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5G Mobile Communication Network's Key Technology

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Abstract: *This article describes what a 5G network is and the direction in which 5G network technology is headed on the basis of information about 5G networks released by various organizations and communication companies. The major focus of this article is an analysis of the prospective wireless technology for the 5G network. It also explains the fundamental ideas, benefits, and difficulties of large-scale antenna technology, ultra-dense networking technology, and the use cases for full-spectrum access technology.*

Keywords: Full spectrum access technology; large scale antenna technology; 5G mobile communication network

I. INTRODUCTION

1.1 Network for Mobile Communications Using 5G

The fifth generation mobile communication network is known as the 5G network. A system connected by everything will be formed by the 5G mobile communication network, creating a civilization that is entirely mobile and connected. People and things will be connected to one another, and the data cloud will become visible. No longer are space restrictions a factor in remote operation. The widespread use of VR, AR, and other gadgets will pave the way for the eventual commercialization of driverless cars.

Through increases in speed, latency, network resilience, and power consumption, 5G mobile communication networks will have a significant impact on smart technology. The information transmission technology used by the 5G mobile communication network, millimetre wave, is what will allow it to operate more quickly [1].

$$C=B\log_2(1+S/N) \quad (1)$$

In equation (1), B is channel bandwidth (Hz), S is signal power (W), N is noise power (W), and C is the maximum transmission rate (bit/ S). It can be seen from the formula that channel transmission rate C is positively correlated with channel bandwidth B, and in order to improve the maximum transmission rate C, channel bandwidth B needs to be increased

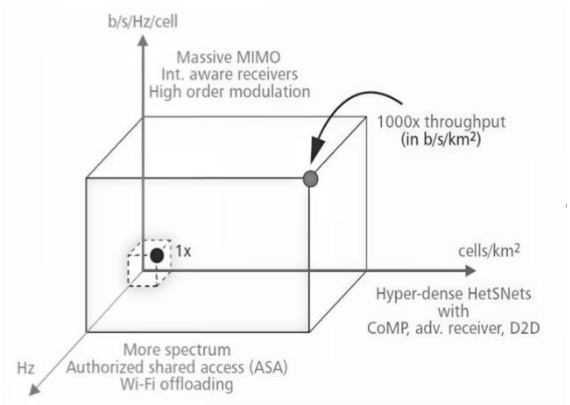

Figure 1: Three basic directions of 5G network upgrade rate

The key to a 5G mobile communication network is increasing the transmission rate. There are three basic ways to increase the transmission rate, as indicated in figure 1:

(1) a configuration that is denser, with more base stations or tiny terminals placed in each square foot.
(2) employ the new frequency band and broaden the new spectrum range.
(3) Through the use of large-scale antenna technology, the spectrum utilisation rate is enhanced and the transmission rate per unit of spectrum resource is raised.

1.2 A Large Scale Antenna

Using large-scale antenna technology, the system capacity may be multiplied hundreds of times. The industry regards it as the primary wireless technology for the 5G mobile communication network. Large-scale antenna technology can increase spectral efficiency in the time domain, airspace domain, and frequency domain as compared to earlier single-antenna and 4/8 antenna systems. Beam forming technology may be used in the dynamic combination of large-scale antennas to focus smaller energy beams in a smaller region and concentrate signal strength in a particular direction and user base, decreasing self-interference and nearby interference [3].
Figure 2 illustrates an application scenario for a large-scale antenna system, comprising different wiring for cities and suburbs, as well as fundamental data transfer between the base station, macro stand, and tiny terminal.

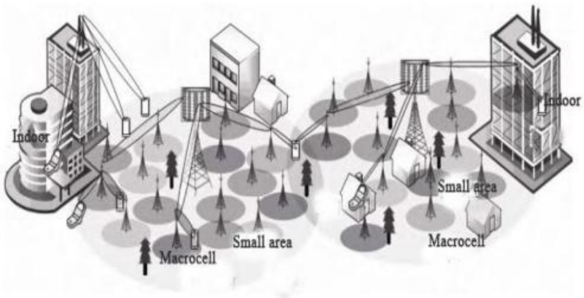

Figure 2: Application scenario of large-scale antenna technology

The following are some benefits of large-scale antenna technology:

1. The network capacity is considerably increased. The spectral efficiency and capacity of the network may be significantly increased by using the directed function of beam assignment.
2. Lower the price of the hardware for the device. Each antenna may transmit signals only at low power thanks to the beam forming function of signal superposition gain, avoiding the need for expensive high dynamic range power amplifiers.
3. Low delay communications. Traditional communication systems need to utilise channel coding and interleaver to spread out the continuous burst mistakes brought on by deep fading into separate time periods in order to fight the deep fading of channels. This procedure results in the receiver accepting all input without question in order to gain information, which causes a delay in the

II. ULTRA DENSE NETWORKING

In addition to increasing the spectrum bandwidth and using large-scale antenna technology to improve the efficiency of the spectrum, improving the degree of spatial reuse is also an effective method to improve the capacity of the 5G wireless system, which is necessary to meet the requirement of increasing the data traffic of mobile networks by several hundred times in the future and increasing the user experience rate by several hundred times [4]. Cell division was once employed by wireless communication networks to shorten cell radii. Cell division became challenging to implement due to the contemporary cell's reduced coverage, necessitating the use of extremely dense networking technologies to instal small base stations in densely populated locations. Figure 3 depicts the structure.
The following are some benefits of hyperdense networking technology:

1. Greater mobility The link between the acer base station and the micro base station may always be maintained since the tiny base stations are distributed inside the acer base station. Users may add, alter, and remove information via the micro-base station, which can also provide users a data connection.

2. improve resource use. In some cases, superdense group network technology allows the terminal to be located closer to the transmission node, allowing for the acquisition of additional spectrum, increased service effectiveness, higher spectrum utilisation rates, and a significant increase in system capacity.

The following are some issues and difficulties that hyperdense networking technology faces:

- The phenomena of interference.
- Due to the close proximity of the signals in the hyperdense network, interference will result.

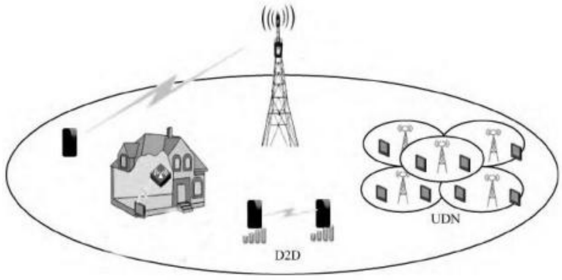

Figure 3: Schematic diagram of the structure of the ultra-dense networking

III. ACCESS TO THE FULL SPECTRUM

Full-spectrum access technology is the process of increasing the speed and effectiveness of data transmission by making efficient use of a variety of communication frequency bands, including high and low frequency bands, continuous spectrum and discontinuous spectrum, etc. [8] The low frequency band below 6GHz and the frequency band of 6–100 GHz are among the frequency bands concerned. When choosing frequency bands, the following guidelines should be kept in mind:

1. In order to prevent interference between various systems, the candidate frequency band must enable mobile business and be compatible with other current companies in the frequency band.
2. To support the 5G network's high-speed transmission, the proposed frequency band must contain a large amount of unrestricted, continuous spectrum.
3. Potential frequency bands must have favourable propagation characteristics.

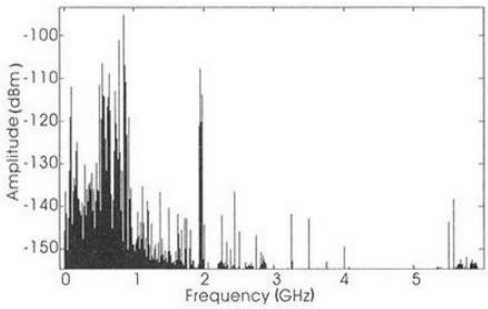

Figure 4: Spectrum resource usage within 6 GHz

The spectrum resources of the low-frequency band are extremely limited and cannot support the development needs of the 5G network, so it must be developed in the high-frequency region above 6GHz. As the spectrum used by various satellite, broadcasting, and ground services is densely distributed below 6GHz, the spectrum resources of the 5G network within 6GHz can be used. Because the continuous spectrum resources above 6 GHz are so abundant, they are better suited to meet the demands of increased mobile broadband and continuous big broadband in the future.

The wide frequency range that the full-spectrum access method covers. Future 5G network requirements will be met by full-spectrum access technology through flexible spectrum resource deployment.

1. EMBB scenario (enhanced mobile broadband) In order to meet the E MBB scenario, high-frequency and low-frequency cooperation is the fundamental method.
2. MMTC (large-scale machine class communication) scenario: MMTC scenario generally USE less than 6GHz, specifically frequency band lower than 1GHz, since the rate requirement of large-scale machine class communication is low, but there is a strong need for coverage. Large-scale machines' communication

requirements can be satisfied by the Internet of things' narrowband band, which uses the 800M and 900M frequencies.

3. UMTC (ultra-reliable and low-latency communication) scenario: UMTC demands extremely high dependability, thus the authorization spectrum will be allocated irrespective of the frequency band choice.

The study of high frequency mobile terminal equipment is still in its early stages. Currently, some hardware products are unable to handle high frequency bandwidth, which prevents full-band access technology from being fully utilised.

IV. CONCLUSION

The 5G network has not yet entered our lives; therefore, it is impossible to predict with certainty how our society will change once it does. In this paper, we introduce the 5G network, discuss the global demand for 5G, and discuss the direction that 5G network technology is going to take in light of these factors. The major focus of this study is an analysis of the prospective wireless technology for 5G networks, along with an introduction to the fundamental ideas, benefits, and application scenarios for full-spectrum access, large-scale antenna technology, and ultra-dense networking. It has been established that the 5G network's development is focused on making it faster and using less energy.

Exploration of the 5G network's path must continue. Unified communication standards will significantly boost the growth of international communication, thus it will be crucial for the development of the 5G network to identify its core technologies early on.

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