

**Remarks of FCC Commissioner Michael O’Rielly
Before the Free State Foundation, Washington, DC
“Next Generation 5G Wireless Networks: Seizing the Opportunities and Overcoming the Obstacles”
July 25, 2017**

Thank you, Randy, for your kind introduction and for inviting me to participate in this well-timed event. Today’s topic – Next Generation 5G Wireless Networks: Seizing the Opportunities and Overcoming the Obstacles – is one of great importance. The use of wireless devices has proliferated faster than most experts ever imagined. Year to year, Americans use more data, connect more devices and have greater expectations for the services provided over wireless networks. Forecasts demonstrate that consumer demand will only increase, and this is before you even consider the Internet of Things connections.

The vision for next-generation, or 5G, networks, is that they will be able to meet the demands of a broad range of applications. While there is no firm definition, everyone agrees that next generation networks will provide greater capacity, faster speeds and lower latency. If expectations materialize into reality, we could have the first truly terrestrial, high-speed, high-capacity, fully-seamless wireless Internet experience, that includes wireless backhaul. Consider that I could soon be travelling on the way to a restaurant and a 5G network will not only drive the car but allow me to download or live stream an advanced color, 8K, UHD episode of *Bubble Guppies* on a tablet to entertain my daughter while trying to enjoy a night out with my wife. At the same time, the network may help me identify where my kid’s missing shoes are. And, that would be greatly appreciated, because experience tells me that they could be practically anywhere on the planet.

It is expected that 5G will fundamentally change the way people use the Internet and even change business culture, and everything will be mobile. For example, 5G will allow virtual reality apps permitting “immersive travel.” You can visit Rome from your couch. A surgeon in New York will be able to operate in Alaska. Industrial manufacturing and production could be controlled wirelessly in real-time. And, I have even seen mentions of hologram video conferencing. It is expected that such innovations will result in economic benefits to the tune of \$500 billion in gross domestic product growth and more than 3 million jobs in the U.S. alone.¹ Globally, it is expected that 5G will generate \$12.3 trillion in economic output, 22 million jobs,² and the total GDP contribution between 2020 to 2035 will be equivalent to an economy the size of India.³

And the race is on: countries across the globe are vying to shape the next generation of mobile technologies and grab their slice of the economic bounty. There is no time to sit on the sidelines when everyone, including the standard bodies, have expedited their work to enable deployments as early as

¹ AccentureStrategy, *Smart Cities: How 5G Can Help Municipalities Become Vibrant Smart Cities* (2017) (Accenture Report), <https://www.ctia.org/docs/default-source/default-document-library/how-5g-can-help-municipalities-become-vibrant-smart-cities-accenture.pdf>.

² HIS Economics/HIS Technology, *The 5G Economy: How 5G Technology will Contribute to the Global Economy* (January 2017), <https://www.ihs.com/Info/0117/5g-technology-global-economy.html> (stating that these predictions are expected in 2035).

³ *Id.*

2019.⁴ So, how do we “seize the opportunity” that future wireless technologies provide and remain the global leader in wireless, while overcoming the many obstacles – or challenges – that lie in the way?

5G Spectrum Needs

While the availability of spectrum is not an obstacle per se, unencumbered spectrum for 5G is not just lying around. 5G has come to mean millimeter waves, but like many, I look at next generation networks as maximizing the capabilities of both current and future networks using low-, mid- and high-band spectrum, including millimeter wave frequencies. Case in point, T-Mobile has announced that they will roll out 5G in the 600 MHz band. Additionally, I foresee 5G as taking advantage of both licensed and unlicensed operations. And, every band mentioned for 5G has been previously allocated for other uses, and this itself presents challenges. So, get a second cup of coffee and put your feet up as I am about to power through a litany of “5G-related” spectrum issues currently under review by the Commission.

Mid-Band Spectrum

The latest spectrum buzz is focused on the mid bands – those between 1 and 6 GHz or 1 and 24 GHz depending on your perspective -- where there is an attractive balance of capacity and propagation. These bands carry more data than low bands, but communications travel farther than millimeter wave. This has advantages in a country of America’s size and geographic diversity. Not to mention, these are the very bands that the global wireless community is now targeting for 5G.

3.5 GHz

For this reason, I have focused some of my attention on the 3.5 GHz band and was pleased to accept the Chairman’s offer to review our rules to ensure they maximize innovation, investment and the efficient use of these frequencies. I have met with many interested parties about their ideas. While a few said make no changes, the majority agreed that the PALs could use some serious improvements, with one provider seeking to license the entire band. Most everyone seems to have expressed their thoughts through one means or another, and the petitions, letters and ex partes reflecting these views have been filed and are currently out for comment.⁵

While the ultimate direction of this proceeding will be based on the record and I will read the comments as part of the deliberative process, I would like to highlight a few issues that became apparent in my conversations with stakeholders. Although many entities are willing to explore unlicensed-style GAA use, more extensive, 5G builds may require greater certainty that investment would not be stranded. To provide such an environment, most stakeholders requested longer license terms, larger geographic areas, and renewability. As I have said before, I am not predisposed to disrupt the three-tier structure; I just want all three tiers of this so-called experiment to work. Frankly, the use of the Spectrum Access

⁴ OnQ Blog, *3GPP Agrees on Plan to Accelerate 5G NR – The Global 5G standard – for 2019 Deployments*, QUALCOMM.COM, Mar., 9, 2017, <https://www.qualcomm.com/news/onq/2017/03/09/3gpp-agrees-plan-accelerate-5g-nr-global-5g-standard-2019-deployments>.

⁵ *Wireless Telecommunications Bureau and Office of Engineering and Technology Seek Comment on Petitions for Rulemaking Regarding the Citizens Broadband Radio Service*, Public Notice, GN Docket No. 12-354, DA 17-609 (June 22, 2017).

System (SAS) and Environmental Sensing Capability (ESC) to facilitate sharing is an experiment in and of itself.

On that note, I understand that there is still significant work to be done on the ESC. It is my understanding that the Department of Defense and FCC are working on an interim step to enable some significant deployments prior to the completion of the ESC. Although this is a start, the ESC must be completed with no further delays to permit full utilization of this band, while protecting U.S. Navy radar systems. Meanwhile, it sounds like work on the SAS is progressing, with systems tests expected to start around the January timeframe. This should match up nicely with our overall timeline to improve the licensed portion. Hopefully, the Commission will vote on a notice of proposed rulemaking in the fall and an order as the New Year arrives or soon thereafter.

Other Bands and the Mid-Band Spectrum Notice of Inquiry

The Commission is also seeking to expand 5G to other mid-band frequencies. The recently posted mid-band spectrum notice of inquiry, which will be voted at the next meeting, is a great opportunity for interested parties to point out any bands between 3.7 and 24 GHz that can be used for wireless broadband. But, make no mistake: the impetus of the NOI is clearly the 3.7 to 4.2 and 6 GHz bands.

Specifically, an ad-hoc coalition of equipment manufacturers, wireless providers, and unlicensed users have some ideas on how to open the 3.7 to 4.2 GHz band, which is in close proximity to the 3.5 GHz PALs, for licensed mobile services, while protecting or accommodating incumbents. This seems exceptionally doable since the C-band is mostly used to transmit video programming, such as AP news-programming and broadcast and cable network feeds from one point to another, and terrestrial point-to-point use is minimal.

Additionally, the coalition proposes that the 6 GHz band would be available for unlicensed use. This is prime spectrum for the unlicensed community because it is adjacent to 5 GHz, which is one of the workhorses of unlicensed. Combining these bands will allow for wider bandwidths and gigabit speeds. The coalition has stated that they will protect the other users in this band, including the many current and any future terrestrial point-to-point systems.

Unlicensed Opportunities - 5.9 GHz

The unlicensed spectrum position will be further improved if unlicensed use is permitted in the 5.9 GHz band, while protecting automobile Dedicated Short-Range Communications (DSRC) safety systems from harmful interference. It is finally time to bring this proceeding to an end and make the determination of whether sharing is possible without causing harmful interference to DSRC. The Commission has run its tests on nine prototypes and is currently analyzing the results. These devices were designed to detect DSRC signals and then vacate the band or share the spectrum with non-safety applications. It is my understanding that the devices perform as claimed in our lab tests, but stay tuned for further reports and next steps from the Commission.

In the meantime, we must determine exactly what safety functions are planned for this band. As I have said before, dedicated DSRC spectrum should not be used to provide safety functionalities – or any services for that matter – that can be offered using other technologies being used today or in the planning stages as we generally move towards more autonomous cars. In fact, at this month's meeting

we considered vehicular radars, which boast of providing many of the same safety benefits as DSRC. If other bands can be used to provide similar safety functions, that would free up more opportunity for unlicensed use and, if there is sufficient overlap, we may need to reconsider the need for DSRC. Combining the 5.9 and 6 GHz bands is the best option to expand current unlicensed operations and promote continued growth, especially since efforts to open additional frequencies in the 5 GHz band, known as UNII-2B, were unsuccessful.

Millimeter Wave Bands

Meanwhile, the Commission's spectrum efforts have progressed the furthest in the millimeter wave bands, which will provide both licensed and unlicensed spectrum. A year ago this month, the Commission released its hallmark order opening these high bands for commercial wireless use. Our action put the U.S in a leadership position when it comes to allocating high-band spectrum. While this was a first step, there are petitions for reconsideration and issues raised in the further notice, including proposals about future sharing mechanisms, that need to be resolved to provide industry the needed certainty. Hopefully, the Commission will take this on in the fall so that industry has full knowledge of the rules for 28, 37, 39 and the 64-71 GHz bands. Further, the Commission must auction the licensed bands as soon as possible, but at a minimum we should schedule the auction so that interested parties can plan appropriately.

But, we can't rest on our laurels. Additional spectrum is needed now and we also need to identify bands for the future. This is why I insisted, a year ago, for additional bands to be added to the further notice. In fact, I would have preferred a more holistic spectrum review so that we could determine which bands are not as efficiently used as possible and which cannot support other uses, but we did move the ball by identifying six additional bands. I would like the Commission to move on all, but I recognize that some may present fewer issues and can be considered sooner. As we identify further bands, incumbency issues become more difficult to resolve. Basically, the low hanging fruit has already been picked.

There are bands, however, that are of greater interest to manufacturers and providers, so we should make the greatest efforts to move those to the head of the line. When talking to industry, it is easy to identify a trend. There is great interest in the 24 GHz and 42 GHz bands, as they are near the 28 GHz and 37 and 39 GHz bands we have already opened. Devices can be manufactured to operate over tuning ranges, so 24 GHz and 28 GHz should be able to be accommodated in the same chip, and 37, 39 and 42 GHz provide the same opportunity. This is especially important for frequencies surrounding 28 GHz, which many countries are unwilling to consider for 5G. Using tuning ranges, devices can operate on 28 GHz in the U.S., but also on 24 GHz, 26 GHz or other nearby bands while in other countries, creating de facto global harmonization.

International 5G Efforts

While the U.S. has moved forward, in some cases without global allocations, harmonization is beneficial for many reasons. For instance, it promotes innovation, investment and research and development, and resulting devices are cheaper to produce because of the greater economies of scale when new technologies can be marketed globally. Additionally, it allows consumers to use the same devices and functionalities both at home and abroad.

It's why events at the World Radiocommunication Conference (WRC) 2015, where certain countries refused to permit simple studies of mobile use in 28 GHz, were so disappointing. Studies should never be blocked as they are the means to determine whether a band can support additional uses. There were also egregious decisions made when it came to the discussion of a mobile allocation at 600 MHz. For the first time ever, a country could only support the allocation if its neighbors approved. This basically created a veto power for certain nations that wasn't even announced until everyone was already in attendance at WRC. Ironically enough, some countries are now regretting their decisions, as forward-looking nations, like the U.S., have rushed ahead, leaving them in the proverbial dust.

This instance helps demonstrate that the International Telecommunication Union (ITU) needs an overhaul. Clearly, greater transparency and process reform are needed. People once doubted the FCC could improve its internal working procedures but we did and have more fixes in the pipeline, so anything is possible. Further, the ITU is being used by authoritarian governments to push their myopic agendas. Controls need to be put into place to ensure that the ITU remains focused on its core mission as opposed to engaging in mission creep, such as their activities to regulate the Internet, to placate certain governments. Failure to reform are likely to lead to calls for the U.S. to defund the ITU. I can't say that I don't understand the frustration, but it may be premature to take this step just yet. If we are at least part of the organization, we have the chance to fight back and win the hearts and minds of the world community.

If the U.S. does remain involved, I suggest that we need to play a bigger role in the ITU leadership. It is ironic that we are the second largest contributor of funds to the ITU, but only one Secretary General has come from the U.S. in 150 years and the last American sector head was approximately 25 years ago.

Unfortunately, efforts to manipulate international processes seem to be spreading. Traditionally, standards bodies have been the domain of industry, engineers and tech geeks. However, lately, there has been a concerted effort by some countries to manipulate these multi-stakeholder bodies. I have heard several reports that some authoritarian governments are now focusing their attention on leadership positions at these organizations so that they can promote their agendas and dictate the future design of not only wireless networks, but also the Internet. This disturbing trend cannot be allowed to succeed. We will rue the day that longstanding standards body processes were allowed to become tainted and their outcomes to become similarly suspect.

Infrastructure and Equipment

Infrastructure

In my opinion, the biggest obstacle standing in front of 5G networks is infrastructure deployment. To realize its potential, 5G will require a densified network of millions of small cells. This will clearly be a timely and capital intensive undertaking. Complicating matters are some state, local and tribal governments that are placing barriers in front of infrastructure, including treating these antennas – which are smaller than pizza boxes and will be placed on buildings, utility poles, and street lights every few blocks or so – like they are macro towers. Of course, I recognize that not all are bad actors, but, as is often the case, the bad actors ruin it for everyone. Despite previous efforts by the Commission and Congress to curb this behavior, problems are still substantial.

For example, providers seeking permitting approvals are still experiencing excessive delays and even flat out moratoria. One provider reports that 75 jurisdictions have taken more than a year to come to an agreement to use rights-of-way, 11 have taken more than 18 months, and two have taken more than two years.⁶ Verizon has reported that at least 34 communities either have explicit moratoria or just refuse to process applications or engage with applicants.⁷ This is blatantly illegal.

Providers' applications are also being rejected for inappropriate reasons, such as radiofrequency (RF) exposure considerations and aesthetics. Some localities have denied new or additional facilities if they don't agree with the proposed type or placement of equipment or because a provider already has coverage, therefore prohibiting quality of service upgrades. Some even go so far as saying that the infrastructure should be located underground, which will never work for wireless services.⁸ We must accept the fate that localities should not be making such decisions, and, in fact, they are expressly prohibited, under the law, from basing decisions on RF exposure.

Finally, providers are paying astronomical fees, comparable to those paid for macro towers, for small cell approvals. It is estimated that wireless operators will invest \$275 billion to build out 5G in the next seven years.⁹ But, I fear it may be difficult to stay within the bounds of this lofty number if state, local and tribal governments continue to exploit small cells to raise revenue.

However, the Commission appears primed to act and currently has three open proceedings on infrastructure. The Chairman has also instituted the Broadband Deployment Advisory Committee to look into some of these issues.

5G Devices and Handsets

Finally, to truly benefit from 5G, consumers will need the mobile devices and handsets to connect to these networks. Commission staff is working to provide guidance on how it will evaluate radiofrequency (RF) emissions for millimeter wave equipment. Current Commission rules pertaining to 6 GHz equipment are based on industry standards that specify limits for whole body exposure, which is used for infrastructure deployments, but not for localized exposure, which is used for mobile handsets and other devices. Simply put, we must interpret how to reasonably tailor existing emission limits designed for base stations to handsets. Without this guidance, there may be manufacturing delays and reduced investment. Therefore, the Commission must provide the guidance it promised in the Spectrum Frontiers Order,¹⁰ and, hopefully, standards setting bodies will also consider these issues expeditiously.

On a side note, back in 2013, the Commission opened a proceeding on RF standards to tee up whether any changes needed to be made to our rules, but this predates 5G. Some localities appear to have impeded deployments of small cells and potentially 5G because they are concerned about health risks. Now, I want to be clear this does not mean that we are putting people at risk from RF exposure. We

⁶ Sprint Corporation Comments, WT Docket No. 17-79, at 44 (Jun. 15, 2017).

⁷ See, e.g., Verizon Comments, WT Docket No. 16-421, at Exhibit A (Mar. 8, 2017).

⁸ See, e.g., CTIA Comments, WT Docket No. 17-79, at 3, 24-29 (Jun. 15, 2017); WIA Comments, WT Docket No. 17-79, at 56-59 (Jun. 15, 2017).

⁹ Accenture Report at 1.

¹⁰ *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8142-43 ¶ 363 (2016).

have standards and rules in place for RF exposure that apply to all infrastructure, including small cells and 5G. If no general changes need to be made, the Commission should acknowledge this and close the docket.

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If there is anyone still awake, those are my views on the enormous potential of 5G networks to change the commercial wireless marketplace and the individual consumer's wireless experience. It also expresses my views on a myriad of issues facing its development and deployment. I certainly thank you for your attention.