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Technologies in semiconductors for the implementation of millimeter wave 5G

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DESCRIPTION

Since the introduction of 1G in 1980 to 4G in 2010, cellular mobile communication has evolved through four generations and been commercially deployed. Nippon Telegraph and Telephone (NTT) commercially introduced 1G, the first generation of analogue mobile communication, in 1979. In order to enable mobility during calls, 1G introduced the modern cellular notion of several cell sites with the potential for call transfers among these sites. The research community has faced many obstacles since the development of this contemporary cellular communication technology, including low spectral efficiency, low data rates, and limited network capacity of cellular networks, to get to the current stage of implementation, where devices can communicate with one another with almost no latency and disruptions, as well as high accuracy. It can be quickly encapsulated to show that 2G was introduced in 1991 and used digital modulation techniques like Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), and Frequency Division Multiple Access (FDMA) in addition to each other to increase spectral efficiency. Initial reported data connection rates were only up to 100 Kbps, which turned out to be much less than what was actually needed to deploy the technology for any type of multimedia application.

The wideband CDMA cellular network used in 3G technology helps to overcome this speed restriction on data transfer by increasing it to a level of roughly 2 Mbps. In addition to improvements in radio access technology and increased channel bandwidth, higher data rates have also been made feasible through expanding network capacity and coverage. In general, the 3G cellular service relied on Wideband Code Division Multiple Access (WCDMA) technologies for radio access and promised speeds of 144 Kbps with mobility and 2 Mbps without when it was initially introduced in October 2001 by NTT.

As opposed to CDMA's 1.25 MHz, the reported values for WCDMA's channel bandwidth were 5 GHz. In order to enhance capacity, the Universal Mobile Telecommunication System (UMTS), also known as 3G, has further developed into a High-Speed Packet Access (HSPA) network. Offering data rates of 14.4 and 5.76 Mbps in the downlink High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA), respectively, has proven successful.

The transition from 3G to 4G was made possible by the adoption of spatial reuse technology and a multi-antenna transmission system, which further enhanced network quality and capacity. It uses technologies including Multiple Input Multiple Output (MIMO), Orthogonal Frequency Division Multiple Access (OFDM), and adaptive beam forming antenna arrays for radio access. Long Term Evolution (LTE)-Advanced, which is real 4G, was released in Sweden and Norway in 2009. In order to reduce network congestion, 4G also allows heterogeneous networks, which combine various wireless communication technologies. With mobility in the 4G network, data rates of up to 100 Mbps are feasible. Today, the orientation is toward employing the underutilized millimeter wave radio frequency band as a radio channel for the deployment of the next generation cellular mobile communication network. The term "mmW" refers to the millimeter wave frequency band, which spans 30 to 300 GHz. It has that name because the wavelength for the frequency in issue ranges from 10 mm to 1 mm Radio Communication Sector of International Telecommunication Union (ITU-R).The IMT2020 acronym stands for International Mobile Telecommunications 2020, the official name for 5G in ITU-R regulations.

Future IoT applications that enable extensive machine-to-machine communication between devices without human involvement make up the other significant application field. Large bandwidth will be required to support the massive amount of data that these apps will produce. Intelligent household appliances, an integrated transportation system, a smart energy network, and industry automation are a few examples of large machine-to-machine communication systems. Additionally, some IoT applications—known as mission-critical control applications—will be necessary for their operation to have extremely low latency and high dependability. These kinds of uses, which also include remotely controlled drones and robotics, automated guided vehicles, and remote medical operations, will be possible with 5G.Before being taken into consideration for 5G cellular mobile connectivity, millimeter wave frequencies were used in a few other applications. Military vehicles have also used mmW systems for mobile ad hoc networks, active protection radar, surveillance radar, and other purposes. Because mmW frequencies can be utilized to create anti-jamming and low interception probability systems, secure communication is another military application area where mmW frequencies have been utilized. Through major improvements in research and 5G field tests, 5G technologies represent an effort to realize the prospects anticipated by the mobile sector. These technologies are being merged to create global 5G standards that can adhere to the limitations.