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Review Article

Application Status and Prospects of 5G Technology in Distribution Automation Systems

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With the continuous development of 5G (5th generation mobile networks) communication technology, increasing attention has been paid to the integration of 5G technology and vertical industry. Based on the consideration of power security, the large-scale application of 5G in the power industry will start from the distribution grid and gradually extend to the high-voltage power grid. There have been some powerful attempts to apply 5G technology in distribution grid automation, distribution grid relay protection, and distribution grid monitoring. This article will summarize the application of 5G technology in these fields, focuses on the analysis of possible problems in technical standards, network security, application costs, and signal coverage, and will propose reasonable prospects and thoughts on the integration of 5G technology and distribution grids.

1. Introduction

The electric power communication network is a valuable foundation supporting the development of the country's electric power capacity. The emergence of 5G communication technology will qualitatively improve all aspects of the electric power communication network. 5G technology is expected to play the role of "connecting everything" in the power communication network [1, 2]. Compared with the previous generation of mobile communication technology, 5G technology, that is, fifth-generation mobile communication technology, has the characteristics of larger bandwidth, lower latency, higher capacity, and wider connections [3]. It has become a key technical basis for establishing a "three-type two-net" strategy in China. Under the influence of the "two-net" strategy, the distribution grid will be deeply integrated with 5G technology in the future, and higher requirements for the economy, safety, and reliability of the operation of the distribution grid will be implemented [4]. The construction of the ubiquitous power Internet of Things runs through all links of the power system and requires a great extent of detection and control for each node of the distribu-

tion grid. Regardless of the method, it is essential to carry out real-time detection and control of the operation status of the distribution network, transmit the control signals sent by the cloud server in a timely manner to each link of the distribution network, and execute the method quickly [5].

Further research on 5G technology will accelerate the development of distribution grid automation [6]. Due to the access of a large number of distributed power sources, the increasing demand of users for power reliability and the high management costs and low efficiency of traditional power distribution methods, distribution grid automation has gradually developed. The construction and development of distribution grid automation will largely alleviate the problems of power waste and uneven power distribution [7]. There are a large number of measurement and control objects in the distribution grid, such as substations, subsection posts, distribution stations, distribution transformers, and section switches. There are usually hundreds or even tens of thousands of sites [8]. Although China has achieved data connections to important nodes, there are still large-scale user-side data and edge data that have not yet been obtained. In terms of distribution grid terminals, most of the terminal

equipment is located in a very harsh geographic environment, so buried optical fibers and power wireless private networks have now become the major power communication methods for terminals [9]. Because of the high cost of optical fiber communication and the lack of optical fiber access conditions in some areas, large-scale buried optical fiber communication cannot be implemented on a large scale. The power wireless private network can only be used to realize the connection of most terminals. In recent years, 3G and 4G power wireless private networks have achieved remarkable results in the "last mile" of the power communication network, but some of the performance indicators of 4G still fail to meet the national strategic target requirements, unlike 5G communication technology [10]. The realization of feeder automation (FA) has gradually transitioned from a noncommunication method achieved through recloser timing adjustment to a centralized intelligent FA method that uses a feeder terminal unit (FTU) or distribution terminal unit (DTU) for fault detection and communication technology for fault isolation and restoration of power supply in nonfaulty sections [11, 12], but the operation effect of the pilot project of distributed intelligent FA is not good. Due to the distrust of the system and equipment, the feeder is semiautomatic, manual, and not fully automatic. In January 2019, the China Southern Power Grid took the lead in completing the 5G network distributed differential protection service test in Shenzhen. This test showed that 5G technology fully meets the various services of grid control under the condition of ultralow latency. In May of the same year, Shenzhen completed the first domestic and foreign field synthesis of synchronous vector measurement based on a 5G distribution grid, smoothly solving the problem of absolute time synchronization and delay between devices. 5G technology will play a vital role in the development of the distribution grid in the near future.

This article will start from the concept, structure, core features, and core technology of 5G technology; summarize the current integration technology of 5G technology in distribution grid automation, distribution grid relay protection, distribution grid monitoring, and vital node monitoring; analyze the challenges that 5G technology and the distribution grid will face; and finally provide a new outlook for the future integration of 5G technology and the distribution grid.

2. 5G Communication Technology

2.1. Concept and Structure of 5G Communication Technology. 5G (5th generation mobile networks) communication technology is the same as the traditional communication network, and it is also a type of cellular mobile communication technology [13]. A schematic diagram of the 5G communication system is shown in Figure 1. The content of a transmission is converted into a bit torrent by a digital analog converter.

The 5G communication system is composed of a core net, macrobase station and microbase station. Compared with microbase stations, macrobase stations have higher transmit power and broader coverage areas. Although the coverage of a single microbase station is limited, a large number of microbase stations will ensure the signal strength of the
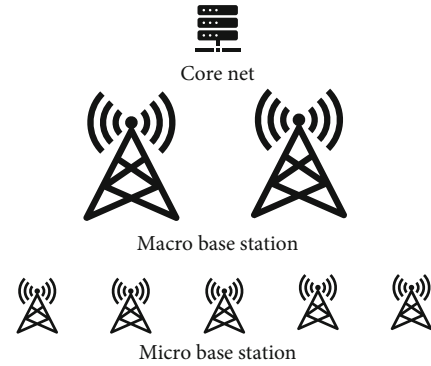

Figure 1: 5G communication system.

area where it is located, making the wireless network more reliable. Microbase stations, macrobase stations, and users are mainly receivers, and the data of all receivers come from the core network. The core network is centrally responsible for the control and data transmission of the entire system and is the core "brain" of the whole system [14].

2.2. 5G Core Features. The core features of 5G are shown in Figure 2 and Table 1. 5G communication technology has a transmission speed far exceeding that of 4G communication technology and has a greater capacity to connect more devices. At the same time, the bandwidth, delay, and reliability of 5G communication technology are five times, ten times, and one hundred times those of 4G communication technology [13]. The emergence of 5G technology will dramatically change electric power.

5G communication technology has an ultrahigh-speed transmission rate incomparable with that of traditional communication technology; that is, the peak speed of the uplink reaches 10 Gbps, and the peak speed of the downlink reaches 20 Gbps. In some tests, a peak transmission speed of 20 Git/s for single user equipment has been achieved [15]. There are three main reasons why 5G communication technology can achieve a transmission speed nearly ten times that of 4G communication technology. 5G technology directly increases its spectrum range to above 6 GHz; it adopts massive antenna technology represented by massive multiple input multiple output (MIMO) [16] and improves the transmission rate through 3D beamforming [17].

Another notable feature of 5G technology is that the number of connections has increased from 10,000 to 1,000,000 per square kilometer, and it supports a data transmission capacity of 10 Mbps per square meter. Due to the increase in its spectrum width and the extensive application of microbase stations, it can support more device connections. The improvement in spectrum width provides conditions for connecting more devices on this basis. Microbase stations were implemented in the 4G communication era, and their effect is very significant. Therefore, in the future 5G era, more microbase stations will be implemented, thereby increasing the connection density and capacity.

5G technology fundamentally changes the network architecture, including the core network and wireless access network, and reduces the air interface transmission delay and
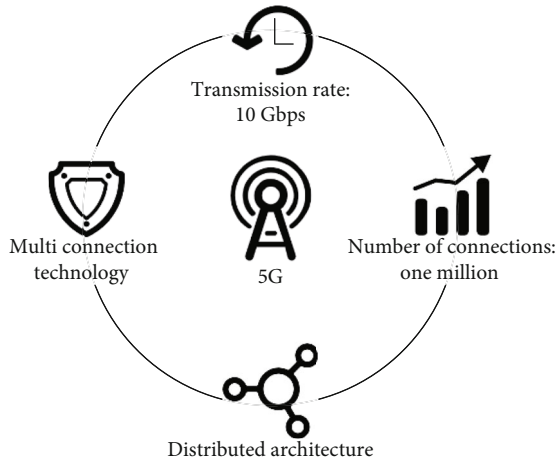
Figure 2: 5G core features.

Table 1: Comparison between 4G and 5G technology.

	4G	5G
Peak transmission rate	100~150 Mb/s	20480 Mb/s
Device connection density	10000/km^2	1000000/km^2
Delay	40~60 ms	10 ms

distance between the source and the node; that is, the core network has changed from traditional centralized to distributed, physically shortening the distance from the user so that 5G technology has a millisecond delay [14].

5G communication technology also has the core characteristics of high reliability, and the performance index for the packet loss rate has reached 0.001%. Multiconnection technology is the reason for the high reliability of 5G communication technology. It provides users with high-reliability communication by combining the wide coverage range and mobility of low-frequency bands with the large bandwidth and high speed of high-frequency bands.

2.3. 5G Core Technology. In addition to its high-profile core features, 5G core technology has also caused heated discussions. 5G technology has many core technologies. Among them, the superior adaptability of edge computing and network slicing in electric power has become a hot topic of research and discussion by scholars.

Due to the emergence of 5G technology, edge computing has returned to everyone's field of vision as the core technology of 5G. Edge computing is based on the completely centralized management and automatic operation of cloud infrastructure. Cloud computing can store a large amount of data in the cloud, so users can dynamically obtain what they need [18]. With the gradual increase in the amount of user equipment, cloud data will become increasingly large and complex, and various performance indicators of cloud computing will be greatly challenged. With the emergence of edge computing, the computing function in the cloud can sink part of the computing authority, which can share the large amount of data and calculations for the cloud.

Moreover, the traditional cloud-to-end distance is long, and edge computing can shorten the distance to the end, endowing edge computing with the characteristics of faster calculation speeds and lower latency [19].

The service objects of the network have gradually developed from the original mobile phones to various types of equipment, and higher requirements have been proposed for the network. Reference [20] proposes a reliable partition solution for the 5G transmission network based on virtual network embedding and provides special protection in elastic optical networks. Network slicing technology is another core technology of 5G technology. Network slicing technology refers to logically cutting a physical network into multiple virtual networks to achieve end-to-end connections. According to different business requirements and security requirements [21], the virtual network can be cut and personalized on demand. When the virtual network in a certain application scenario fails or is abnormal, it will not affect other virtual networks.

3. Application of 5G Technology in the Distribution Grid

3.1. Distribution Grid Automation and Relay Protection. At present, 2.5G dedicated wireless communication is mostly used for low-voltage switch cabinets in distribution grids, and a small number of switch stations use optical fiber communication. The automatic fault diagnosis and isolation of a medium-voltage distribution grid cannot be guaranteed. The low-voltage distribution grid has a low degree of automation and requires many workforce and material resources for maintenance.

3.1.1. Accurate Fault Location. Traditional fault location technology is mainly divided into two methods: one method locates the fault based on additional equipment, and the other method locates the fault based on the measurement information of the distribution line. The fault location of additional equipment is mainly determined by the sectionalizer and recloser method [22] and the fault indicator method [23]. In the second method, the accuracy of the fault location is based on the measurement information of the distribution line [24]. The decisive factor is the need for sufficient measurement information for analysis to achieve accurate fault location determination. Current fault location technology achieves accurate fault location determination through algorithm optimization or by predicting the passage of accident collectors. In the literature [25], an FTU is established at the circuit breaker and section switch so that the fault current is detected, and the algorithm is used to locate the fault. Reference [26] collects the status of fault indicators and smart meters through the control center and uses a multihypothesis method to quickly identify faults and activate protection devices. This easily shows that for current precise fault location technology, most of the analysis methods are continuously optimized after various measurement information has been collected.

The core features of 5G technology are large bandwidth and low latency, which can greatly reduce the collection time

of key information in the distribution grid. At the same time, the distribution grid can be combined with the edge computing capability of 5G technology, and this low-latency computing business can be delegated to an edge computer room. At the same time, edge computer rooms are close to the access side, reducing the data transmission distance from the physical level and increasing the fault removal speed. The large bandwidth and low latency of 5G technology extend the precise fault location technology in the distribution grid. In the literature [27], distributed power distribution fault detection based on edge computing is introduced. In the fault detection system of this work, the network layer uses mostly 4G networks and optical fiber power private networks. Current 4G communication technology is far inferior to 5G communication technology in terms of latency and bandwidth, and optical fiber networks cannot be widely used due to their cost and environmental conditions. In the near future, a 5G power local area network will be the main communication method in the distribution grid.

3.1.2. Fault Isolation. FA plays an important role in fault isolation in distribution grid automation. At present, centralized FA applies simple principles and mature strategies, and distributed FA has gradually evolved due to the large number of distributed energies needing access.

The most significant feature of centralized FA is that it needs to upload measurement information to the master station when a permanent fault occurs. The feeder monitoring terminal of each switch or ring network cabinet must communicate with the power distribution master station, which is controlled by the master station. After that, the dispatcher isolates the fault and applies self-healing schemes for different situations [28]. Reference [29] introduced a centralized intelligent feeder automation system based on IEC61850 and explained the information sequence diagram of fault isolation and fault detection for centralized FA in detail. The continuous interaction of this information is very complicated. The document does not give a reliable communication method that can support such a complicated information exchange process and the time to successfully isolate the fault. In such a continuous isolation solution that requires uploading and downloading, only a 5G network with large bandwidth, low latency, and strong reliability can provide communication technology support and improve the efficiency of fault isolation on the original basis.

The greatest difference between distributed FA and centralized FA is that distributed FA does not rely on the global information of the master station, completes fault location identification and isolation through mutual communication and cooperation between terminals, and reports the results and process of processing. Although the distribution grid has been continuously connected to various distributed loads in recent years, distributed FA has the characteristics of one-time fault handling and a strong ability to adapt to the line, which makes the distribution grid more reliable; thus, distributed FA has become a current research hotspot and direction. Reference [30] introduced a method for implementing intelligent distributed feeder automation in active distribution grids, which can isolate faults within milliseconds and realize power supply in nonfaulty areas within seconds. According to the technical requirements of distributed intelligent feeder automation proposed in the literature, rapid fault isolation achieved through remote control, and smart electronic equipment is desired, so the main communication method in the literature chooses the optical fiber-based communication method. However, due to the cost of optical fibers and because some areas are not suitable for dedicated optical fibers, this will become the main reason restricting their large-scale application. The wireless network provided by 5G communication technology can reduce the power communication network's reliance on optical fibers, cover a wide range of smart electronic devices, and complete remote control more accurately and quickly. Due to the superior characteristics of 5G technology, its cost will be greatly reduced, and its core technology edge computing capability can be applied to the application of distributed FA, reducing the time delay from the physical distance.

3.1.3. Differential Protection. Due to its selectivity and efficiency, differential protection has become a reliable selective main protection method for power system equipment [31–33]. Differential protection is based on Kirchoff's current law (KCL), which compares the incoming and outgoing currents of the relays at both ends of its protection section to determine internal and external faults and act. The reliability of differential protection depends entirely on the communication system at both ends of the line [34]. The greatest limitation of early differential protection systems with buried cables and overhead lines used as communication media is that the protection length is limited and the relays at both ends will lose their original functions when the line is disconnected. After that, differential protection that uses optical fibers and digital communication networks as the communication medium [35] appeared and is still in use today, which makes up for the previous generation of differential protection and, to a large extent, guarantees the shortcomings of relay function loss due to line disconnection. Reference [36] pointed out that wireless networks have a unique position and advantages in many communication media; that is, they have a lower cost and faster response time than cable optical fibers. At the same time, relays can also ignore system parameter changes; the construction of a 30 km differential protection scheme is proposed by connecting the relays used in differential protection to the relays at the sending end and the receiving end through a wireless transmission network. 5G technology is about to be applied in wireless communication [37]. Because of its large capacity and wide coverage, 5G technology will allow more relay connections, especially due to its superior time delay characteristics, to allow information and data to be transmitted more accurately and quickly.

3.2. Distribution Grid Monitoring

3.2.1. Power Distribution Room Monitoring. The primary need is to ensure the safety and stability of the environment inside power distribution rooms. Through the sensors installed in distribution rooms and 5G communication technology, indoor temperature, humidity, and the presence of

dangerous gases (SF_6/O_3 etc.) can be transmitted to on-duty personnel in real time, and appropriate schemes can be arranged to ensure the normal operation of all equipment in the distribution room within a standard range.

Second, it is necessary to conduct real-time monitoring of important equipment in power distribution rooms. Some important equipment, such as transformers, switch cabinets, power distribution cabinets, and DTUs, exists in power distribution rooms. In traditional power distribution room management, it is necessary to arrange personnel to regularly inspect and monitor equipment. With the emergence of 5G technology and the development of sensors, 5G technology can be combined with existing sensors. For example, multiple sensors are installed around the transformer to obtain data such as the operating temperature of the transformer, the vibration acceleration of the transformer tank, and the electrical output of the transformer and then monitor and analyze these data. After that, the data are uploaded to the monitoring personnel in real time through the 5G communication network. When an abnormality occurs, the alarm from the power distribution room can be received in the shortest time, and a set of suitable fault solutions can be automatically generated and calculated. In this way, the normal operation of the equipment in the power distribution room can be ensured to the greatest extent, the efficiency of monitoring and maintenance of the power distribution room can also be improved, and the monitoring cost can be reduced.

Because of its small size, convenient installation, and low cost, medium-voltage distribution grid phasor measurement units (PMUs) bring a qualitative improvement in fault diagnosis and fault location technology to the distribution grid [38, 39]. The combination of PMUs and 5G technology will gradually develop in the direction of visualizing the operation of the distribution grid. This will depend on the core features and core technology of 5G technology [40]. Power distribution rooms can build a 5G cellular network and rely on the large bandwidth, low latency, and large capacity of 5G technology. Power distribution rooms can not only monitor the operation of the distribution grid in real time but also obtain a large amount of accurate terminal data and bus information, as well as equipment operating status [41]. The large amount of data is visually fed back to the client for real-time monitoring and control. 5G technology can provide faster upload and download speeds to support the data transmission of high-definition video and pictures during repair processes; at the same time, these data will be returned to the center in real time. 5G communication technology not only provides a possibility for the visualization of the distribution grid but also improves the efficiency of the daily inspection of the distribution grid, reduces costs, and improves efficiency.

The ring main unit is an important part and key link in the automation of the distribution grid, so it is of great significance to integrate automatic monitoring and detection in the ring main unit of a distribution room. The traditional ring main unit mostly relies on the connection of cables or optical fibers to realize multipoint detection and control. Wired data transmission will increase the complexity of the line inside a ring main unit and increase security risks. Compared with wireless public network, 5G is more expensive. The real-time standard of on-line ring main unit monitoring is very strict. Because of its outstanding core characteristics, 5G technology can replace the existing data transmission of wired and wireless public networks. It can ensure real-time monitoring and reduce cost without increasing the complexity of the ring main unit. Multiple units in a ring main unit will also better complete their functions with the integration of 5G communication technology. For example, the signal processing unit inside a ring main unit needs to control the returned telemetry signal, remote signal, and other control devices while also simultaneously realizing visual online real-time detection for the ring main unit.

3.2.2. Online Monitoring. 5G technology lays the foundation for the future application of online monitoring technology in smart grids [42]. A distribution transformer is important basic equipment for distribution grid operation, so monitoring its data is necessary. The transformer terminal unit (TTU) is an important core device for the automatic online monitoring of distribution grids. Depending on the TTU used for the real-time monitoring data of distribution transformers, the abnormal operation status of distribution transformers can be discovered and solved in time.

TTUs have stringent standards for communication networks. It is necessary to pay attention to the cost-effectiveness and real-time performance of communication networks to ensure high reliability. Optical communication meets the requirements of reliability and real time, and due to the large number of TTU devices and their wide distribution, it is obviously impossible to use optical communication for a wide range of purposes. At present, more communication modes are power line carriers and wireless communication networks. The main disadvantage of a power line carrier is that when the distribution transformer is abnormal, the speed of data transmission for monitoring is slow, and it is also vulnerable to harmonics and electromagnetic interference between power lines. 5G communication technology, to a large extent, meets the stringent requirements of TTU devices for communication. When a distribution transformer is in abnormal operation conditions, the abnormal operation data can be quickly transmitted, and the low latency of the data can be guaranteed. At the same time, 5G's superior coverage ensures the connection of multiple TTU devices in some areas. 5G communication technology is of great significance for future online TTU monitoring.

3.2.3. Intelligent Interconnection of Power Distribution Equipment. Distribution grids contain a large number of power electronic devices, such as series-shunt compensators, contactless switches, and active power filters. These devices often operate in an independent form to meet the growing demand of distribution grids [43]. With the introduction of increasingly more distributed energy, power electronic devices are gradually developing toward interconnection. Reference [44] introduces several communication methods used in distribution grids to connect power and electronic devices, among which cellular networks are a mature communication technology. However, traditional cellular

communication technology is conducive to communication between smart meters and distribution stations or remote nodes, but as a public platform, the cellular network will have the drawbacks of network congestion and long delays. In the future, power electronic devices in the distribution grid may be interconnected and integrated through 5G cellular networks or network slicing technology to achieve the integration of energy information.

3.3. Important Node Monitoring.
Knowing the trend direction [45] requires unified detection and the control of a large number of connected distributed energy sources in distribution grid automation. However, the greatest difficulty with distributed energy monitoring is that the topology of the distribution grid cannot be identified [46]. Research on sensors, such as topology sensors and high-precision phasor units of μPMUs, largely solves the problem of topology identification [47, 48]. Subsequently, reference [49] assumes that the nodes of the distribution grid are measurable, measures and controls the nodes of the distribution grid, realizes the identification of the distribution grid topology through node data, and successfully identifies the access points of the distributed energy. Regardless of which method is used, the nodes are arranged and calculated from the nodes in the distribution grid. There are many nodes in the distribution grid. To achieve multipoint collaborative computing and ensure data delay, a 5G wireless network and distribution grid nodes can be combined. Wireless intelligent devices are placed on important nodes in 5G communication technology, such as connecting sensors and the intelligent terminals of the distribution grid of a 5G network. Because the coverage of the 5G signal is wide enough, the sensors in a region can be interconnected. At the same time, an edge computer room combined with 5G edge computing can realize the identification of distributed energy access and distribution grid topology in a region.

4. Challenges of Distribution Grids with 5G Technology

4.1. 5G Technical Standard Maturity Match.
In the first half of 2020, the technical freeze of the release 16 (R16) standard for 5G technology and the establishment of ultrareliable and low-latency communication (URLLC) standards were completed. Smart grids have just been established in 3GPP release 18 (R18), which is the first definition of a 5G + smart grid end-to-end standard architecture. Research on how 5G technology can support the business needs of distribution grids and even power grids is still in the initial stage, and it will take a long time to freeze the R18 technical standard. Due to the lack of certain technical standards, the application of 5G technology in distribution grid-related business is still in the initial stage of exploration, and the large-scale application of 5G technology needs further exploration.

All distribution terminals will be integrated with 5G technology in the future; for example, the communication module of 5G technology will be embedded in the distribution terminal. At present, relevant research on 5G communication terminals is still in progress. The market of intelligent communication terminals has been saturated before. Although the emergence of 5G technology gives communication terminals the opportunity to reenter the market, the relevant supporting industries of 5G technology are unable to support the development of 5G communication terminals and mass manufacturing [50].

4.2. 5G Network Slicing Security Issues.
Reference [51] provides a simple key generation and key management scheme that provides a quantum secure key hierarchy in the 5G scenario for Internet of Things devices. The security of network slicing technology in 5G communication technology needs to be solved. Currently, there are many new security issues in network slicing specially tailored to the distribution grid. For new network attack, this indicates whether the network can resist attack from outside when network slicing is implemented. Network defense means of network slicing need further research and exploration. Since the formation of network slicing is achieved by several virtual networks separated by physical networks, it is possible to achieve mutual noninfluence mentioned in network slicing. However, the degree of independence of a single sliced network and the associated problems with other networks will lead to new network security problems, such as information and data leakage in the slice. Only by ensuring the operational safety of the distribution grid can we further promote and apply network slicing technology in the distribution grid.

4.3. Network Cost Performance.
Another problem to be considered in the application of 5G technology is the cost performance of a network, that is, the choice of a public network or a private network. Compared with public networks, private networks have the advantages of network security, information data transmission speed, and relatively smooth signal switching and reselection, but their construction cost is incomparable to that of public networks. 5G technology has a high transmission speed, and its data transmission is also more expensive. A problem with network construction is that the network must be reasonably arranged within the range of acceptable costs. It is obviously unreasonable to choose only one of them. Therefore, if the operators can flexibly open the network architecture system in the future and cooperate to discuss a set of suitable network selection schemes, the scheme can also be used to reasonably design different business requirements for the distribution grid. To ensure safety, flexibility, and reliability, the distribution grid and 5G technology can be integrated in depth.

4.4. 5G Signal Penetration.
The signal problem of 5G technology has always been a hot topic; that is, how to improve the speed without sacrificing signal strength is of interest. In the era of 4G-LTE systems, because its wavelength is approximately 8 m, 5G mainly uses millimeter waves, so its antenna length is greatly shortened, and more antennas can be arranged in space to improve the transmission rate at one time. However, the signal strength of the 5G millimeter wave is weak; that is, signal attenuation in the transmission process is very serious. For the signal penetration problem of 5G communication technology, although the uplink and

downlink decoupling technology of "downlink 5G frequency, uplink 4G frequency" has been proposed, the construction of a large number of microbase stations and application of massive MIMO technology to base stations are design schemes to be adopted in cities. For the distribution terminals applied to some harsh environmental conditions, such as terminals built in remote areas, the construction level of base stations cannot reach the scale of base stations in cities and the cables buried in the ground, so the reception effect of signals may not be good. Therefore, to apply 5G technology to terminals to complete data collection and transmission or achieve remote functions in the distribution grid, only technical theory can be achieved, but for specific technology implementation, it is still far from reaching this goal.

5. Conclusions

The emergence of 5G technology will change the architecture of traditional mobile communication and its security. The existing communication network was not achieved overnight. The relevant 5G technical standard, R18, is still being studied. Even if the standard is completely frozen, it is impossible to deploy 5G in an all-around way. Only using the original special power network can the existing optical fiber network be retained. For some distribution grids, 5G communication technology can be combined, and a set of network structures combining private networks and public networks can be developed with operators to pave the way for transition. For example, [52] introduces a kind of low-cost, data-centric next-generation lightless network, and Gigabit wireless LAN technology based on an optical fiber wireless network to meet the requirements of a 5G communication network. In addition, we also need to consider the location of constructed 5G base stations, signal, security, and anti-interference issues. Further research programs and plans for the integration of 5G technology into the distribution grid are needed.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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