5G and Millimeterwave

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Unlike 3G or 4G, 5G is not just about the wireless connection between smart phones, computers, and the internet. It is about everything: home appliances, door locks, security cameras, cars, wearables, and many other inert devices. It is about the smart home, the smart office, and the smart city. When fully developed, the 5G wireless network is estimated to support 1,000-fold gains in capacity, connections for at least 100 billion devices, and a 10 Gb/s individual user experience with near-zero response times [1]. By comparison, current 4G download speed is limited to 1 Gb/s in theory, but much lower in practice due to many factors. Undoubtedly, higher speed means more bandwidth. The higher frequency bands that are being examined for 5G are the ultimate solution for this increased need for bandwidth since the 4G focus on microwave bands 6 GHz or below has many concerned about crowding and oversaturation.

The industry has made good progress in its effort to define 5G. In December 2015, the World Radiocommunication Conference (WRC-15) [2] had proposed the 5G frequency bands above 6 GHz are, 24.25 to 27.5 GHz, 37 to 40.5GHz, 42.5 to 43.5 GHz, 45.5 to 47 GHz, 47.2 to 50.2 GH, 50.4 to 52.6 GHz, 66 to 76 GHz and 81 to 86 GHz. Additionally, the frequency bands, 31.8 to 33.4 GHz, 40.5 to 42.5 GHz and 47-47.2 GHz are also proposed for 5G applications under certain constrains. Shortly after the WRC-15, in July 2016 [3], the FCC classified nearly 14 GHz of licensed and unlicensed spectrum for 5G usage: 27.5 to 28.35 GHz; 37.0 to 38.6 GHz; 38.6 to 40.0 GHz; and a new unlicensed band at 64 to 71 GHz. This was a major move forward by the United States toward beginning the development and implementation of 5G, the first to be done on an official level. Since then, China, Japan, Europe, and many other countries are moving into the same direction. On Sept. 22, 2017, Huawei and Intel announced their partnership for 5G collaboration on NR based interoperability development testing, which gives this movement even more momentum [1].

The proposed high frequency 5G bands fall well within the millimeterwave spectrum of 30 to 300 GHz. Today, wherever you see 5G, you probably will also see millimeterwave. Millimeterwave offers smaller wavelength, wider bandwidth, and widely available spectrum. The smaller wavelengths result in more compact and lightweight component designs, which are desirable for many system applications. Wide bandwidth results in higher data rates in communication systems, higher range resolution and target identification in radar systems, and higher immunity to jamming and interference. Those with concerns generally point to its higher path loss, limitation of the transmission based on the "line of sight," and high-priced hardware due to high precision tolerance control. On this point, millimeterwave technology has always been seen as an expensive and even unapproachable technology due to the immaturity of the devices and complex manufacturing process in past decades. Even today, some of the industry's leading manufacturers still believe that "COTS" (Commercial Off-the-Shelf) and "millimeterwave" do not belong in the same sentence. They still see the low volume and high-performance requirements as prohibitive to cost.

However, this outlook is quickly changing. Technological advances, especially the improvements related to simulation and design tools, semiconductor device performance and consistency, and manufacturing methods, have started to make many of these concerns obsolete. **Industry-recognized EM and circuit simulator software leaders like Keysight ADS, CST Microwave Studio, Ansys 3-D Design, Sonnet Suites, and National Instruments AWR are at the forefront of this shift. These computer-aided design tools have reduced design uncertainties and enhanced design accuracy greatly.** Combining these software with mechanical design tools, such as SolidWorks and circuit layout tools such as Cadence Design Systems, allows both the design cycle time and cost to be reduced dramatically. In the meantime, the advance of the millimeterwave monolithic circuits (MMIC) based on GaAs, InP, GaN, CMOS and SiGe technologies have resulted in mature and reliable devices and subsystems up to and beyond 100 GHz. The leaders in this space are Analog Devices, Qorvo, IBM, MACOM, Northrup Grumman (NGC), HRL Laboratories (HRL), Microsemi, United Monolithic Semiconductors (UMS), Infineon and Gotmic. Combined with modern CNC machines, Wire EDM, electroforming, and pick-and-place technologies, the industry has been shifting from custom-built to COTS offerings for single function products, such as antennas, amplifiers, mixers, oscillators, switches, attenuators, power divider and couplers. This move mirrors the path of maturation that the microwave industry experienced in the past.

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Today, SAGE Millimeter has defined and developed thousands of COTS products, most of which can be found on our website. Every product is accompanied by a full datasheet, pricing, and inventory count and/or lead time for convenient browsing and immediate purchase and delivery. We know that COTS offerings will have a great impact on the millimeterwave industry and 5G-pioneering R&D programs by reducing development cost and cycle time. It will also benefit the traditional aerospace, military, scientific research programs, as well as other commercial opportunities, such as the driverless car, drones, WiGig, IoT, SmallSat and CubeSat, etc. The marketplace asked, and we have responded.

References

[1] http://www.huawei.com/en/news/2017/9/Huawei-5G-collaboration-Intel

[2] https://www.wirelessweek.com/news/2016/07/fcc-unanimously-opens-nearly-11-ghz-spectrum-5g

[3] https://www.fcc.gov/international/world-radiocommunication-conference-wrc-15

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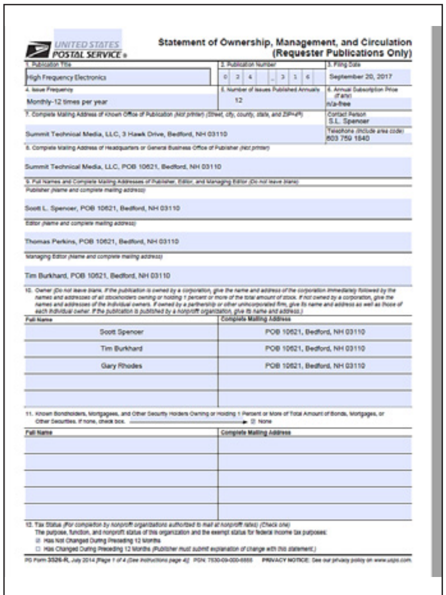

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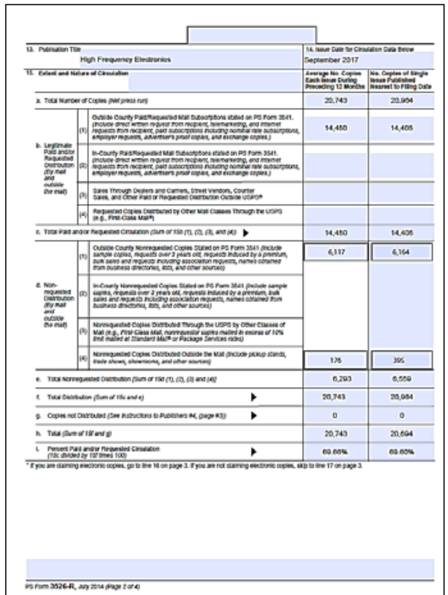

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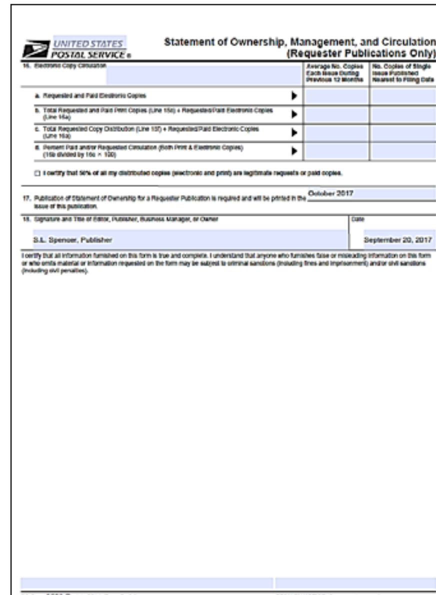

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