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

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
	)	
Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands	)	ET Docket No. 95-183 (Terminated)
	)	
Implementation of Section 309(j) of the Communications Act – Competitive Bidding, 37.0-38.6 GHz and 38.6-40.0 GHz Bands	)	PP Docket No. 93-253 (Terminated)
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664
	)	

Comments of the Wireless Innovation Forum on the Notice of Inquiry in the Above-Captioned Proceeding

1. Introduction

The Wireless Innovation Forum (Forum) is a U.S.-based international non-profit organization driving technology innovation in commercial, civil, and defense communications around the world. Forum members bring a broad base of experience in Software Defined Radio (SDR), Cognitive Radio (CR), and Dynamic Spectrum Access (DSA) technologies in diverse markets and at all levels of the wireless value chain to address emerging wireless communications requirements through enhanced value, reduced total life cost of ownership, and accelerated deployment of standardized families of products, technologies, and services.

By this filing, the Forum submits its comments in the above-captioned proceeding, which we hereafter refer to as the "above 24 GHz" proceeding. For convenience, we will generally refer to bands above 24 GHz as millimeter wave (mmW) bands, recognizing that this terminology is not

strictly correct. However, we note that most of the bands under discussion in the Notice of Inquiry (NOI) fall above 30 GHz, and thereby do constitute true mmW bands.

2. Discussion

The Forum commends the FCC on beginning the process of exploring mobile communications in bands traditionally used for fixed, satellite, scientific, and defense applications. Over 90% of allocated bandwidth, and over 99% of regulated bandwidth,[1] falls above 24 GHz. Establishing a flexible regulatory framework and encouraging technical developments in this frequency range could ultimately provide broadband mobility at data rates unheard of today, even if only small portions of the radio spectrum above 24 GHz are opened.

In the NOI, the Commission requests comment on a very large number of technical and regulatory issues relevant to mobile use of mmW bands. The Forum is providing general comments on those areas that are particularly relevant to its mission and to the interests of its members. Our comments are consistent with our existing identification of specific areas of major innovations that are required to create the foundation for next-generation wireless devices.[2] Our comments are also consistent with the Forum's mission statement of advocating for the innovative utilization of spectrum and advancing radio technologies that support essential or critical communications.[3] The Forum's general comments in this inquiry are listed here, and are discussed in more detail in the following sections.

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[1] The allocated radio spectrum consists of the frequency range 9 kHz – 275 GHz. For the purpose of regulation, the FCC considers all frequencies less than 3 THz to be radio frequencies.
[2] http://groups.winnforum.org/winnforum_top_ten
[3] http://groups.winnforum.org/advocacy

- In the mmW bands, the Commission should adopt a flexible regulatory framework for temporary, cooperative, and/or opportunistic access.
- Rules for mobile uses of mmW bands should be technology and application neutral to enable innovative and efficient use of the spectrum.
- The Commission should encourage academic and industry research to spur technology development within the domain of mmW wireless mobility.

2a) Adopt a Flexible Regulatory Framework

Section C of the NOI invites response on which licensing schemes the Commission should adopt for mobile mmW systems and how existing incumbents would be affected. The NOI proposes the following four options for regulating the mmW spectrum: licensing vacant spectrum by auctioning exclusive rights to geographic areas, adopting non-exclusive licensing rules using automated frequency coordination, authorizing operations pursuant to Part 15, and a hybrid approach.

The Forum has previously stated that employing a flexible regulatory framework "will lower regulatory barriers to entry and promote technological innovation through easier and faster access to spectrum, enabling incumbents and entrepreneurs to pursue new business opportunities throughout the wireless value chain."[4] Thus, the Forum encourages the Commission to adopt a flexible regulatory framework for the mmW bands, such as is outlined in Option 4 (Hybrid) to permit a mix of licensed, unlicensed, and lightly licensed services.

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[4] Wireless Innovation Forum, "WInnForum Top Ten Innovations: Innovation # 10: Flexible Regulatory Framework for Temporary, Cooperative and Opportunistic Access," Available online: http://groups.winnforum.org/p/bl/et/blogid=39&blogaid=62

The Forum previously praised the flexible regulatory framework the Commission proposed for 3.6 GHz that accommodated multiple tiers of access (incumbent, priority access, and general authorized access), auctioned short-term, but renewable, geographic area licenses, and included special considerations for contained access facilities.[5] Adapting the 3.6 GHz framework to the mmW bands will similarly promote innovation, spectrum efficiencies, and economic growth. Furthermore, we note that Forum members Google and Federated Wireless believe that the Spectrum Access System concept can be readily extended to mmW spectrum and that the Commission has previously successfully deployed database-enabled light-licensing at 70/80/90 GHz.

The Forum has stood up a Spectrum Sharing Committee that facilitates dialog among incumbents, new entrants, and spectrum access system providers in the 3.6 GHz band, to address technical and policy issues for achieving a successful spectrum sharing environment. The framework of that committee is extensible to other bands, including those above 24 GHz. The Forum plans to engage the Committee on spectrum sharing arrangements in mmW bands as activities develop, and encourages interested stakeholders to inquire regarding participation.

2b) Rules should be Technology and Application Neutral

The Forum urges the Commission to make technology and application neutrality a key aspect of the rules ultimately adopted in an above 24 GHz proceeding for several reasons: First, the technologies in the mmW bands are evolving rapidly, much faster than the time scales used

[5] Comments of the Wireless Innovation Forum on the Federal Communications Commission FNPRM Seeking Comment on Amendment of the Commission's Rules with Regard to Commercial Operation in the 3550-3650 MHz Band.

in administrative law rulemakings. The technical decisions that seem clear today may become obsolete in view of new technical developments and it is likely that rulemakings will be unable to follow developments is a timely way due to vastly differing time scales, e.g., “technology moves at Internet speed”.

While the Commission mandated a specific technology for 1G cellular, since 1987 regulations for new Commercial Mobile Radio Services (CMRS) constrained CMRS deployments only to interference-related technical criteria. This has allowed the rapid evolution from 2G to 3G to 4G without new rules dealing with the details of the transmitted waveforms. Technology neutral rules will be necessary for the timely evolution of 5G mobile systems and beyond.

CMRS depend critically on “backhaul” connectivity between base stations. Traditionally this backhaul has used wired, fiber optics, or fixed service radio systems. While fiber and wire are inexpensive on a unit length basis, the installation costs in urban and suburban areas can be very high. Thus CMRS operators need the flexibility of using all three media for backhaul. The large total bandwidths possible in 5G mmW cells will require significant backhaul capacity - in the range of tens to hundreds of Gbps. Traditional fixed systems have been unable to coexist with mobile systems in the same area because the antennas cannot be sufficiently isolated from each other. However, the small wavelengths above 24 GHz allow novel antenna technology, and adequate isolation appears likely. Alternatively, TDMA and spectrum sharing techniques might allow adequate separation. These technologies are rapidly evolving, but too much mandatory regulatory detail could discourage innovation. In general the Commission should allow CMRS mmW licensees to also use their licensed spectrum for backhaul use subject only to interference protection of other users.

While the NOI focuses on mobile use in 24-86 GHz, it also asks for input on some more general issues. Specifically, the questions in paragraph 45 focus on mmW for backhaul. While mobile technologies now under development focus on the 24-86 GHz region, there are fixed technologies that have been and are being developed for higher frequencies. For example in the 2008 Beijing Olympics, video was distributed between venues using a 120 GHz backhaul-like fixed service link[6] that achieved operational data rates of 11.1 Gbps. While the Commission has frequency allocations up to 275 GHz, at present it has no service rules above 95 GHz[7]. We urge the Commission to include spectrum above 86 GHz and above the current 95 GHz limit for fixed use by CMRS licensees for backhaul purposes. We see no valid reason to keep bands with explicit mobile and fixed allocations empty when the technology to use them is at hand. While footnote 64 of the NOI raises possible concerns about "coexistence with passive services" there are many bands above 95 GHz where passive service are now co-primary with both fixed and mobile allocations[8]. The issue of co-primary allocations is not a new issue for the Commission and there are long-standing procedures to allow licensing by all classes of co-primary users while respecting the rights of others. We urge the Commission to create service rules in some of the bands above 95 GHz for backhaul to support CMRS systems.

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[6] A. Hirata , *et al.*, Transmission Trial of Television Broadcast Materials Using 120-GHz-band Wireless Link, *NTT Technical Review*, Vol. *7* ,No. 3, p. 1-6 (Mar. 2009) (Available online: https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr200903sf3.pdf&mode=show_pdf)

[7] The minor exceptions to the assertion that there are no service rules above 95 GHz are the small bands for the Amateur Radio Service and Industrial, Scientific, and Medical Equipment

[8] For example: 95-100 GHz, 102-109.5 GHz, 111.8-114.25 GHz, 122.25-123 GHz, and 130-134 GHz

2c) Encourage Research on mmW Mobility for 5G and Beyond

While the Commission's NOI is focused on the relatively near-term objectives of enabling next-generation broadband mobility at mmW frequencies, the Commission should also foster further developments in technology that will lead to breakthroughs for mmW mobility for 5G and beyond. The key to opening mmW bands to wireless mobility is research and development in support of new and improved technologies, devices, protocols, and policies that enable efficient and reliable communications at these very high frequencies. As pointed out in the NOI, various government agencies and private industry have already invested in such research, but there is more to be done. The FCC should encourage continued investments in this domain by the Institute for Telecommunications Sciences, the Defense Advanced Research Projects Agency (DARPA), the National Science Foundation's Enhancing Access to the Radio Spectrum (EARS) program, the National Institute of Standards and Technology's Communications Technology Laboratory (CTL), and other government agencies. The Commission's continued involvement in the Wireless Spectrum R&D (WSRD) senior steering group of the Networking and Information Technology Research & Development (NITRD) program is encouraged as a means to coordinate government research funding in relevant topic areas.

While private industry is already investing in many targeted aspects of 5G technology development, some of the most fundamental achievements are often the result of academic and small business research funded by the government. Besides encouraging such investments, the FCC should also help foster expanded interaction among academic and small business researchers, government agencies, and industrial partners, in order that the exchange of ideas can lead to new developments for future mobile broadband technologies, especially those that can make use of the enormous bandwidth resources available at mmW frequencies. The Commission should work with

other agencies, with WSRD, and with associations such as the Forum to arrange more venues, such as workshops and conferences, that bring together all interested parties to present the results of current research and to generate ideas for new avenues of exploration.

Lastly, the Commission should help facilitate field trials of mmW technology so that such technology can more quickly be transferred to the commercial domain. The Forum applauds the Commission on the reform of experimental licensing rules that was adopted in January 2013[9], but we note that the new and more versatile framework has not yet been put in place two years later. The Forum recommends that implementation of the new experimental licensing rules be a Commission priority in 2015. The Forum also reiterates its support for the Commission's ongoing activities (with NTIA) in developing a "Test City" concept for large-scale trials of new technologies, including those that use mmW frequencies.[10]

3 Conclusions

The Wireless Innovation Forum commends the Commission for its efforts to open bands above 24 GHz for mobile communications. On behalf of its members, and as discussed in more detail above, the Forum makes the following recommendations in response to the 24 GHz Notice of Inquiry:

- In the mmW bands, the Commission should adopt a flexible regulatory framework for temporary, cooperative, and/or opportunistic access.

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[9] Federal Communications Commission, "In the Matter of Promoting Expanded Opportunities for Radio Experimentation and Market Trials under Part 5 of the Commission's Rules and Streamlining Other Related Rules," FCC 13-15, adopted January 31, 2013.

[10] Comments of Wireless Innovation Forum to ET Docket No. 14-99 ("Model City for Demonstrating and Evaluating Advanced Sharing Technologies ")

- Rules for mobile uses of mmW bands should be technology and application neutral to enable innovative and efficient use of the spectrum.
- The Commission should encourage academic and industry research to spur technology development within the domain of mmW wireless mobility.

Respectfully submitted,

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