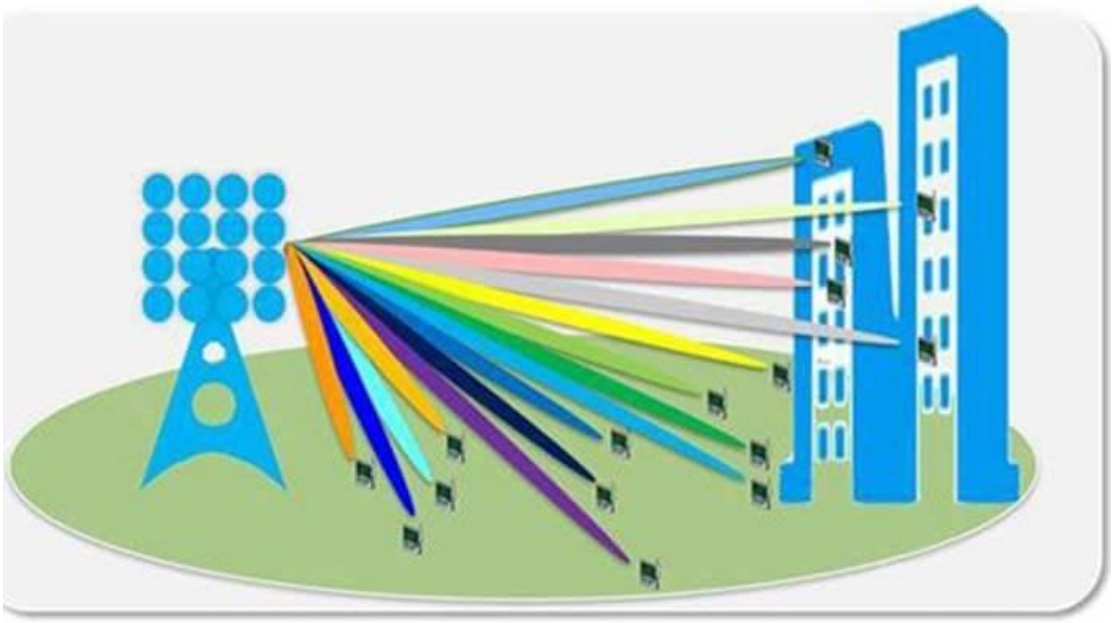
What 5G Massive MIMO Can Bring To Us?



The new 5G and massive MIMO are everywhere. What can the 5G massive MIMO bring to our life?

With the continuous progress of information technology, digitalization, and big data, the development of antenna technology also has higher requirements, and the communication system keeps developing to the higher frequency band and larger bandwidth.

Looking back to the radio communication technology, from the 1895 Italian scientist Marconi, the first wireless telegram is filled with the other side of the ocean. It has already passed more than 120 years in social life, aerospace, military, etc. Radio communications technology has played an irreplaceable role.

With mobile communications close to ordinary people, bringing our lives and work, today's human beings can entirely not imagine what life will be like.

In the mobile communication network, the essential front-end part of the whole system, the antenna, never stops upgrading the footsteps. The antenna carries the critical role of the communication system to send and receive signals. All communication data need to be transmitted through the antenna, so the antenna's performance directly affects the performance of the whole wireless communication system.

The development of antennas is also from the initial single-channel single channel to the antenna to the current multi-frequency multi-channel, large-scale antenna technology.

With the continuous progress of information technology, digitalization, and big data, the

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development of antenna technology also has higher requirements, and the communication system keeps developing to the higher frequency band and larger bandwidth. Large-scale antenna technology continues to superimpose to cope with the gradually complex scene changes, the poor signal situation in the building, and the vast area of high communication quality demand.

Many readers may not understand large-scale antenna technology, what value it brings to the industry, how it is related to 5G NR, and what trends will change in the future. Let's discuss these topics together today.

What is the value of 5G Massive MIMO technology?

Before discussing the 5G massive antenna technology and its value to the industry, let's briefly introduce the meaning of Massive MIMO. The use of a large-scale antenna array in the base station is called Massive MIMO. To facilitate understanding, we analyze from the perspective of the difference between traditional equipment. Large-scale antenna technology has two fundamental changes:

1. The change of antenna array. Compared with the traditional device two antennas, four antennas, eight antennas, the number of channels with Massive MIMO technology up to 32 or 64, the number of antenna arrays can be 192, 512, or even higher. The gain dramatically exceeds the traditional equipment.

2. The dimension of signal coverage. From the previous, only the horizontal direction of movement to the horizontal direction and vertical airspace movement, the signal radiation is electromagnetic beam.

5G Massive MIMO's function of this technology is mainly used to improve network coverage, user experience, the role of system capacity. The technology has been widely used in wireless communications, such as 4G era people's daily lives mainly used in communication networks and Wi-Fi hotspots.

From the theoretical point of view, the number of antennas directly impacts the frequency efficiency, transmission rate, and reliability of the communication system. Communication base stations are equipped with many antennas, which are used to improve the efficiency of the communication spectrum.

The use of 5G Massive MIMO technology allows the number of communication waves to be concentrated in the planned range, effectively avoiding the interference between signals in different areas and reducing the transmission power of communication. From the perspective of application scenarios, the value of massive antenna technology includes.

1. In the scenario of urban coverage, such as office buildings in the urban environment, users are distributed in three dimensions in space, densely populated but relatively scattered. The coverage of traditional equipment is relatively poor because of the loss of walls. The large-scale antenna technology can meet the demand for high-quality data transmission in such scenarios, dramatically improving urban users' mobile network experience.

2. In terms of local hotspots, mainly target areas with high user density, such as significant events, concerts, shopping malls, open-air gatherings, and transportation hubs. These places have a lot of interference, complex terrain, dispersed people flow, and a sizeable overall transmission data

volume. Large-scale antenna technology can provide high-quality data transmission services and bring users the thrill of online surfing.

3. In suburban and wireless backhaul scenarios, suburban coverage mainly solves the wireless transmission problem in remote areas, and wireless backhaul mainly solves the data transmission problem between base stations, especially the data transmission problem between macro stations and small cells.

The application of 5G massive MIMO antenna technology improves the network coverage capability and communication system capability.

It helps communication operators to make full use of existing base station addresses and spectrum resources.

The 5G massive MIMO antenna technology provides excellent resource convenience for developing and implementing the 5G communication system. It profoundly will affect the development trend of the base station antenna industry.

The 5G Massive MIMO brings gradually increasing competitiveness

The 5G network construction is in full swing. We can see that the application of 5G has penetrated thousands of industries, such as industrial manufacturing, medical field, mineral energy, etc.

5G brings the transformation of efficiency and cost for the industry. In the background, these industries continue to deepen the development trend and profoundly affect the development of the base station antenna industry.

We know that the most significant core feature of 5G is the wide connection, low latency, and large bandwidth, and the ability of considerable bandwidth and Massive MIMO's multi-channel capability perfectly fits as the amplifier of 5G features.

We know that MIMO introduced the multiple antenna technology in the 4G era, and the most significant change is to improve the peak cell rate and cell edge coverage performance. In the 5G era, with the upgrade of deployment bands, the scale of multi-antenna technology is further expanded, and the 5G Massive MIMO brings better three-dimensional network coverage performance and efficient experience for users.

For example, in the subway scenario, Huawei and Telecom joined forces to introduce 5G Massive MIMO technology to effectively solve the indoor 5G inter-cell interference problem and increase the network rate for users by more than 40%. The results of this scenario can also be replicated in superstores, restaurants, stadiums, and other scenarios to bring users and industries a multi-scene 5G upgrade with a gigabit experience.

In the 5G era, it is also necessary to bring the technology of multiple antennas into various frequency bands of network communication and to unleash the capacity and experience of large bandwidth in these various frequency bands. In industry practice, the base station size of 5G Massive MIMO devices has been innovated to become more compact, reducing the cost of 5G network updates and bringing a tenfold experience upgrade relative to 4G.

In outdoor applications, we know that many places with dense human traffic in urbanization, such as scenic spots and transportation hubs.

5G massive MIMO is characterized by hundreds or thousands of people staying and concentrating

simultaneously, generating substantial data volumes in a specific area.

In this type of scenario, the wireless environment is more complex, and the flow of people is more significant, so the demand for total and large network capacity can be solved by more intensive network facilities and 5G Massive MIMO deployment.

With the practical application of the 5G Massive MIMO in these scenarios, we can find its continuous improvement of industrial competitiveness. The practical application of the 5G Massive MIMO on the ground brings the upgrade of 5G value and provides a clear direction for some 5GtoB services.

In the future, 5G Massive MIMO will continue to upgrade and iterate the increase of antenna scale and the development of innovative antenna array implementation, innovative deployment forms, innovative applications, etc. Further evolution and upgrade towards supermassive antennas will provide higher spectral efficiency, energy efficiency, and innovative applications.

Deep into the future of 5G Massive MIMO digital intelligence space

For the wireless communication field, the main keynote of the future development is toward the direction of faster and stronger bandwidth and rate.

The 5G Massive MIMO in this development keynote, the technical level will also move toward the direction of ultra-large-scale, and at the same time, under the trend of low carbon and environmental protection of digital economy development, deep into the direction of green, low carbon and energy-saving, specifically contains the following three directions.

1. **Continuously meet the demand for new scenes and applications in the post-5G and 6G era.**

The proposed super large-scale antenna technology is based on the demand for new scenarios and applications in the future digital era. With the number of antennas and chip integration continuing to improve, through the deployment of a super large-scale antenna array, 5G massive MIMO can significantly upgrade the application of new materials and tools, communication spectrum efficiency, and network coverage to a broader, more flexible, higher accuracy and energy efficiency and other directions.

For example, the 5G Massive MIMO can perform beam adjustment in three-dimensional space. The super-scale antenna technology can also provide non-ground coverage services, such as communication services for drones, airliners, and ground-orbiting satellites.

From the user's point of view, distributed ultra-large-scale antenna can also provide higher spatial resolution. What does it mean? It means that the transmission method of the future network is also likely to change towards a user-centered way from the network center, covering the needs of the individual user network precisely.

2. **The 5G Massive MIMO intelligent direction of evolution.**

With the continuous evolution and in-depth development of artificial intelligence and machine learning, the evolution of the entire communication network will also evolve in the direction of supporting automatic configuration, automatic deployment, automatic optimization, and other network intelligence.

Potentially some new application scenarios will emerge, and the flexible deployment of centralized and distributed ultra-large-scale antennas will further meet the demand of information applications and provide better coverage and connectivity performance for new

applications.

Especially in the emergency communication scenario, the ultra-large-scale antennas provide ubiquitous links for users in the combined service of air-ground integration scenario applications and satellite communication.

3. **The 5G Massive MIMO low carbon and green development.**

Green 5G massive MIMO requires breakthrough innovation in the site and power aspects. 5G Massive MIMO technology needs to evolve to narrower service channels, thus reducing the base station's transmit power and thus reducing the energy consumption of the base station.

For the construction cost of base stations, technology iterations are needed to drive coverage maximization so that the transmit power and coverage can reach the lowest power consumption configuration.

At the same time, it is also necessary to ensure the upgrade of operator benefits and user experience. This multi-win situation requires continuous polishing and upgrading of industry and technology, and the value evolution of the wireless communication industry has a long way to go.

The development of super large-scale antenna technology brings a lot of imagination to the future digital world. In the future, we can enter the digital world smoothly and unhindered in any corner of the urban space, video conferencing, giant games, video content downloading. Even the meta-universe digital world travel is no longer limited by the dense crowd and high data network demand.

What exactly is the ultimate form of the communication industry? What will be the shape of the industry with super-scale antenna technology? What we can predict is only a tiny part of the peek.

The leap from 3G to 4G era took nearly six years, and now it is in the process of the leap from 4G to 5G. The continuous upgrading of communication capability and network speed has brought significant changes to our digital life.

From the perspective of information content, the beginning of the text to pictures and then the extreme development of video, the efficiency of our access to information, and the presentation of content have been disruptive changes.

The future in the super large-scale antenna technology-enabled 6G era will change the digital world.

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