Opening up the existing 10.0-10.5 GHz band for wireless broadband services is a needed step in that regard.”³³ Joink LLC indicates that Mimosa’s proposal is an effective way to bring additional spectrum to rural areas that currently have only limited access to broadband services, while at the same time avoiding harmful interference with incumbent operations in the 10 GHz band.³⁴

Mimosa’s proposal, which would facilitate broadband deployment in rural areas, continues the pursuit of policies that led to the Commission’s adoption of its Part 90Z rules nine years ago.

In the *3650 MHz Order*, the Commission expressed its view that:

[T]he 3650 MHz band is well-suited to respond to the needs expressed by the growing number of entrepreneurial wireless internet service providers . . . that currently bring broadband services to consumers particularly those living in rural areas of the United States. Today, rural consumers often have fewer choices for broadband services than consumers in more populated areas. . . . [T]he actions we take herein for the 3650 MHz band will allow further deployment of advanced

³¹ David Jones Comments at 1. *See* Amplex Comments at 1 (explaining that spectrum in the 10 GHz band would improve the ability to deliver broadband services economically and efficiently to suburban and rural customers).

³² David Jones Comments at 1.

³³ Richard Quattrocchi (“Quattrocchi”) Comments at 1.

³⁴ Joink LLC explains that:

In rural areas, access to fast and reliable broadband service is limited. Additional spectrum will greatly improve speed and availability. . . . Having highly directional antennas will also reduce the amount of interference wireless providers could cause to existing operators. Obviously, existing operators should have reasonable protections and certain areas will need to be “blacked out,” blocking use completely. Other areas could have specific restrictions on what portion of the frequency block may be used based upon incumbent users. Certainly, there are massive rural areas where no use restrictions would be necessary.

Joink LLC Comments at 1.

telecommunications services and technologies to all Americans, especially in the rural heartland³⁵

The Commission’s objectives in making the 3650 MHz band available for wireless broadband have been largely frustrated because of the small amount of spectrum (25 megahertz) allowed on radios with contention-based protocols, including those based upon low-cost repurposed Wi-Fi silicon chipsets. “Wireless operators have often chosen to use the unlicensed Part 15 5 GHz band instead, because wider and more channels are available, albeit without spectrum coordination.”³⁶ The record in this proceeding supports Mimosa’s view that expanding the Part 90Z rules to include 500 megahertz of spectrum in the 10 GHz band will further advance the Commission’s objectives for rural broadband deployment.

C. Enabling the Use of Spectrum in the 10 GHz Band for Wireless Broadband Will Serve Consumers, Promote Competition, and Benefit the National Economy.

Mimosa explains in its Petition that making the 10.0-10.5 GHz band available for wireless broadband services will benefit consumers “by adding to the spectrum capacity available for broadband and enhancing the options of wireless service providers in meeting consumer demand for wireless broadband[.]”³⁷ will “enhance broadband competition and lower wireless carriers

³⁵ *Wireless Operations in the 3650-3700 MHz Band*, ET Docket No. 04-151, *Rules for Wireless Broadband Services in the 3650-3700 MHz Band*, WT Docket No. 05-96, *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, *Amendment of the Commission’s Rules With Regard to the 3650-3700 MHz Government Transfer Band*, ET Docket No. 98-237, Report and Order and Memorandum Opinion and Order, 20 FCC Rcd 6502, 6503-04 (para. 2) (2005) (“3650 MHz Order”).

³⁶ Petition at 14 (footnote omitted).

³⁷ *Id.* at 22.

costs, both of which will benefit consumers[,]”³⁸ and will “benefit the national economy generally”³⁹ by enhancing the deployment of broadband networks and thus providing businesses with the ability “to expand their operations, reach new customers, and compete in new markets”⁴⁰

Considerable support exists in the record for Mimosa’s views regarding the beneficial impact of making spectrum in the 10 GHz band available for wireless broadband. *First*, consumers will benefit. One commenter points out, for example, that a large number of consumers have limited or no access to Internet connections because of the lack of infrastructure.⁴¹ “Opening up . . . the 10Ghz spectrum for wireless providers will give those people an easier way to access the internet. Giving them another resource [will enable them] to better educate themselves, keep up to date on important global changes, and [have] a chance to lead a better life.”⁴²

Second, enabling wireless broadband service providers to utilize 10 GHz spectrum benefits the national economy. Commenters agree that making the 10 GHz band available for wireless broadband would stimulate the economy⁴³ and provide “sorely needed high tech jobs”⁴⁴

³⁸ *Id.* at 23.

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ Daniel Gostrer Comments at 1.

⁴² *Id.* See Aeronet Broadband Comments at 1 (explaining that the availability of 10 GHz spectrum “would allow us to offer higher capacity links in the 1 Gbps range, facilitating the current FCC goals of higher Broadband adoption and speeds among consumers”); Joseph Cracchiolo (“Cracchiolo”) Comments at 1 (stating that “[u]se of the 10.0 to 10.5 GHz spectrum in point-to-point and point-to-multipoint modes could serve to bring faster access to starved areas of our state [Arizona]”); Michwave Technologies Comments at 1 (arguing that “the 10GHz range would be perfect not only to offer faster service to our customers, but to also improve reliability over current offerings”).

⁴³ Shelby Broadband Comments at 1.

⁴⁴ Quattrocchi Comments at 1.

In the *AWS-3 Order* adopted last month, the Commission stressed that “[w]ireless broadband is a critical component of economic growth, job creation, and global competitiveness and consumers are increasingly using wireless broadband services to assist them in their everyday lives.”⁴⁵ Fixed broadband services play an important role, with “WISPs serv[ing] more than 3 million customers, many of whom live in rural areas where access to wired broadband is limited or non-existent.”⁴⁶ Moreover, as one commenter has observed, Mimosa’s proposal will allow WISP operators to provide cable and fiber speeds at lower cost, driving down consumer prices.⁴⁷

In Mimosa’s view, one could conservatively predict that the availability of the 10 GHz band for wireless backhaul will expand the current WISP market by at least 10 percent; that small expansion alone will provide broadband services to more households than the entire current membership of the ARRL.⁴⁸

And, *third*, competition is enhanced by enabling wireless broadband service providers to utilize spectrum in the 10 GHz band. Commenters observe that incumbent telecommunications service providers and cable operators currently exert considerable power in the market for broadband services, reducing incentives for technological innovation, driving up prices, and limiting

⁴⁵ *AWS-3 Order* at para. 3 (footnote omitted).

⁴⁶ MegaGate Broadband, Inc., Comments at 1.

⁴⁷ Rory Conaway (“Conaway”) Comments at 1.

⁴⁸ Fixed wireless service provides Internet access for more than 3 million Americans today. JAB Wireless, based in Colorado, is one of the largest WISP operators in the world. They report an annual subscriber growth rate of over 30 percent, with much of their access networking operating in the Part 15 5 GHz band. See PRN Newswire, “JAB Broadband Utilizes Cambium Gigatower To Meet Subscriber and Growth Demands” (Apr. 2, 2013), *accessed at* <http://www.prnewswire.com/news-releases/jab-broadband-utilizes-cambium-gigatower-to-meet-subscriber-and-growth-demands-201026701.html> (noting that “JAB’s subscriber base has grown constantly over the last seven years. In the past year alone, it has increased by more than 60 percent.”). Many WISPs state that heavy congestion in the 5 GHz band is a deterrent to subscriber growth.

choices available to consumers.⁴⁹ Making the 10 GHz band available for broadband services helps to address these competitive issues. Such a step would “increase consumer choice and competition in the home broadband market[,]”⁵⁰ would “drive consumer prices lower [and] provide better and faster services,”⁵¹ and would “provide additional competition in urban areas.”⁵²

These competitive opportunities provided by the 10 GHz band warrant special attention, because the possibilities that can be realized if the band is opened up for wireless broadband are substantial. As Mimosa has noted, 19 million Americans lack access to broadband,⁵³ but a significantly larger number of people—72 million (30 percent of the U.S. adult population), according to a Pew Research survey⁵⁴—do not have any broadband in their homes. Affordability is a key issue: The Pew Research survey shows that only 54 percent of households with annual incomes of less than \$30,000 have broadband at home.

The 10 GHz band can play an important role in enhancing broadband competition, thus making broadband more affordable for Americans who lack any broadband service. WISPs currently operate principally in rural markets, bringing fixed broadband to consumers who are not being served by AT&T, Verizon, or other large providers. WISPs currently are not able to compete

⁴⁹ Eric Copeland Comments at 1; Pellissier Comments at 1.

⁵⁰ Pellissier Comments at 1.

⁵¹ Conaway Comments at 1.

⁵² Cracchiolo Comments at 1. *See* Quattrocchi Comments at 1 (arguing that opening up the 10 GHz band for wireless broadband will “foster greater competition in a market dominated by fewer and fewer ISPs and wireless carriers”).

⁵³ *See* Section I, *supra*.

⁵⁴ *See* Pew Research, “Home Broadband 2013,” Aug. 26, 2013, *accessed at* <http://www.pewinternet.org/2013/08/26/home-broadband-2013/> (showing that “70% of American adults ages 18 and older have a high-speed broadband connection at home”). According to the U.S. Census Bureau, the U.S. population in 2012 was estimated to be 313,873,685, of which 76.5 percent (240,113,369) were persons 18 years old or older. U.S. Census Bur., *accessed at* <http://quickfacts.census.gov/qfd/states/00000.html>.

in markets dominated by large broadband service providers because WISP networks are not sufficiently scalable to accommodate significant expansion of their customer base.

Access to 500 megahertz of spectrum in the 10 GHz band will assist wireless broadband service providers' efforts to deploy overlay networks in areas currently served by the dominant incumbent carriers. These networks will have the potential of providing an alternative for broadband to millions of consumers that, for example, is more cost effective than DSL-provided broadband.

Overall, when combined with the fact that amateur radio operators will still retain access to the 10 GHz band under Mimosa's proposal, it is evident that the proposals made in the Petition provide a greater public benefit than restricting the spectrum solely for amateur and radiolocation applications.⁵⁵

D. The 10 GHz Band Is Not Suitable for Small Cell Mobile Communications.

There can be no doubt that the country lacks sufficient spectrum for many modern forms of communication, including mobile connectivity. As Chairman Wheeler has indicated in a recent blog, "[i]f we don't free up more airwaves for mobile broadband, demand for spectrum will eventually exceed the supply."⁵⁶

Mimosa is concerned, however, about the feasibility of a suggestion made by Qualcomm Incorporated ("Qualcomm") that, notwithstanding Mimosa's proposal that the 10 GHz band

⁵⁵ See Matt Larsen Comments at 1 (arguing that "[s]etting this [10 GHz] spectrum aside for general purpose broadband access represents the best value for the public").

⁵⁶ Tom Wheeler, Chairman, FCC, "Channel Sharing: A New Opportunity for Broadcasters" (Feb. 11, 2014), accessed at <http://www.fcc.gov/blog>.

should be made available for wireless backhaul links,⁵⁷ “the band may be better suited to directly support [small cell] mobile operations”⁵⁸ In Mimosa’s view, use of the band for mobile point-to-multipoint operation, linking small cells to individual handheld devices, is not practical.⁵⁹

A key issue with the use of the 10 GHz band for mobile applications is the increased Free-Space Path Loss (“FSPL”)⁶⁰ relative to traditional cellular spectrum. As Mimosa notes,⁶¹ FSPL increases as the square of the frequency, and thus, the loss at 10.25 GHz is 8.3 times greater than at 3,550 MHz.⁶² Another important factor is the increased attenuation due to foliage and other obstructions at the higher frequencies. Consider the simplified foliage loss formula referenced in OET Bulletin No. 70:

$$L = 0.2 \times f^{0.3} \times R^{0.6}$$

⁵⁷ Mimosa envisions the 10 GHz band as having widespread applicability for backhaul operations involving point-to-point connectivity from a cellular tower to backbone networks. Making the band available for this use would have the important effect of making the market for these operations more competitive.

⁵⁸ Qualcomm Comments at 1. OTI and PK also suggest that the Commission should consider “authorizing low-power use of the [10 GHz] band for personal/portable devices, including off-the-shelf consumer devices.” OTI & PK Comments at 2. *See id.* at 6-7.

⁵⁹ Mimosa is suggesting, in fact, that the Commission consider proposing that the 10 GHz band be available only for fixed wireless broadband operations, and not for mobile wireless broadband. See Section IV.B.1., *infra*.

⁶⁰ Free-Space Path Loss is defined as the loss in signal strength of an electromagnetic wave that would result from a line-of-sight path through free space (usually air), with no obstacles nearby to cause reflection or diffraction. “Free-Space Path Loss,” *accessed at* http://en.wikipedia.org/wiki/Free-space_path_loss.

⁶¹ See Section IV.B.1., *infra*.

⁶² The Commission has proposed to make the 3550-3650 MHz band “available for innovative mobile and fixed wireless broadband services” *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354, Notice of Proposed Rulemaking and Order, 27 FCC Rcd 15594, 15596 (para. 1) (2012).

where f is the frequency in megahertz, and R is the distance through foliage in meters, valid for distances of less than 400 meters.⁶³

The following example illustrates the practical issues raised by any efforts to utilize spectrum in the 10 GHz band for small-cell point-to-multipoint operations. Consider an urban small-cell application along a tree-lined street, whereby the propagation is from a standing position through a mixture of clear space and tree foliage to a small cell mounted 300 meters away on the side of a building. Presume that 100 meters of the propagation is through foliage, and 200 meters is through clear space.

Using the formula referenced in OET Bulletin No. 70, the foliage-related attenuation is 37 dB at 3,550 MHz, while it becomes 50 dB at 10.25 GHz. Over a distance of 300 meters, the FSPL at 3,550 MHz is 93 dB, and the FSPL at 10.25 GHz is 102 dB. Presuming a handset EIRP of 24 dBm for both cases (no antenna gain), and an antenna gain of 15 dBi on the small cell (limited by pointing practicality), the receive signal strength in the 3,550 MHz case is -91 dBm, while at 10 GHz the receive signal would be -113 dBm.

The typical LTE uplink bandwidth is 180 kHz (15 kHz tone spacing, and 12 tones per PRB (physical resource block)). Assuming a 4.5 dB receiver noise figure, the realized thermal noise floor is -116 dBm. Thus, in this example of a small-cell scenario, the 3,550 MHz LTE uplink signal-to-noise ratio (“SNR”) would be a healthy 25 dB, while the 10.25 GHz LTE uplink SNR would be an unusable 3 dB.

⁶³ FCC, Office of Engineering and Technology (“OET”), *Millimeter Wave Propagation: Spectrum Management Implications*, Bulletin No. 70 (July 1997) (“OET Bulletin No. 70”), at 14 (referencing CCIR Doc. Rpt. 236-2).

An additional problem with the Qualcomm approach is Qualcomm's apparent desire to completely clear the 10 GHz band for mobile use by a date certain in order to auction the spectrum for licensed mobile wireless use.⁶⁴ Given the existing record, attempts to clear radiolocation users (including the Federal Government) and amateur radio operators from the 10 GHz plan would present complex issues and likely evoke an even greater outcry from amateur radio operators, inevitably delaying the availability of the band for wireless broadband use. Mimosa's proposal for shared use of the band with incumbent operations can be implemented with less difficulty and disruption, and with greater speed.

Finally, although, as Mimosa has discussed, the 10 GHz band is not suitable for mobile point-to-multipoint operations, the band can be easily utilized for *fixed* point-to-multipoint services. Unlike mobile user devices, client radios in fixed point-to-multipoint operations could utilize high-gain antennas (operating at 20 to 30 dBi gain), which minimize the signal-to-noise issues described above. Mimosa believes that the suitability of the 10 GHz band for fixed point-to-multipoint operations would greatly enhance carrier operations in the band.

IV. ISSUES RAISED BY PARTIES OPPOSING MIMOSA'S PROPOSALS DO NOT WARRANT A DENIAL OF THE PETITION.

Comments raising concerns regarding Mimosa's proposals, in addition to contending that the Commission lacks authority to take the actions proposed in the Petition, focus principally on interference issues relating to incumbent amateur and radiolocation operations, and the claimed unsuitability of the 10 GHz band for wireless broadband. As Mimosa explains in the following sections, none of these concerns provides a basis for denying the Petition.

⁶⁴ See Qualcomm Comments at 3.

A. Scope of the Commission’s Authority.

ARRL argues that “it [is] impossible [for the Commission] to grant the relief sought by Mimosa” because Footnote US128 to the Domestic Table of Allocations prohibits all non-Federal services in the 10.0-10.5 GHz band other than amateur service, the amateur-satellite service, and the non-Federal radiolocation service.⁶⁵ ARRL concludes that “US Footnote 128 is dispositive”⁶⁶ because the Commission is “not at liberty to ignore this footnote” and is therefore obligated to refrain from granting Mimosa’s Petition.⁶⁷ This argument is unavailing.

ARRL’s contentions ignore the fact that the Commission inherently possesses both the authority and discretion to revise any footnote to the Domestic Table of Allocations. There is no limitation, legal or otherwise, that prevents the Commission, in the context of the proposed rule-making, from revising Footnote US128 to permit fixed services in the 10.0–10.5 GHz band, with a condition that such operations must protect Federal radiolocation services.⁶⁸

ARRL also notes that there is no ITU allocation in Region 2 for fixed services in the 10.0–10.5 GHz band.⁶⁹ Mimosa is well aware of this. Of course, the International Telecommunication

⁶⁵ ARRL Comments at 5-6.

⁶⁶ *Id.* at 6.

⁶⁷ *Id.*

⁶⁸ The Commission has held that Section 2.102(b)(1) of the Commission’s Rules “contemplates that . . . rulemaking proceedings will be conducted to amend the [domestic] Table of Frequency Allocations before authorizing any use of frequencies that is not in accordance with the Table.” *Inquiry Into the Development of Regulatory Policy in Regard To Direct Broadcast Satellites for the Period Following the 1983 Regional Administrative Radio Conference*, Gen. Docket No. 80-603, Notice of Proposed Policy Statement and Rule-making, 86 FCC 2d 719, 726 (para. 21 n.15) (1981). In that rulemaking, the Commission was contemplating the authorization of DBS operations on frequencies currently allocated to terrestrial microwave users on an interim basis, while it awaited actions at the 1983 Regional Administrative Radio Conference that would make decisions regarding frequencies and orbital slots allocated to the United States. *See id.* at 720-21 (paras. 4-5).

⁶⁹ ARRL Comments at 5.

Union (“ITU”) Table of Allocations can be modified, and that is exactly what Mimosa is working toward in this proceeding. In fact, as ARRL correctly notes, International Footnote 5.480 allocates the 10.0–10.45 GHz band in 14 countries in ITU Region 2 to the fixed and mobile services on a primary basis, and in one additional country in ITU Region 2 to the fixed service on a primary basis.⁷⁰ Mimosa ultimately seeks to modify Footnote 5.480 so that the 10.0–10.5 GHz band will be allocated for fixed services on a primary basis in the United States.

Contrary to ARRL’s assertions, the Commission possesses the authority to manage U.S. spectrum, even to the extent of taking actions that are inconsistent with the International Table of Allocations, so long as these actions do not pose any risk of harmful interference to other countries’ use of the spectrum. As a general matter, while the U.S. is bound by the spectrum allocations in the Table of Allocations, “U.S. domestic spectrum uses may differ from the international allocations provided these domestic uses do not conflict with our neighbors’ spectrum uses that do comply with international regulations or bi-lateral agreements.”⁷¹ The ITU Constitution acknowledges this prerogative by “fully recognizing the sovereign right of each State to regulate its telecommunication”⁷² Moreover, the Commission’s *Best Practices for National Spectrum Management*

⁷⁰ *Id.* at 5 n.7. Mexico, for example, took advantage of this allocation pursuant to International Footnote 5.480 seventeen years ago by auctioning spectrum in the 10 GHz band for the purpose of providing microwave point-to-point and point-to-multipoint links for fixed and mobile wireless access and other services. See Organization for Economic Development, *Regulatory Reform in Mexico: Regulatory Reform in the Telecommunications Industry* (1999) at 8, accessed at <http://www.oecd.org/regreform/2507189.pdf>.

⁷¹ NTIA, *Background Paper: Radio Frequency Spectrum Allocations in the United States* (Dec. 2005) (emphasis added), accessed at http://www.ntia.doc.gov/legacy/osmhome/chart_03.htm. See “Radio Spectrum Allocations 101,” accessed at <http://www.spectrumwiki.com/wp/allocations101.pdf> (indicating that “to the extent that any non-compliance with the ITU table does not cause interference to other countries that abide by the ITU plan, each country is free to (and often does) modify the ITU table to suit its needs”).

⁷² Constitution of the International Telecommunication Union, Preamble (Dec. 22, 1992), accessed at <http://hk.lexiscn.com/law/constitution-of-the-international-telecommunication-union.html>.

indicates that one such practice involves “working in collaboration with regulatory authorities of other regions and countries to avoid harmful interference”⁷³

The Commission has indicated that it will apply a public interest test in deciding whether its spectrum allocation actions must be consistent with World Radiocommunication Conference (“WRC”) actions or other international agreements. For example, in the *WRC-03 Implementation Order* an issue before the Commission was whether it should revise Footnote US368 because its terms were inconsistent with a decision made at WRC, Geneva, 2003 (“WRC-03”) regarding the allocation of spectrum for Little LEO feeder links. While the Commission’s public interest determination in that case was to revise the US footnote to reflect the WRC-03 action,⁷⁴ in the case of the Mimosa Petition the public interest warrants a different result.

⁷³ FCC, *Best Practices for National Spectrum Management*, accessed at <http://www.fcc.gov/encyclopedia/best-practices-national-spectrum-management>. The Commission notes that, although international practices are not included in this statement of best practices, some of the best practices are “intended to harmonize global spectrum management policies, to the extent practicable, by harmonizing practices among national administrations.” *Id.*

There is Commission precedent, however, for taking actions regarding spectrum allocations and use that are not consistent with agreements with other countries. In the *800 MHz Band Public Safety Order*, for example, the Commission acted to adopt a band plan that was “inconsistent with current international agreements.” *Improving Public Safety Communications in the 800 MHz Band, et al.*, WT Docket No. 02-55, *et al.*, Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order, 19 FCC Rcd 14969, 14986 (para. 25) (2004) (“*800 MHz Band Public Safety Order*”). The Commission decided to require that 800 MHz band operations remain consistent with the current agreements with Canada and Mexico until the agreements were modified to conform to the Commission’s reconfiguration of the 800 MHz band. The Commission noted its intent “that interference-free cross-border mutual-aid capability remain paramount during this interim period preceding modification of the applicable international agreements.” *Id.*

⁷⁴ *Amendment of Parts 2, 25, and 73 of the Commission’s Rules to Implement Decisions from the World Radiocommunication Conference (Geneva, 2003) (WRC-03) Concerning Frequency Bands Between 5900 kHz and 27.5 GHz and to Otherwise Update the Rules in this Frequency Range*, ET Docket No. 04-139, Report and Order, 20 FCC Rcd 6570, 6612 (para. 116) (2005) (“*WRC-03 Implementation Order*”) (indicating that, “[a]lthough the decision made at WRC-03 is inconsistent with the provisions outlined in footnote US368, we find it serves the public interest to maintain but revise the conditional allocations to reflect the WRC-03 action”).

Specifically, as Mimosa has discussed, its Petition proposes a means of furthering efforts to make advanced broadband available to consumers across the Nation, especially in rural areas, while at the same time promoting competition and benefiting the national economy. Mimosa also addresses issues concerning the ability of fixed broadband service providers to share the 10 GHz spectrum with incumbent users without compromising incumbents' use of the band. These public interest considerations warrant, at a minimum, the initiation of a rulemaking proceeding, in which one of the issues would be whether Footnote US128 to the Domestic Table of Allocations should be amended to accommodate Mimosa's proposals.

ARRL also contends that the Petition should be dismissed as premature, pursuant to Section 1.401(e) of the Commission's Rules,⁷⁵ because action by the Commission on the Petition would prejudice and possibly foreclose an opportunity to implement a 2015 WRC ("WRC-15") agenda item⁷⁶ relating to the allocation status of the 10 GHz band.⁷⁷ This argument also lacks merit.

Although the Commission is considering draft recommendations from the Advisory Committee for WRC-15 related to AI 1.12 that would support the allocation of an additional 600 megahertz of spectrum to the EESS as a secondary allocation in the 9.9-10.5 GHz band,⁷⁸ this consideration—and the possible modification to the international Table of Allocations—do not in any

⁷⁵ 47 C.F.R. § 1.401(e).

⁷⁶ WRC-15 Agenda Item 1.12 ("AI 1.12"). This agenda item will consider extending the current worldwide allocation to the Earth exploration-satellite (active) service ("EESS") in the 9.9-10.5 GHz band (and other bands), in accordance with Resolution 651 (WRC-12).

⁷⁷ ARRL Comments at 5-6.

⁷⁸ *FCC Seeks Comment on Recommendations Approved by the Advisory Committee for the 2015 World Radiocommunication Conference*, IB Docket No. 04-286, Public Notice, 29 FCC Rcd 540 (2014) ("WRC 15 Public Notice"). See Letter from Karl B. Nebbia, Associate Administrator, Office of Spectrum Management, NTIA, to Ms. Mindel De La Torre, Chief, International Bur., FCC (Dec. 13, 2013), Attach., "Draft

manner preclude the Commission from considering and moving forward on Mimosa's proposal to add fixed services on a primary basis to the 10 GHz band. The rulemaking is an appropriate forum for Commission consideration of Mimosa's proposal in light of, and ideally in tandem with, its review of draft recommendations related to AI 1.12.

B. Incumbent Amateur Radio Station Operations.

In responding to arguments raised by opponents to its Petition in the following sections, Mimosa explains that engineering analyses and other factors demonstrate that amateur radio stations in the 10 GHz band are not likely to experience harmful interference from broadband operations in the band, and that the Equivalent Isotropically Radiated Power ("EIRP") limit proposed by Mimosa would not result in harmful interference. In addition, Mimosa demonstrates that its proposed contention-based protocol and band plan, together with existing enforcement requirements, will provide further insurance against harmful interference.

1. Differences in Signal Strength Would Not Likely Result in Problematic Levels of Interference.

Several parties opposing Mimosa's Petition argue that use of the 10 GHz band by fixed broadband operations would overpower the weaker signals generated by amateur radio operations in the band.⁷⁹ These differences in signal strength, the opposing parties contend, would create insoluble interference issues. These contentions are misplaced.

Mimosa has undertaken a careful technical analysis demonstrating that broadband operations in the 10 GHz band will not create harmful interference to amateur radio operations. One

Proposals for the Work of the Conference." The Advisory Committee has recommended in its proposed revisions to the NTIA draft proposals that the EESS allocation in the 9.9-10.5 GHz band be secondary, and not primary. *WRC-15 Public Notice*, Attach. 1, 29 FCC Rcd at 621.

⁷⁹ See, e.g., ARRL Comments at 10.

reason for this conclusion involves the increased FSPL at the frequencies in the band, combined with the use of high-gain antennas.

FSPL increases as the square of the frequency. At 10 GHz, the FSPL is 113 dB over a distance of 1 kilometer. A 600 millimeter parabolic antenna at 10 GHz has a gain of approximately 36 dBi, although the off-axis response would be -10 dBi or lower. Typical point-to-point fixed broadband radios operate at less than 1 watt of conducted power (30 dBm) so as to preserve amplifier linearity for high-order Quadrature Amplitude Modulation (“QAM”),⁸⁰ either as a single carrier or Orthogonal Frequency-Division Multiplexing (“OFDM”).⁸¹

Take for example a new radio operating under Part 90 rules as contemplated by the proposals made in Mimosa’s Petition, transmitting 30 dBm in an 80 MHz OFDM point-to-point link that is off-axis from a radio amateur service operating an Earth-Moon-Earth (“EME”)⁸² system located 1 kilometer away.

The in-band energy arriving at the amateur radio site would be -93dBm. With OFDM spread evenly over 80 MHz, the power spectral density is -172 dBm/Hz. For purposes of this example, assume that the amateur radio operator is listening in the adjacent channel, without a

⁸⁰ Quadrature Amplitude Modulation is both an analog and a digital modulation scheme, conveying two analog message signals, or two digital bit streams, by changing (or “modulating”) the amplitudes of two carrier waves, using the amplitude-shift keying digital modulation scheme or amplitude modulation (AM) analog modulation scheme. “Quadrature Amplitude Modulation,” Wikipedia, *accessed at* http://en.wikipedia.org/wiki/Quadrature_amplitude_modulation.

⁸¹ Orthogonal frequency-division multiplexing is defined as a method of digital modulation in which a signal is split into several narrowband channels at different frequencies. “Orthogonal Frequency-Division Multiplexing (OFDM),” SearchNetworking, *accessed at* <http://searchnetworking.techtarget.com/definition/orthogonal-frequency-division-multiplexing>.

⁸² An Earth-Moon-Earth communication is defined as a radio communications technique that relies on the propagation of radio waves from an earth-based transmitter directed via reflection from the surface of the moon back to an earth-based receiver. “Earth-Moon-Earth Communication,” Wikipedia, *accessed at* http://en.wikipedia.org/wiki/Earth-Moon-Earth_communication.

guard band. Applying the usual adjacent channel Power Spectral Density (“PSD”) mask for Wi-Fi-based radios (–20 dBm), the undesirable energy within the EME channel will be –192 dBm/Hz or lower. This is far below the reported EME receiver Noise Temperature⁸³ of 180 K, which translates to –176 dBm/Hz. Thus, in this example, the adjacent channel operation of a point-to-point wireless broadband link, as contemplated in the Petition, would create no harmful interference to a nearby radio amateur service operating in a low-noise application like EME.

In addition, several other factors demonstrate that protestations regarding harmful interference to amateur radio operations are misplaced, and thus should not stand in the way of the Commission’s initiating a rulemaking proceeding.⁸⁴

First, many radio amateurs in the 10 GHz band operate on a sporadic basis, engaging in narrowband communications that utilize narrow-beam antennas. Much of this activity involves contests in microwave communications.⁸⁵ It is reasonable to conclude that instances of harmful

⁸³ One use of Noise Temperature is in the definition of a system’s Noise Factor or Noise Figure. The Noise Factor specifies the increase in Noise Power (referred to the input of an amplifier) due to a component or system when its input Noise Temperature is T_0 . “Noise Temperature,” Wikipedia, *accessed at* http://en.wikipedia.org/wiki/Noise_temperature.

⁸⁴ Nonetheless, Mimosa recommends that the Commission, in initiating such a rulemaking proceeding, should consider proposing that the 10 GHz band be made available only for fixed wireless broadband operations on a shared basis with incumbent users, and not for mobile wireless broadband, as a further means of guarding against any potential for harmful interference. Such a limitation would not affect utilization of the band by mobile wireless carriers for fixed backhaul operations, or by WISP providers for broadband services to end-user customers. As Mimosa has discussed, the band, in any event, is not suitable for small cell mobile communications. See Section III.D., *supra*.

⁸⁵ Tony Long, founder of Reactance Labs (a company that sell kits and products for builders of amateur radio microwave transceivers and other experimenters) explains that:

Microwave Amateur Radio is a hobby within a hobby, namely Amateur [or] “Ham” radio. . . . In the United States, the majority of amateur microwave radio activity occurs during annual contests, including the ARRL 10 GHz and Up Cumulative Contest. During this annual two-weekend contest, microwave enthusiasts take their radios outside to make contacts with one another, frequently from the tops of mountains due to the line-of-sight nature of microwaves. These contacts are usually voice (single-sideband suppressed carrier) or CW (Morse Code). Points are awarded for a combination of distance between contacts and

interference are likely to be infrequent in the case of sporadic transmissions utilizing 5 to 10 kilohertz within the 500 megahertz of the 10.0-10.5 GHz band.

In a typical scenario, if an amateur radio user were to seek access to a channel in the 10 GHz band for a brief period of usage (which is the most common type of amateur use of the band), and finds that the selected channel is being utilized by a fixed wireless operation, the amateur operator can select a different, clear channel. Given that amateurs will have this channel selection option at the time they seek to initiate use, they have the ability to operate on unoccupied channels.

Second, the record suggests that the 10 GHz band is not heavily utilized by amateur radio operations.⁸⁶ As one commenter points out, “the amateur radio community [operating in the 10 GHz band] recognizes that the 10.0-10.5GHz band is not presently being fully utilized and is justifiably being considered in the [Mimosa] Petition.”⁸⁷

Third, modern technological advances offer solutions to interference issues that might arise from shared use of the 10 GHz band by amateur radio operations and wireless broadband providers.⁸⁸

number of unique call signs collected. Most activity occurs in the 10 GHz band, but extra points are awarded for any higher bands

“Getting Started in Amateur Microwave Radio,” *accessed at* <http://reactancelabs.com/?p=111>.

⁸⁶ See, e.g., Kelly Hall Comments at 1; Gerald Richardson Comments at 1; Hidenori Takahashi Comments at 1 (noting that the 10 GHz band is currently underutilized by amateur radio operations, even in densely populated areas such as Los Angeles). While amateur radio use of the band “has become popular in recent years,” Petition at 18 (footnote omitted), *cited in* ARRL Comments at 3 & n.4., there is little evidence to suggest that this popularity has resulted in heavy use of the band by amateur radio operators.

⁸⁷ Greg Bailey Comments at 1. Mr. Bailey opposes granting the Petition on the grounds that “additional information needs to be gathered and considered” before a rulemaking is initiated. *Id.*

⁸⁸ For example, as Ramy Abdallah explains, “[m]odern receivers (aka software defined radios) are cognizant of interference. They can adapt the transmission to cause minimal impact on other communication services sharing the spectrum. The use of highly directional antennas would further reduce the interference impact. The rulemaking would stir innovation in this [area].” Ramy Abdallah Comments at 1.

And, *fourth*, precedent exists for the Commission’s utilization of rulemaking proceedings as a means of enabling various stakeholders to work out suitable arrangements to address spectrum interference issues. For example, in a recent Commission decision broadening the availability of wireless consumer signal boosters, the Commission adopted “industry consensus-based technical rules for Consumer Signal Boosters, which incorporate sufficient safeguards to mitigate interference to wireless networks.”⁸⁹ The Commission was committed to allowing “parties to try to reach a consensus on the technical requirements and procedures that will enable currently available signal boosters to continue to serve the needs of consumers while addressing the interference concerns raised by carriers.”⁹⁰

While Mimosa has demonstrated that fixed broadband services will not create harmful interference to radio amateurs’ operations in the 10 GHz band, Mimosa nonetheless welcomes the opportunity to work with other stakeholders to reach a consensus on any necessary technical rules in the context of a rulemaking proceeding.

For all the reasons discussed above, assertions made by parties opposing Mimosa’s Petition regarding the risks of harmful interference are an insufficient basis upon which to deny the Petition or forestall a rulemaking proceeding to examine and implement Mimosa’s proposals.

⁸⁹ *Amendment of Parts 1, 2, 22, 24, 27, 90 and 95 of the Commission’s Rules to Improve Wireless Coverage Through the Use of Signal Boosters*, WT Docket No. 10-4, Report and Order, 28 FCC Rcd 1663, 1664 (para. 2) (2013).

⁹⁰ *Amendment of Parts 1, 2, 22, 24, 27, 90 and 95 of the Commission’s Rules to Improve Wireless Coverage Through the Use of Signal Boosters*, WT Docket No. 10-4, Notice of Proposed Rulemaking, 26 FCC Rcd 5490, 5544 (2011) (Statement of Commissioner Mignon L. Clyburn).

2. Several Factors Illustrate the Reasonableness of Establishing an EIRP Limit of 55 dBW in the 10 GHz Band.

Mimosa proposes in the Petition that the Commission establish an EIRP⁹¹ limit of 55 dBW for fixed station operations in the 10.0-10.5 GHz band pursuant to the Part 90Z rules, pointing out that this EIRP level is necessary to overcome rain fade in the frequency band.⁹² Several parties object to this proposal, arguing that “[t]his very high EIRP in the context of point-to-multipoint services in this band is inconsistent with any continued access to any portion of the band by the Amateur Service.”⁹³

Three principal factors, however, support Mimosa’s proposal. *First*, Mimosa’s proposed use of an EIRP limit of 55 dBW is based on and is consistent with transmitter power limitations already established by the Commission for the 10.7-11.7 GHz band in Part 101.⁹⁴ While it is true that fixed operations do not share the 10.7-11.7 GHz band with amateur radio, the Commission nonetheless has recognized the importance of an EIRP limit of 55 dBW in ensuring reliable service to end-user customers. In adopting 55 dBW as the maximum EIRP limit for operations in the 10.7-11.7 GHz band (and for operations in all bands from 4 GHz to 40 GHz subject to the Part 101 rules), the Commission determined that:

The current [lower] limits often force engineering compromises in some bands, which deprive the public of optimum levels of service. Raising the maximum power

⁹¹ EIRP “represents the total power measured at the output of a radio station antenna, and consists of the sum of the output power of the transmitter, any losses between the transmitter output and the antenna, and the antenna gain.” *Reorganization and Revision of Parts 1, 2, 21, and 94 of the Rules to Establish a New Part 101 Governing Terrestrial Microwave Fixed Radio Services*, WT Docket No. 94-148, *Amendment of Part 21 of the Commission's Rules for the Domestic Public Fixed Radio Services*, CC Docket No. 93-2, *McCaw Cellular Communications, Inc. Petition for Rulemaking*, RM-7861, Report and Order, 11 FCC Rcd 13449, 13470 (para. 50 n.89 (1996) (“*Part 101 Order*”).

⁹² Petition at 19.

⁹³ ARRL Comments at 10. See Roger Rehr Comments (“Rehr Comments”) at 1.

⁹⁴ Petition at 19 & n.69 (citing Section 101.113(a) of the Commission’s Rules).

permitted will give users additional flexibility to design microwave networks to overcome adverse terrain and atmospheric conditions without the necessity of requesting a waiver of the current power limitations.⁹⁵

The Commission concluded that increasing the EIRP limit would not increase the potential for interference, and also indicated that, “[g]enerally, it is industry practice to use no more power than essential to provide a quality service.”⁹⁶

Second, amateur radio operations are not subject to any maximum EIRP limits. Instead of establishing such limits, the Commission’s rules provide that “[n]o [amateur] station may transmit with a transmitter power exceeding 1.5 kW PEP.”⁹⁷ The Part 97 rules do not impose any power reduction requirements as a consequence of an amateur radio station’s operating with a high-antenna gain.

For a continuous wave signal, 1.5 kW PEP is the equivalent of 31.8 dBW. While such a power level is impractical for the 3 centimeter band (*i.e.*, 10.0-10.5 GHz), amateur radio operators routinely use a transmitter power of 13 dBW (20 W). For EME operations, a typical parabolic antenna is 3 meters in diameter, producing a gain of approximately 47.5 dBi. Hence, the EIRP of a typical EME operation is 60.5 dBW, which is almost four times the maximum EIRP limit proposed in the Petition for wireless broadband operations.

And, third, there is precedent in other countries for establishing an EIRP limit of 55 dBW for fixed station operations in the 10.0-10.5 GHz band. Specifically, in licensing the 10 GHz band in Great Britain, Ofcom has permitted a maximum EIRP of 55 dBW in the band for frequency

⁹⁵ *Part 101 Order*, 11 FCC Rcd at 13471-72 (para. 57).

⁹⁶ *Id.* at 13472 (para. 57).

⁹⁷ 47 C.F.R. § 97.313(b). Peak envelope power (“PEP”) is defined as “[t]he average power supplied to the antenna transmission line by a transmitter during one RF cycle at the crest of the modulation envelope taken under normal operating conditions.” 47 C.F.R. § 97.3(b)(6).

blocks of 30 megahertz and larger.⁹⁸ Radio amateurs in Great Britain operate on a secondary basis in the band, and “[u]se by the amateur service on a national basis would only be permitted where the amateur licensee could be confident of not causing interference to the National 10 GHz Licensee.”⁹⁹

Finally, ARRL argues that it would be possible “for a wireless broadband provider to utilize a 360-degree azimuth, fixed antenna at 55 dBW EIRP and to operate that facility *anywhere* in the band.”¹⁰⁰ ARRL concludes that, without any antenna limitations, 55 dBW EIRP is far too high.¹⁰¹ This analysis is not persuasive because it does not account for the fact that the antenna gain for a 360 degree antenna would necessarily be sufficiently low so that the EIRP level would be limited. Mathematical calculations demonstrate that a sector antenna operating with an elevation beamwidth of 4 to 5 degrees (a more narrow beamwidth would not be practical because it would introduce problems associated with adequate terrain coverage) would limit the power emission of a 360 degree antenna to 28 dBW EIRP (10 dBW conducted power into an 18 dBi sector antenna), well below the 55 dBW limit proposed by Mimosa.

⁹⁸ Office of Communications (“Ofcom”), *Auction of Spectrum: 10 GHz, 28 GHz, 32 GHz and 40 GHz*, Information Memorandum (Aug. 7, 2007), at 4, *accessed at* <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-awards/completed-awards/10-28-32-40-ghz-awards/10-40IM.pdf>.

⁹⁹ *Id.* at 147.

¹⁰⁰ ARRL Comments at 11 (emphasis in original).

¹⁰¹ *Id.*

3. Any Risks of Harmful Interference Will Be Effectively Mitigated by Mimosa’s Proposed Use of a Contention-Based Protocol.

Mimosa proposes in its Petition a requirement that all stations operating in the 10 GHz band use a contention-based protocol.¹⁰² Criticism from some commenters that this requirement would not be effective in shielding radio amateurs from harmful interference are not persuasive.¹⁰³

As a general matter, the Commission has explained that contention-based protocols are extremely effective in enabling efficient and cooperative shared use of spectrum while minimizing interference because the protocols:

allow multiple users to share the same spectrum by defining the events that must occur when two or more devices attempt to simultaneously access the same channel and establishing rules by which each device is provided a reasonable opportunity to operate. Under this approach, terrestrial operations can operate in geographic areas of their own choosing and, because a contention-based protocol will control access to spectrum, terrestrial operations will avoid interference that could result from co-frequency operations.¹⁰⁴

The contention-based protocol thus enables users to assess the availability of clear channels, acting as a “courtesy” mechanism that facilitates co-existence among all users sharing the spectrum and operates to ensure the continued operation of all users’ networks.

It is useful to note that “[a]ll Wi-Fi networks are contention-based . . . systems, where the access point and the mobile stations all vie for use of the same channel.”¹⁰⁵ The explosive growth of Wi-Fi illustrates the power and effectiveness of contention-based protocols in enabling shared use of spectrum. The Wi-Fi market passed a milestone two years ago when the number of Wi-Fi

¹⁰² Petition at 18.

¹⁰³ See ARRL Comments at 11.

¹⁰⁴ *3650 MHz Order*, 20 FCC Rcd at 6508 (para. 16).

¹⁰⁵ Tutorialspoint, “What is Wi-Fi?”, accessed at http://www.tutorialspoint.com/wi-fi/wifi_quick_guide.htm.

enabled devices shipped since the inception of Wi-Fi technologies exceeded 5 billion. Projections are that the number will pass 10 billion next year.¹⁰⁶

In addition, in the case of radio amateurs operating in the 10 GHz band, the use of an automated contention-based protocol will not be necessary to ensure that amateurs do not encounter harmful interference. The typical scenario of shared use in the band by fixed wireless broadband operations and radio amateurs is one in which the broadband operations' networks will be utilizing portions of the spectrum on a virtually continuous basis, whereas radio amateurs' use will be sporadic and will occupy extremely small portions of the band.

In this scenario, the issue will not be whether the wireless broadband networks are able to hear and adjust to the radio amateurs' weak signals. Instead, if a radio amateur seeking to initiate a voice communication encounters a broadband network, the amateur will have the option of accessing a different channel if interference might be an issue on the initially-selected channel. Scanning for a clear channel has long been the primary way that radio amateurs select their frequency of operation. This practice will work effectively in the 10 GHz band, as it has in lower frequency Part 97 bands where much more congestion is present.

¹⁰⁶ ABI Research, "Total Cumulative Wi-Fi Enabled Device Shipments Reached 5 Billion in 2012, Set To Double by 2015," *accessed at* <https://www.abiresearch.com/press/total-cumulative-wi-fi-enabled-device-shipments-re>.

4. The Band Plan Proposed by Mimosa Will Be Effective in Enabling Shared Use of the 10 GHz Band While Avoiding Harmful Interference.

Mimosa proposes a band plan for the 10.0-10.5 GHz band to protect frequencies in the band that are most often used by amateur radio operators, creating a specific guard band and utilizing a 20 megahertz channelization scheme.¹⁰⁷ Some commenters claim that the band plan would not be effective in guarding against harmful interference because radio amateurs are actively engaged in operations throughout the 10 GHz band.¹⁰⁸ These concerns expressed by commenters regarding the proposed band plan lack merit.

As Mimosa has discussed, the nature of amateur radio operations in the 10 GHz band makes it unlikely that these operations will face any significant risk of harmful interference. Amateur radio communications are typically sporadic and they generally utilize only a small sliver (5 to 10 kilohertz) of a wide swath of spectrum in the band. Thus, radio amateurs have the capability to select channels in the band that are free from any utilization by wireless broadband operations.

Mimosa's proposed band plan would provide radio amateurs with added insurance against the risk of interference by establishing a guard band as well as a non-mandatory channelization arrangement reserving the 10.350-10.370 (amateur calling band) and the 10.450-10.500 segment (amateur satellite) for use by amateur radio operators.

As an alternative, the Commission could more narrowly restrict amateur radio operations in the 10 GHz band to weak channel signals identified by the European Conference of Postal and Telecommunications Administrations in Footnote EU17, specifically, 10.36-10.37 GHz (voice

¹⁰⁷ Petition at 19.

¹⁰⁸ See ARRL Comments at 9.

band) and 10.45-10.46 GHz (amateur satellite).¹⁰⁹ Mimosa also notes that, in Great Britain, Ofcom has decided, as a means of avoiding interference with licensed operations in the band, to restrict amateur radio operations to sub-bands that do not overlap with auctioned spectrum in the band.¹¹⁰

5. Concerns Expressed in the Record Regarding the Inability To Enforce Mechanisms To Avoid Harmful Interference Are Misplaced.

Amateur radio operators express concerns about the Commission’s ability to enforce requirements and restrictions intended to prevent interference between fixed wireless broadband operations and amateur radio operations in the 10 GHz band.¹¹¹ These concerns should not be given any weight.¹¹²

¹⁰⁹ Footnote EU17 adopted by the European Conference of Postal and Telecommunications Administrations (“CEPT”) provides:

EU17: In the sub-bands . . . 10.36-10.37 GHz, 10.45-10.46 GHz the amateur service operates on a secondary basis. In making assignments to other services, CEPT administrations are requested wherever possible to maintain these sub-bands in such a way as to facilitate the reception of amateur emissions with minimal power flux densities.

International Amateur Radio Union, “10.0-10.5 GHz,” *accessed at* http://www.iaru-r1.org/index.php?option=com_content&view=article&id=196:3-centimeter&catid=53:spectrum&Itemid=149.

¹¹⁰ The sub-bands are 10.0-10.125 GHz and 10.225-10.475 GHz, with the 10.45-10.50 GHz band available for amateur satellite operations. *See* Radio Society of Great Britain, “5.7 and 10 GHz,” *accessed at* <http://rsgb.org/main/operating/band-plans/microwaves/5-7-and-10ghz/>.

¹¹¹ *See* ARRL Comments at 10 (arguing that “the non-interference requirement is unenforceable as a practical matter”).

¹¹² Mimosa notes that some amateur radio operators have commented that compliance and enforcement issues would be complicated by the fact that WISPs generally lack the technical capabilities to operate radios within the 10.0-10.5 GHz band so as to avoid interference with their activities. *See* Rehr Comments at 2. It is interesting to observe that some of the negative comments from amateurs have come from individuals who previously operated a WISP business themselves. From Mimosa’s experience interacting within the WISP community, it appears evident that a large number of WISPs are either current or former amateur radio operators. Consequently, it is reasonable to conclude that the level of technical capability within the WISP community is very similar to the technical capabilities within the amateur radio community.

Mimosa notes that one commenter (also a radio amateur), after reviewing an employment posting on the Mimosa website, opines that Mimosa’s confidence in the non-interference protocols it is advocating is called into question because the “required personnel are not yet employed” Peter Stutman (“Stutman”) Comments at 6. In fact, Mimosa currently employs more than 25 engineers and computer scientists, many

As a threshold matter, enforcement concerns are largely mitigated by the fact that, as Mimosa has discussed,¹¹³ a number of factors support the conclusion that interference between amateur radio incumbents and broadband operations in the 10 GHz band is unlikely to be severe and can be effectively managed. In addition to that fact, moreover, other considerations suggest that amateur radio incumbents would not be adversely affected by harmful interference.

First, the Commission's coordination rules will work effectively to mitigate interference.¹¹⁴ Under these rules, which Mimosa proposes to make applicable to operations in the 10 GHz band,¹¹⁵ a database identifying the locations of registered stations is available at the Commission website. Although amateur radio operators do not register their stations in this database, they would be able to access the database to determine the location of existing fixed operations in the band, since fixed broadband providers would be registered and their station locations would be maintained in the database. The amateurs could then select channels of operation that would be free from interference.

Second, as Mimosa has discussed,¹¹⁶ concerns expressed by ARRL and other commenters regarding the efficacy of the contention-based protocol process lack merit from an engineering

having advanced degrees, and many having worked in the leading companies developing advanced radio technologies, including the latest generation of high-volume Wi-Fi chips.

¹¹³ See Sections IV.B.1.–IV.B.3., *supra*.

¹¹⁴ 47 C.F.R. § 90.1319(d). Mimosa notes that Nickolaus Leggett's concern that implementation of the Petition would lead to widespread adoption of high-powered consumer wireless devices is misplaced. *See* Leggett Comments at 2-3. Under the Commission's rules, radios will be purchased and operated by the service provider, not by consumer broadband subscribers. This distinction is important, because the coordination process Mimosa has described in the text has proven successful in the 3.65 GHz band.

¹¹⁵ Petition, App. A.

¹¹⁶ See Section IV.B.3., *supra*.

perspective.¹¹⁷ In Mimosa’s view, the advantages and effectiveness of contention-based protocols, as explained by the Commission in the *3650 MHz Order*, are directly relevant to broadband wireless operations in the 10 GHz band.¹¹⁸ The Commission observed that contention-based protocols required by its Part 90Z rules “will have to ensure that all users will have a reasonable opportunity to operate, so that no operator can block others’ access to the spectrum[,]”¹¹⁹ and concluded that “a contention-based protocol is a reasonable, cost effective method for ensuring the ability of any user to access the spectrum.”¹²⁰

And, *third*, equipment used to provide wireless broadband in the 10 GHz band will be subject to the certification requirements of Section 90.203 of the Commission’s Rules.¹²¹ Pursuant to the Section 90.203 requirements (1) applications for equipment authorization must contain specific information regarding the methods employed to meet the Commission’s rules; (2) certification applications for systems using advanced antenna technology must provide the algorithm used

¹¹⁷ See OTI & PK Comments at 5 (indicating that these commenters “strongly agree with Mimosa’s suggestion that shared access to the band on a secondary basis should not involve exclusive licensing, but should include the sort of coordination that is encouraged by the contention-based protocols required under Part 90, Subpart Z”).

¹¹⁸ The Commission characterizes contention-based protocols as having the following properties: “procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel.” *3650 MHz Order*, 20 FCC Rcd at 6522 (para. 56).

¹¹⁹ *Id.* at 6523 (para. 58) (footnote omitted).

¹²⁰ *Id.*

¹²¹ 47 C.F.R. § 90.203. Equipment governed by Part 90Z is subject to these requirements, and Mimosa’s proposals would make equipment used in the 10 GHz band subject to the Part 90Z rules.

to reduce the EIRP to the maximum allowed in the event of overlapping beams; and (3) applications must contain information regarding how the equipment meets the requirement to employ a contention-based protocol for gaining access to the spectrum.¹²²

C. Incumbent Radiolocation Operations.

To address concerns that allocating spectrum in the 10 GHz band for wireless broadband could risk interference with radar equipment operated in the band, Mimosa proposes that the Commission should apply DFS restrictions¹²³ to wireless broadband operations in the band, explaining that such restrictions would be effective in addressing any issues regarding interference with radar operations.¹²⁴ There is little comment in the record concerning Mimosa’s proposal to utilize DFS as a means of guarding against interference with radar operations, although one commenter contends that wireless broadband could cause significant interference to radar operations. As Mimosa will explain, this concern is misplaced.

Mimosa’s belief that DFS restrictions will work effectively to address any risks that wireless broadband operations in the 10 GHz band would interfere with incumbent radar operations

¹²² *3650 MHz Order*, 20 FCC Rcd at 6527 (para. 67).

¹²³ The Commission explains that:

DFS is a mechanism that detects the presence of radar signals and dynamically guides a transmitter to switch to another channel whenever a particular condition (indicating a conflict with an active radar operation) is met. Prior to the start of any transmission, a . . . device equipped with DFS capability must continually monitor the radio environment for radar’s presence. If the . . . device determines that a radar signal is present, it must either select another channel to avoid harmful interference with radar, or go into a “sleep mode” if no other channel is available.

Part 15 U-NII Devices Order at para. 11 n.14. NTIA further explains that “DFS is a form of sensing-based sharing technology that requires signal detection where knowledge of certain parameters of the radar signal such as pulsewidth, pulse repetition interval, and the number of pulses per burst are used to improve signal detection.” NTIA, *Evaluation of the 5350-5470 MHz and 5850-5925 MHz Bands Pursuant to Section 6406(b) of the Middle Class Tax Relief and Job Creation Act of 2012* (Jan. 2013) at 2-8 (footnote omitted).

¹²⁴ Petition at 19-20.

has been buttressed by the actions recently taken by the Commission in the *Part 15 U-NII Devices Order*. In fact, Mimosa suggests that the Commission should apply the DFS restrictions developed in that proceeding (including the provisions of Section 15.407(h)(2) of the Commission’s Rules, as adopted in that proceeding¹²⁵) to fixed wireless broadband operations in the 10 GHz band.

Devices operating in the 5 GHz band are required to be capable of testing for seven types of radar signatures, including ship-borne radar, airborne radar, and the Terminal Doppler Weather Radar (“TDWR”) system. The devices must meet pass/fail criteria pursuant to Commission test certification procedures, and must receive such certification from the Commission before being authorized to operate in the band. This same approach should be taken for wireless broadband devices used in the 10 GHz band.

The Commission and NTIA have worked closely with the Department of Defense and with industry representatives to ensure that DFS testing mechanisms and requirements are effective in addressing interference issues affecting radar operations in the 5 GHz band. For example, NTIA’s

¹²⁵ 47 C.F.R. § 15.407(h)(2). The rule provides that:

U-NII devices operating . . . in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is –64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a Power Spectral Density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is –62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

Id.

Office of Spectrum Management led a government-industry project team to develop proposed compliance measurement procedures for the 5 GHz band.¹²⁶

These efforts have led to “several changes to [the] Part 15 rules and compliance measurement procedures to improve the DFS functionality, thus further reducing the harmful interference risk to TDWR and other radar systems, *e.g.* increasing the sensing bandwidth, modifying the sensing threshold, and testing DFS functions against a new radar waveform.”¹²⁷ The DFS mechanisms—with the improved functionality developed by the Commission in the *Part 15 U-NII Devices Order*—will be highly effective in protecting radar operations in the 10 GHz band.

In opposing Mimosa’s DFS proposal, Peter Stutman claims that there could be significant interference from wireless broadband operations in the 10 GHz band because radar systems transmit “very brief high-power pulses. In turn, a radar system receives radar ‘returns’ which are usually very weak signals. It doesn’t take much received signal power from a spurious source to degrade or completely corrupt a radar system.”¹²⁸

Mr. Stutman’s concern is not well-grounded, because the strength of the return signal to the radar receiver is not the most significant consideration. The receiver is co-located with the radar transmitter, which emits a pulse that, although typically brief in duration, is high-powered, as Mr. Stutman notes. DFS radar detection mechanisms will have the capability to detect the powerful pulse emitted by the radar transmitter, and this detection will be sufficient for the DFS mechanisms to avoid co-channel operations with the radar system.

¹²⁶ NTIA Comments, ET Docket No. 02-122 (Oct. 1, 2013) at 10.

¹²⁷ *Part 15 U-NII Devices Order* at para. 70.

¹²⁸ Stutman Comments at 2.

D. Suitability of the 10 GHz Band for Wireless Broadband.

Mimosa’s proposal calls for making spectrum in the 10 GHz band available on a shared basis principally for high-capacity macrocell backhaul covering long distances, and for both point-to-point and point-to-multipoint operations.¹²⁹ While there is support in the record for the suitability of the 10 GHz band for these spectrum uses,¹³⁰ some commenters argue that issues associated with propagation in the band make the band a poor candidate for “long distance, high capacity, and high reliability links.”¹³¹ These arguments are not persuasive.

The suitability of the 10 GHz band for long-haul backhaul operations is demonstrated by comparing the band to the 11 GHz band, regulated under Part 101 of the Commission’s Rules. The 11 GHz band, with propagation characteristics similar to those found in the 10 GHz band, is experiencing widespread use because of its capabilities for long-haul operations at very high data rates. Information in the Commission’s Universal Licensing System (“ULS”) indicates that there are more than 37,000 active licenses in the 10.7-11.7 GHz band, and that there are numerous licensed links covering distances of 25 kilometers or more.¹³²

¹²⁹ See Petition at 20.

¹³⁰ See, e.g., SSC Comments at 6 (indicating that “Mimosa correctly points out the benefits of the 10 GHz band versus other possible bands. For example, the 10 GHz band offers better propagation characteristics than the much higher bands available today, such as the 70/80 GHz bands, and the 10 GHz band suffers less rain fade than those higher bands.”).

¹³¹ Northern Lights Radio Society Comments at 1. *But see* OTI & PK Comments at 4 (explaining that “[t]he propagation characteristics of this [10 GHz] band could be particularly beneficial to rural broadband providers, including the nation’s roughly 2,000 [WISPs], which often lack access to affordable high-capacity backhaul and connectivity”).

¹³² The minimum path length requirement is 5 kilometers. 47 C.F.R. § 101.143(a).

In addition, two recent actions taken by the Commission—authorizing the use of two-foot Category B antennas¹³³ and allowing 80 megahertz channels in the 11 GHz band¹³⁴—have stimulated further interest in the band by reducing costs and enabling backhaul providers to handle greater capacity and provide faster data rates.

Given the fact that, as Mimosa has noted, the 10 GHz band and the 11 GHz band share similar propagation characteristics, and the fact that the 11 GHz band receives heavy usage from backhaul operators, claims that the 10 GHz band is not suitable for long-haul backhaul traffic have little credence. In fact, some parties opposing the Petition have argued that the availability and suitability of 11 GHz spectrum for long-haul backhaul operations lessens the need to make 10 GHz spectrum available for this purpose, as Mimosa has proposed.¹³⁵ Increased levels of congestion in the 11 GHz band,¹³⁶ however, coupled with difficulties in obtaining new licenses in major metropolitan areas because of coordination issues with legacy radios, are undercutting the 11 GHz band as a viable option for additional backhaul use. Worsening problems in the availability of the 11

¹³³ See *Amendment of Part 101 of the Commission's Rules to Modify Antenna Requirements for the 10.7-11.7 GHz Band*, WT Docket No. 07-54, RM-11043, Report and Order, 22 FCC Rcd 17153, 17188 (2007) (App. B, Final Regulatory Flexibility Analysis) (indicating that “[s]maller antennas that comply with the revised Category B standard cost less to acquire, deploy, and maintain, thereby reducing the expenditure of capital and human resources”).

¹³⁴ *Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees*, WT Docket No. 10-153, *Petition for Rulemaking filed by Fixed Wireless Communications Coalition to Amend Part 101 of the Commission's Rules to Authorize 60 and 80 MHz Channels in Certain Bands for Broadband Communications*, RM-11602, Second Report and Order, Second Further Notice of Proposed Rulemaking, Second Notice of Inquiry, Order on Reconsideration, and Memorandum Opinion and Order, 27 FCC Rcd 9735, 9756 (para. 52) (2012).

¹³⁵ See Michael Sabal Comments at 1.

¹³⁶ Unwired, Ltd., Comments at 1.

GHz band in fact served as a motivation for Mimosa's Petition requesting the Commission to make the 10 GHz band available for wireless broadband operations.

V. CONCLUSION.

There is significant support in the record for the proposals made in the Petition filed by Mimosa Networks, Inc. Objections raised regarding these proposals do not warrant a denial of the Petition. Mimosa therefore respectfully requests the Commission to initiate a rulemaking proceeding for the purpose of making spectrum in the 10.0-10.5 GHz band available for use in the provision of fixed wireless broadband services pursuant to Part 90, Subpart Z, of the Commission's Rules.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I, John Cimko, hereby certify that a true and correct copy of the foregoing Reply of Mimosa Networks, Inc., was sent by first-class mail, postage prepaid, on the 25th day of April, 2014, to the following:

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