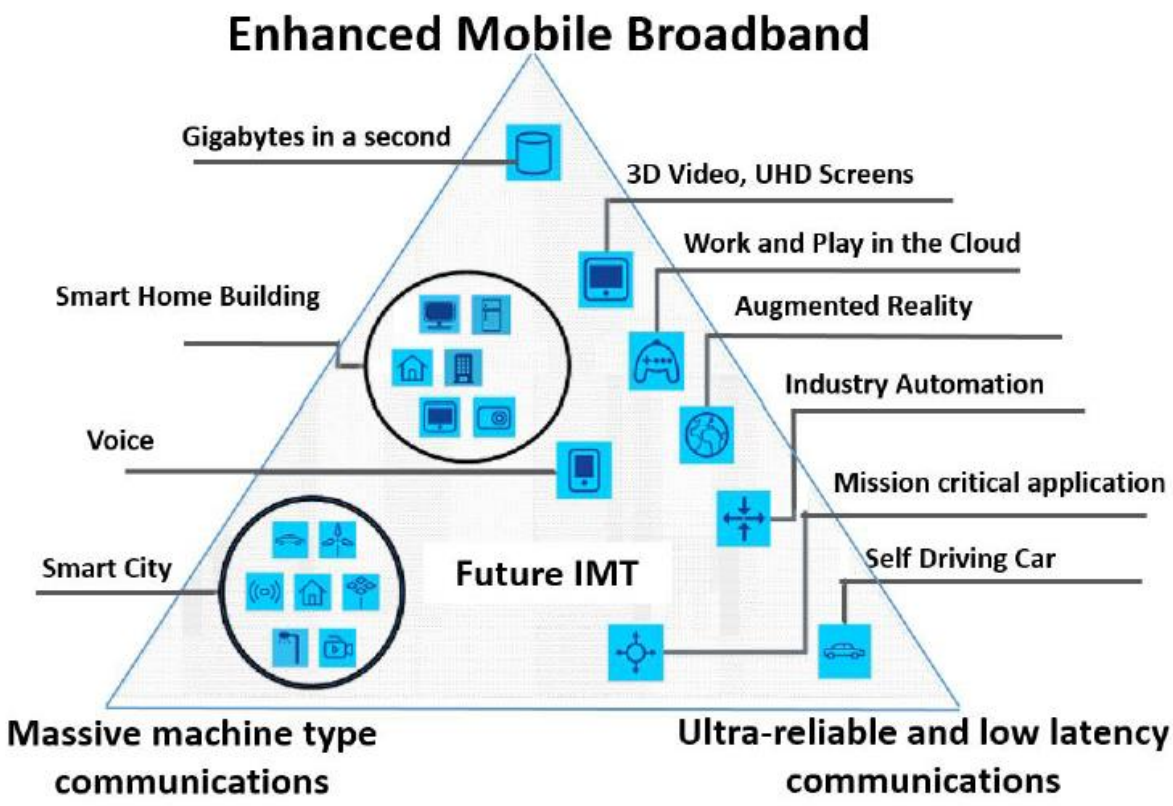
5G Americas is pleased to address the Communications and Technology Subcommittee on "The Race to 5G and its Potential to Revolutionize American Competitiveness." The mission of 5G Americas is to advocate for and foster the advancement and full capabilities of LTE wireless technology and its evolution beyond to 5G throughout the ecosystem's networks, services, applications and wirelessly connected devices in the Americas. 5G Americas is a Market Representative Partner of the standards forum 3GPP, where 5G is being standardarized, and works with regulators and associations around the world to foster deployment of wireless technologies. 5G Americas represents operators and vendors from around the region, not just in the United States. 5G Americas' Board of Governors members include América Móvil, AT&T, Cable & Wireless, Cisco, CommScope, Entel, Ericsson, HPE, Intel, Kathrein, Mavenir, Nokia, Qualcomm, Samsung, Sprint, T-Mobile US, Inc. and Telefónica. 5G Americas represents our region in the Global 5G Event, held biennially in countries in Asia, Europe and the Americas that are dedicated to winning the race to 5G.

Leading countries within Asia and Europe understand that 5G will revolutionize their competitiveness. We are pleased the Subcommittee is also examining this link. 5G Americas believes the deployment of 5G use cases will indeed revolutionize American competitiveness. 5G – or the Fifth Generation of wireless broadband - is actually comprised of three broad areas of use cases, or applications: enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (mMTC) (also known as Internet of Things or IoT) and Ultra-Reliable Low Latency Communications (URLLC). The image below diagrams this 5G triangle, which helps to demonstrate the broad impact on global competitiveness 5G will have:



From autonomous, connected cars, to augmented reality in manufacturing, massive IoT deployments, smart cities and smart homes, 5G deployments will enhance productivity, contributing to Gross Domestic Product increases. 5G applications will have important societal benefits as well, such as remote surgery and robotic care for shut-ins or the elderly. Hearing or visually impaired citizens will be more mobile through the use of self-driving cars and smart, safer homes. The Subcommittee should understand that many of the productivity and societal benefits of 5G will be available in the immediate and near-term in use cases made possible by 5G's foundation, LTE Advanced and LTE Advanced Pro.

The economic benefits of 5G have been estimated by several analysts, including Accenture, which concludes that 5G could add $500 Billion to the U.S. GDP, through $275 Billion in investment, resulting in 3 million new jobs, and result in savings and other economic benefits to local communities of $160

Billion.[1] With the right spectrum framework and expediting local permitting, 5G could add $1.2 Trillion in long-run consumer benefits, according to the American Consumer Institute.[2]

The Energy & Commerce Committee has historically led the process for repurposing spectrum to a more economic use, whether from one commercial use to another, or from government to commercial use. Repurposing additional spectrum is the best way to ensure the U.S. will continue to lead the race to 5G, whether through additional spectrum auctions or government sharing. The U.S. led the way in 4G because it made newly accessible spectrum available at 700 MHz, through this Subcommittee's efforts to repurpose the broadcast spectrum in the band, transitioning broadcasting to the more efficient digital television of today.

This Subcommittee is familiar with the growth in wireless broadband. Our members forecast that the mobile data traffic in just three to four years out will be 7-8 times more than today.[3] The mobile industry continues to improve the spectral efficiency of wireless broadband technology, including through antenna, filter, virtualization, slicing and interference cancellation technologies. But ultimately, accommodating 7-8 times more mobile traffic will require more spectrum. Ideally, most of the new spectrum will be in licensed bands, with additional unlicensed spectrum used to offload traffic from licensed bands. Licensed spectrum can offer a guaranteed level of service, and facilitates the operator's congestion management and load balancing. Licensed spectrum traditionally has been mutually exclusive, and therefore subject to auctions under the Communications Act.

[1] Accenture Strategy (January 2017).
[2] American Consumer Institute Center for Citizen Research (ACI), available at https://www.techrepublic.com/article/how-5g-could-add-533b-to-us-economy-by-2024/
[3] Ericsson Mobile Report June 2017; Cisco VNI Mobile, 2017.

For this reason, 5G Americas supports Rep. Guthrie and Rep. Matsui's Spectrum Auction Receipts legislation, which the Commission needs enacted to hold any further spectrum auctions, and urges the Committee to act on that quickly, as well as encourage a companion bill in the Senate.

Spectrum sharing is another opportunity to make sufficient spectrum available for 5G, particularly where for an array of reasons, relocation of government or commercial incumbents is unusually challenging. Incumbents that don't utilize their spectrum very often in both the temporal or geographical domain could share those channels with mobile services when the incumbent is not operating. As the Committee considers spectrum policy, it should bear in mind that future spectrum should be allocated in bands where it can provide the most benefit to wireless consumers.

It is now widely understood by policy makers such as Members of the Subcommittee that all ranges of spectrum will be needed for 5G applications and services. No single band will provide a complete solution for 5G requirements, given the diversity of future applications and their requirements for wider bandwidth, reduced latency and extended coverage area. Adequate amounts of low, mid- and high-band spectrum will be needed, and necessary to win the *Race to 5G*. Spectrum from 3 – 6 GHz easily supports mobility, and provides a balanced mix of bandwidth and coverage, something that high and low-band frequencies alone can't offer independently. Most of the frequency ranges below 6 GHz are suitable for all deployment scenarios, because of low and mid-band's wider coverage. The lower part of the new "Mid-Band", the 6-24 GHz range, can be used in similar scenarios as the spectrum below 6 GHz, and the upper portion has similar characteristics as the spectrum above 24 GHz.

Very high frequencies in the millimeter waves (30 GHz) support higher data rates, and the lower frequencies (1 GHz and below), with their ability to penetrate walls, ensure reliable indoor services. The propagation characteristics of spectrum in the 24-86 GHz range are suitable for certain applications, mainly outdoor hotspot and indoor micro and pico-deployment environments. The possibility of

identifying bands within the 24-86 GHz range for wireless broadband is currently being studied by the United Nations' International Telecommunication Union ("ITU") for decision at the next World Radiocommunication Conference in 2019 (WRC-19), as well as by the FCC in its *Spectrum Frontiers* proceeding. Because of its allocation of mmW spectrum thus far, the FCC has positioned the U.S. very well for the WRC-19 negotiations.

Infrastructure

As 5G Americas noted in a filing to the FCC on wireless broadband infrastructure, a streamlined small cell siting is critical for U.S. leadership on 5G. Our federalism has been a benefit in so many areas of economic activity. But other nations, particularly those focusing on 5G, have a more top-down approach in communications policy. Japan, South Korea and China all have uniform, streamlined processes for cell siting. The European Union, which has some of our challenges in federated action, is working on a model code for cell siting.[4] Congress in its oversight and legislative capacity should ensure that the Commission take necessary steps to accelerate 5G deployment, and to provide additional tools, if needed, to preserve the U.S. lead in deploying advanced networks.

While American innovation has flourished in our decentralized, market-oriented governance, when it comes to government siting processes, the more efficient the better. Accordingly, 5G Americas supports the FCC and other stakeholders' work at its advisory council, the Broadband Deployment Advisory Counsel, in recommending model codes for state and local government siting of broadband stations like small cells. As necessary, should that effort not result in the streamlined siting required for the U.S. to lead in 5G, 5G Americas supports this Congress or the FCC establishing national standards for the siting

[4] EUR. PARL. DOC. (COM(2016) 590—2016/0288 (COD)).

of small cells needed for 5G network densification. Additionally, 5G Americas supports the FCC's proposed order on eliminating historic review for replacement poles to support wireless antennas. 5G Americas urges the FCC to do more to eliminate unnecessary reviews in rights-of-way and in other areas with no possibility of adversely affecting historic properties.

The Global Race to 5G

The *Race to 5G* will be won in the countries that have allocated the most useful spectrum for 5G. To date, countries in Asia and Europe have identified bands in the mid-band range of 3.4-3.8 GHz and in either the 26 GHz range or 28 GHz range. Because of the identification for 5G in that mid-band range in leading countries around the world, 5G Americas advocated to the FCC that it revised the existing rules for the 3550-3700 MHz band to make the licenses 10 year, with market-size licenses, and power limits that encourage investment for 5G. Accordingly, 5G Americas is pleased with the Commission's Notice of Proposed Rulemaking that propose these changes.

Below is a review of the what other regions are doing in their race to 5G:

Europe

Europe's Radio Spectrum Policy Group (RSPG) is a high-level advisory group that assists the European Commission in the development of radio spectrum policy. The RSPG developed an opinion on spectrum bands for next generation wireless systems (5G) as agreed to in the RSPG Work Programme for 2016. The opinion was finalized November 2016 and identified a strategic roadmap for 5G in Europe. In particular, the roadmap identified the following main building blocks for 5G spectrum: 1) Medium bandwidth spectrum at 3.4-3.8 GHz as a "primary" band, which will provide capacity for new 5G services and 2) High-bandwidth spectrum at 24.25-27.5 GHz as the "pioneer" millimeter wave band to give ultrahigh capacity for innovative new services, enabling new business models and sectors of the economy to benefit from 5G.

With respect to individual European countries, **France's** spectrum regulator announced plans to allocate spectrum for 5G by the September 2017 timeframe in the 3400-3800 MHz range. The plan is to establish band plan allocations of more than 300 MHz of contiguous spectrum by 2020. Additional reorganization is planned to extend the amount of spectrum to 340 MHz by year 2026.

Germany's federal network regulator published a framework document on June 28, 2017, with plans for 5G spectrum. In 2018, the 3400-3700 MHz band will be awarded as national licenses in 10 MHz blocks. The 3700-3800 MHz band will be awarded at a later stage depending on demand for local/regional licenses. The regulator also announced plans to develop an application procedure to allow access to the 26 GHz (24.25 GHz-27.5 GHz) band for 5G. Other millimeter wave bands may be considered over time.

Ireland completed its 5G auction in the 3.6 GHz band, which included 350 MHz in the 3475-3800 MHz band. Three Ireland CEO Robert Finnegan stated that the company wanted to acquire the optimum bandwidth for 5G of 100 MHz in the auction, in a band that was internationally recognized as capable to support 5G use cases below 6 GHz.

The **United Kingdom's** regulator is taking a leading role internationally in identifying spectrum bands for 5G and has published a report on 5G Spectrum in the UK." The telecom regulator has already begun the role of identification and allocation of spectrum for 5G. In the mid-band, Ofcom has taken action in the 3.4-3.6 GHz band, where 150 MHz is ready for auction later this year. Ofcom also released a consultation in October 2016 proposing to repurpose 116 MHz in the 3.6-3.8 GHz band. A further consultation on this topic is planned for later this year. In the millimeter wave band, Ofcom has said that it fully supports the identification of the 26 GHz band by the Radio Spectrum Policy Group and has started efforts to determine what actions are necessary to make this spectrum available for 5G.

The Americas

In addition to our own FCC, Canada's regulator is looking at the same bands for 5G that the FCC adopted in 2016. **Canada**'s Innovation, Science and Economic Development (ISED) issued a consultation for spectrum in the 28 GHz, 37-40 GHz and 64-71 GHz frequency bands to support 5G deployments. 5G Americas urged ISED to make those bands available for 5G, as the FCC has done, in order to promote global economies of scale.

Asia

China

In July 2017, China's Ministry of Industry and Information Technology (MIIT) approved the 4.8-5.0 GHz, 24.75- 27.5 GHz and 37-42.5 GHz bands for China's 5G technology research and development testing.21 This action follows MIIT approval of the frequency band 3.4-3.6 GHz in January of 2016, which is to be used for 5G trial in both Beijing and Shenzhen. These tests are meant to verify the various aspects of the 5G technologies and provide a foundation to facilitate early ecosystem development. In June 2017, the Ministry of Industry and Information Technology Radio Administration expanded the frequency range to 3.3-3.6 GHz, with 3.3-3.4 GHz limited to indoor use and 4.8-5.0 GHz. It also issued a public consultation to seek comments on the spectrum use for 5G.

Japan

Japan's analysis of potential frequency bands nevertheless indicates that the frequency ranges which currently have priority for 5G in the millimeter wave bands are 24.25-29.5 GHz, 37.0-40 GHz and 40.5-43.5 GHz, with 27.5-29.5 GHz receiving priority attention. In mid-band spectrum, Japan is currently considering 3.6-4.2 GHz and 4.4-4.9 GHz for 5G. Japan also has already allocated spectrum in the 3.5

GHz band. After summer 2017, its Ministry of Internal Affairs and Communications plans to identify which bands will be available for 5G initial deployment and when that will happen for mobile broadband.

South Korea

South Korea plans to launch a 5G network at the 2018 Winter Olympics, which will be held in Pyeongchang in February 2018. In a press release, SK Telecom announced in June 2017 that it has successfully demonstrated 5G communications using the 3.5 GHz band. SKT plans to use both the 3.5 GHz and 28 GHz bands for 5G network rollouts. A national broadband plan was published early 2017 and indicates 3.4-3.7 GHz and 27.5-28.5 GHz, with the latter possibly to be extended by up to 2 GHz to give a total of 3 GHz, 26.5 – 29.5 GHz. There is an interest in more spectrum for 5G in the longer term, though not decided which frequency band.

Australia

In February 2016, the Australian Communications and Media released the paper *5G and Mobile network developments—Emerging issues*. It recognized that supporting international harmonization played a critical role in leveraging the economies of scale achieved and the resulting benefits for Australia arising from lower device costs. The Australian Communications and Media Authority (ACMA) also issued a discussion paper seeking comment on whether and how to proceed with making the 3575-3700 MHz band available for mobile broadband services. ACMA is also interested in examining spectrum form 3400-3700 MHz.

Other regions' fiscal investment:

5G Americas does not seek any government funding – it simply requests adequate spectrum and supportive regulatory policy. But for insight into other regions' view of 5G as industrial policy, we note that in Europe, up to 700 million Euro in public funding is appropriated for 5G, with the goal to match that 700 Million Euro by the European private sector, including a leveraging factor of 5 of additional private investment. Together, the planned European investment results in private value of about 3.5 billion Euro.

Internationally Harmonized Spectrum

Spectrum is internationally harmonized both in our own regional spectrum committee, the Organization for American States' Committee on International Telecommunications ("CITEL") and in Geneva at the United Nations' International Telecommunication Union ("ITU"). Every four years, the ITU hosts a World Radiocommunication Conference ("WRC"), at which U.S. vendors and operators hope to harmonize spectrum for wireless broadband. The U.S. prepares for these quadrennial WRCs through CITEL. So U.S. participation in CITEL is crucial for delivering U.S. consumers innovative and affordable wireless services. At the last WRC, in 2015, the U.S. had the most proposals to CITEL on WRC agenda items, and CITEL had the most wins at the WRC. So being well-organized at CITEL is in the economic interest of U.S. consumers.

The benefits of global harmonization are not limited to situations where all regions have identical spectrum allocations. These benefits can also be derived from "tuning range" solutions, in which adjacent or nearly adjacent bands can be considered harmonized so long as equipment can be reconfigured to operate over multiple bands. In other words, they are within the same "tuning range." Such operational flexibility may sometimes involve radio equipment that operates across a superset of

band allocations over several regulatory jurisdictions. It may also entail using specific hardware configurations that are tailored for one or more markets. In considering spectrum allocations, therefore, policymakers should consider not only frequencies that can be allocated domestically, but also the possibilities provided by such global tuning range solutions. Based on early 5G strategic plans detailed in the previous section, there are several immediate possibilities for global harmonization, considering the "tuning range" for bands 3.3-4.2 GHz, 24.25-29.5 GHz and 37- 43.5 GHz. Specifically, 3GPP has included 24.25-29.5 GHz in its 5G Non-Standalone NR that will be part of its Release 15 to enable large-scale trials and commercial 5G deployments as early as 2019. This 3GPP 5G NR is expected to cover the spectrum blocks 27.5-28.35 GHz (U.S., Japan, Sweden, Estonia), 26.5- 29.5 GHz (Korea) and 24.25-27.5 GHz (EU, China). These are considered for potential 5G deployments by different administrations around the world, enabling a larger 5G ecosystem to facilitate service adoption, roaming and achieve greater economies of scales.

Necessary Regulatory Actions

Since 5G is targeting improvements across three fronts, enhanced mobile broadband, massive-scale connectivity, and ultra-reliable low latency service, there are different spectrum requirements than previous generations of cellular technology. To meet the new and emerging use cases it will most likely be best to utilize a portfolio of spectrum assets consisting of low-band, mid-band, and mm-Wave spectrum.

Low-band spectrum, with its propagation and penetration characteristics, could be used to provide in-building coverage in urban areas and wide-area coverage in more rural areas. Mid-band spectrum could be utilized for capacity and high speed in both urban and suburban zones. The large bandwidths available in the mmWave bands can achieve high data throughput speeds but the somewhat limited

propagation distances and penetration at these higher frequencies could possibly confine usage to more concentrated areas. It is therefore important that regulators take actions to ensure adequate spectrum resources are available in all bands and allocate adequate bandwidth to support the varied use cases of 5G.

Therefore, Congress, the FCC and NTIA should consider how 5G services can be harmonized internationally, even if identical allocations cannot be used everywhere. To that end, Congress, the FCC and NTIA should consider specific allocations within a broader globally harmonized and licensed band that accounts for the needs in various regions or countries. Under this approach, each country would apply the tuning range concept, with a focus on specific bands appropriate for its needs. The near-term bands for mid-band and high-band consideration are 3.3-4.2 GHz, 24.25-29.5 and 37-43.5 GHz. Beyond these bands, it is proposed that global harmonization remain as a priority in the identification and allocation of spectrum for 5G, especially bands that have been identified under WRC-19 Agenda Item 1.13.

Conclusion

The 5G use cases of enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (mMTC) and Ultra-Reliable Low Latency Communications (URLLC) may have different spectrum requirements to a varying degree. However all the use cases need spectrum both below and above 6 GHz. Below 6 GHz, mmWave bands, and the Mid-Band range of 6-24 GHz, the subject of the FCC's recent Mid-Band NOI, are all important spectrum resources for 5G deployments. One key characteristic of all of these potential 5G spectrum resources is that they are mainly shared spectrum and require clearing and/or development of sharing mechanisms. This leads to the need for the FCC, NTIA and federal users

to take concrete, measurable actions to make sure that a reasonable amount of licensed spectrum becomes available for initial 5G deployment in licensed spectrum.

Exponential growth in mobile data demand in conjunction with the spectrum needs of upcoming bandwidth intensive applications envisioned for 5G necessitate the availability of new licensed spectrum pools. To date, the FCC has largely made spectrum available for 5G in the mmWave spectrum, at 28, 37 and 39 GHz, and not as much spectrum below 6 GHz. Several 5G Americas Members hold or are pursuing through secondary market transactions licenses for the 28 GHz and 39 GHz ranges. Yet, 5G use cases have varied spectrum needs and effectively require spectrum across all bands. 5G Americas is pleased that the FCC has proposed changes to the 3550-3700 MHz band rules, and initiated the Mid-Band NOI, because it is critical that low-band, mid-band and mmWave spectrum resources are available for the initial 5G rollouts. In that regard, the U.S. is fortunate that 600 MHz auction winners have announced that once 5G network equipment and handsets are available, they plan to upgrade from 4G to 5G in that new spectrum. 5G Americas is also pleased that the U.S., led by the FCC, has encouraged other countries in our region and globally to examine both the 600 MHz and the 3300-3700 MHz band for mobile broadband. Likewise, one Member of 5G Americas that holds a significant amount of 2.5 GHz spectrum has announced that they will deploy 5G in the band, once 5G equipment is available.

As mentioned, it is highly desirable to have globally harmonized spectrum allocations for 5G applications and thus the FCC should allocate spectrum with international harmonization as a consideration. The benefits of global harmonization are not limited to situations where all regions have identical spectrum allocations. These benefits can also be derived from “tuning range” solutions, in which adjacent or nearly adjacent bands can be considered harmonized, so long as equipment can be reconfigured to operate over multiple bands. With the above actions, the U.S. will be well-positioned to win the *Race to 5G*, and benefit from services and applications that will ensure American competitiveness.