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Research on Key Technologies of Green Communication in 5G Mobile Network

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Abstract: Compared with 4G mobile communication network, 5G mobile communication network transmission speed will reach 10 times of 4G network, which can meet the communication demand after 2020, break through the space and time limitation of information transmission, shorten the space distance of mobile communication, and bring better communication experience to users through the highest level of interconnection. With the development of mobile Internet, the latest 4G network can no longer meet the growing demand for high data rate and mobility in the future. With the advent of 5G era, the requirement of green communication has been put forward. In terms of 5G mobile communication network construction, problems such as high traffic consumption and low network energy efficiency should also be solved, so as to provide users with more accurate mobile services and meet their increasing service demands. Therefore, it is necessary to strengthen the research on green communication key technologies of 5G mobile communication network, so as to better promote the upgrading and transformation of mobile communication network.

Keywords: 5G; Mobile communications; Green communication; Key technologies

1. Introduction

5G mobile communication network is the next generation of mobile communication technology. In 2012, ITU issued a vision for the future of 5G mobile communication network, which mainly covers business scenarios, users and other development trends. The ITU released the work schedule of 5G mobile communication network in February next year, striving to promote the research of 5G mobile communication network. The first stage in the worksheet of 5G mobile communication network is before 2015, aiming to study the development trend and spectrum of 5G mobile communication network technology. The second stage is from 2015 to 2017, starting the standard formulation of 5G mobile communication network. The third stage is from 2017 to 2018. This stage is mainly about the collection of technologies related to 5G mobile communication network. The fourth stage is 2018-2020. The goal of this stage is to evaluate and standardize the collected technologies. The ultimate goal of the above four stages is to make 5G mobile communication network capable of commercial application by 2020.

2. Research Status of Green Communication Technology

The mobile communication system consumes the highest proportion of the components of the wireless access network, up to 80%, and the access network side of the largest power consumption is the base station, the power consumption of about 50~80%. Improving the energy efficiency of base station in mobile communication network is the key to realize green communication. The research on the network energy-saving technology of the base station in the access network is of great value not only for the realization of the current network green communication but also for the realization of the energy efficiency index of the future 5G network. At present, green communication technology of access network in the industry is mainly divided into three levels, namely device level, link level and network level.

2.1. Device level energy saving technology

On the one hand, the energy efficiency of the base station energy-consuming devices can be improved to reduce the energy consumption of the base station; on the other hand, the reasonable scheduling mode of the energy-consuming devices can be selected according to the service characteristics of the base station to reduce the unnecessary power cost and achieve the purpose of energy saving. In baseband, rf and feeder, rf part is the main energy consuming part of base station, among which power amplifier unit consumes the most energy. However, the basic performance of power amplifier, such as efficiency and linearity, is not ideal, which is the main factor affecting the network energy efficiency. In particular, LTE systems will form peak average power ratio due to modulation mode. In order to achieve the signal quality required by the system, the amplifier needs to have good linearity, which will cause the working range of the amplifier to be much lower than saturation, resulting in very low efficiency of the amplifier. Improving the basic

performance of power amplifier devices, adopting more advanced power amplifier and processing related signals are the key to optimize the power consumption of power amplifier units.

2.2. Link level energy saving technology

Although the transmitted power occupies a small proportion in the total power of the base station, due to the efficiency factors of power amplifier, antenna, feeder and other devices, the total power of the radio frequency part of the base station usually occupies a considerable proportion in the power of the base station. At the same time, base station transmission power configuration plays a decisive role in wireless communication system service capability. Through reasonable resource scheduling strategy and high energy efficiency transmission technology, on the premise of ensuring network service capacity, optimizing link transmission power plays a crucial role in improving the energy efficiency of the whole wireless system. From the point of view of link level, literature points out that the improvement of link level transmission energy efficiency mainly depends on three kinds of important tradeoffs: wireless resources and transmission power tradeoffs, transmission performance and transmission power tradeoffs, and processing complexity and transmission power tradeoffs.

2.3. Network level energy saving technology

Based on the link-level transmission technology with high energy efficiency, the network-level energy-saving technology optimizes the energy consumption of wireless communication network from the perspective of the whole network, which is the key to realize the green communication of wireless network. By introducing a small station into heterogeneous wireless communication network, the transmission distance between the user and the access point is obviously shortened, thus the transmission power consumption is greatly reduced. UDN technology through ultra-dense deployment of small stations is the research hotspot of 5G system in the future, which is expected to achieve thousandfold data rate improvement and hundredfold energy efficiency improvement. Ultra-dense heterogeneous networks will increase network interference and system processing complexity. How to carry out the deployment of high-energy station network and realize the control of high-energy network topology structure in network operation are the two core issues to realize the high-energy UDN. Other network-level energy-saving technologies include cooperative communication networks, wireless resource allocation schemes and multimedia broadcast/multicast and network integration.

3. Domestic and Foreign Green Communication Policy Orientation and Development Strategy

5G communication will bring about huge energy loss has attracted the attention of the communication industry at home and abroad. Under the seventh framework project, the European telecommunications commission initiated TREND, a network design project for true energy efficiency, a cognitive radio and collaborative technology research project based on energy efficiency. France telecom has launched opera-net, which aims to save 20% of its energy by 2020. Britain's MVCE has proposed the Green Radio project, which focuses on network architecture and Green wireless technology.

In terms of energy conservation and emission reduction in communications, the national development and reform commission has established statistical monitoring indexes for energy conservation and emission reduction. According to the contribution of energy consumption, the state-owned assets supervision and administration commission (sasac) adjusted the three major operators from "general enterprises" of energy conservation and emission reduction to "concerned enterprises" in 2010. The ministry of industry and information technology proposed to vigorously develop the green ICT industry and promote green IDC and green base stations. The above measures indicate the government's mandatory requirements for green energy saving in communication.

In order to attract the attention of the whole industry chain on green communication, sasac, NDRC and miit have organized the annual green communication conference since 2008. In 2012, with the theme of "green development and efficient operation", the conference set up two themes of "green communication planning and basic network energy saving" and "key links and path realization of green communication". In 2013, with the theme of "innovation and practice of green communication", the conference focused on the network construction and operation of green communication and discussed product innovation, technology innovation and program innovation of green communication in the industrial chain. In February of the same year, the ministry of industry and information technology issued a guideline on further strengthening the work of energy conservation and emission reduction in the communications industry. In 2014, with the theme of "green 4G network construction and energy conservation innovation", the conference focused on 4G network construction and Shared energy conservation solutions and practice models in the communication industry centering on energy conservation and emission reduction needs and challenges under the new situation. In 2015, the ministry of industry and information technology organized a conference on energy conservation and emission reduction in the communication industry.

The conference took "green communication under Internet +" as the theme, and carried out experience sharing and technology exchange on hot topics such as communication industry under Internet +, application and release of energy conservation innovation results and experience exchange.

In terms of green communication, China's three major operators have also taken strategic measures. China telecom has realized energy conservation and emission reduction through "green communication, green products and green procurement", and has taken measures such as optical network city, transformation of energy-consuming equipment, promotion of distributed base stations and cloud network. China mobile realized the "green action plan" by developing c-ran network structure, promoting the construction mode of base station without computer room and adopting green energy. China unicom promotes distributed base stations and intelligent energy saving off technology to improve energy saving and emission reduction. With the efforts of governments, industry associations, operators and all parties in the industry chain, the concept of green communication will be well developed in the era of 5G.

4. Research on Key Technologies of Green Communication based on 5G Mobile Communication Network

4.1. Key technology analysis

For 5G mobile communication network, it is difficult to meet the requirements of network green communication by adopting traditional network deployment mode. In view of this situation, self-organizing network and ultra-dense heterogeneous network can be proposed. With self-organizing networks, centralized, distributed and hybrid network architectures can be adopted. Among them, SON distributed self-organizing network has good scalability, high response speed and efficiency, and is less dependent on the system, so it can be used to achieve intelligent deployment and operation and maintenance management of 5G mobile communication network. However, due to the low development level of self-organizing network technology in China, it is difficult to realize self-planning and self-configuration in the phase of network deployment and self-healing and self-optimization in the phase of network operation and maintenance, so the effective application of self-organizing network technology cannot be realized. In this context, ultra-dense heterogeneous network has indeed become the key technology for 5G mobile communication network to achieve green communication, which can meet the demand for 1,000-fold traffic growth. If the network deployment is carried out by using this technology, the traffic growth needs to be satisfied by reducing the cell radius and increasing the number of low-power nodes. Therefore, in the era of 5G, the deployment of various wireless nodes that can reach more than 10 times of the existing sites will be completed, so that the number of active users and sites can reach 1:1 ratio, and high-quality communication services can be guaranteed for users. In practice, it is necessary to solve the complex topological structure of the ultra-dense heterogeneous network, so as to ensure the compatibility between the network and the existing communication system. In addition, the ultra-dense heterogeneous network architecture and the existing communication interference coordination algorithm can only solve the problem of a single interference source, so the same frequency interference problem of complex networks cannot be overcome. For different services, the dynamic deployment of the network should be realized so that the adjacent nodes can be effectively perceived and the energy-saving configuration of the network can be realized. Therefore, when the green communication implementation of 5G mobile communication network is studied, the deployment of ultra-dense network should also be emphasized.

4.2. Key technology application

In the deployment process of ultra-dense heterogeneous network, the key problem is to solve the deployment location and density of high energy efficiency Small Cell. Aiming at the same community or sector, the network traffic sharing of acer station can be realized by adding small stations, so that the network energy efficiency can be improved. However, too many small stations will generate large energy consumption, and bring burden to areas with strong interference or sparse users. The system capacity provided is limited, causing serious inter-cell interference and overall decline in network energy efficiency. To solve this problem, high-efficiency Pico deployment scheme and wired Picocell back transmission can be adopted to provide users with mobile communication services with quality not lower than that of acer. The X2 interface is used to realize macro - micro collaboration and strengthen the management of network load and interference. In actual deployment, 3GP LTE FDD simulation platform is needed to set simulation parameters to achieve network fading calibration. Under the standard channel model of m. 2135, if there is too much Pico in the network, the high-efficiency deployment plan cannot be obtained by traversing all positions. Therefore, after the Pico deployment is completed in the target macro sector, the relative positions of the other two sectors should be the copies of the target station. It is assumed that there are 7 cells, the target cell is set as the intermediate cell, and the remaining cells are all duplicates. The Pico position representation by polar coordinate method can obtain the network topology diagram as shown in figure 1. Based on the coordinates of a single sector, contour distribution maps of network statistical energy effi-

ciency can be generated to determine the energy efficiency of network elements under different location conditions of Pico.

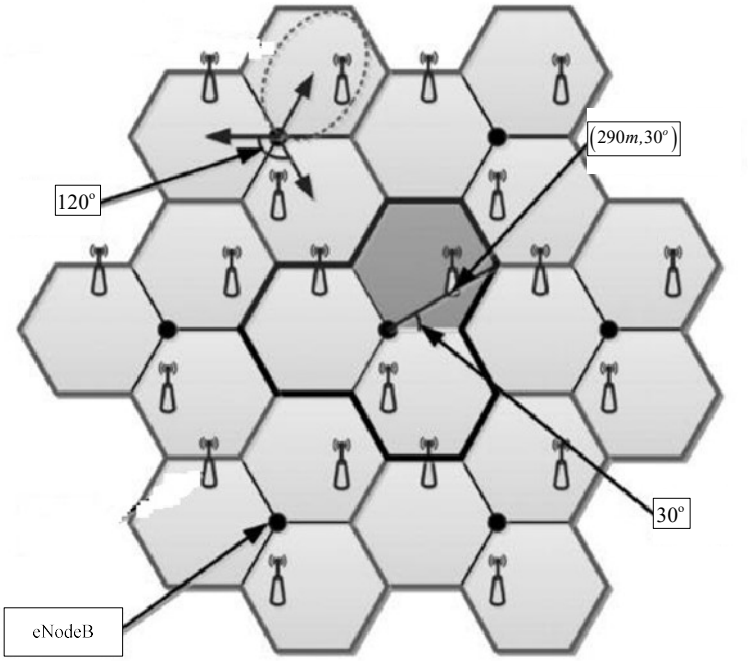

Figure 1. Network topology diagram

When Pico location, sampling, every 20 m, 15 ° need to complete a simulation. Assuming that the distance between eNodeB stations is 700m and the radius of the sector is 500m, it is necessary to complete 170 simulations to traverse all positions. According to the energy efficiency changes of each network element, the best deployment scheme can be selected. As shown in table 1, the intensive Pico high-energy deployment scheme was analyzed under different number of small stations. Through the summary, the deployment rules of the scheme can be obtained, that is, multiple picos are deployed in each sector, and the Pico power should be avoided to be too small, and the Pico should be kept as far as possible from the eNodeB station. Pico stations should be kept at least 50m apart. If the distance between two stations exceeds 130m, mutual interference can be ignored. According to the change of traffic volume, the quantity of Pico shall be adjusted, and the network topology control shall be awakened by turning off Pico. In addition, the eNodeB antenna main lobe direction and station spacing should exceed 300m to reduce interference.

Table 1. Intensive pico high energy efficiency deployment scheme under different number of small stations

Number of Stations	Deployment Plan
1	Deploy Pico location at (370m, 60 °) and nearby
2	In (370 m, 60 °) (320 m, 30 °) or (370 m, 60 °) (320 m, 90 °) or (320 m, 90 °) (320 m, 30 °) and nearby Pico deployment location
3	In (320 m, 30 °) (370 m, 60 °) or location (320 m, 90 °) and deployment of Pico location nearby

After the network deployment, the efficient network topology mechanism needs to be established. For mobile communication users, due to uneven user deployment and certain randomness, it is difficult to accurately calculate network energy consumption based on hot spot distribution. In order to obtain the optimal network topology, the setting of Small Cell wake-up/sleeping mechanism should also be completed. The user distribution curve can be obtained through dynamic adjustment, and the energy consumption of densely deployed Small stations can be reduced according to the energy consumption curve. Small Cell should not be dormant for the base station layout mode with low density of Small station. In view of the high density of the site, it is necessary to complete the setting of large-scale energy saving scheme. The ran3-like SI/WI sleep/wake scheme is adopted to propose a dynamic Small Cell wake scheme based on sub-frame level to achieve the goal of dynamic energy saving. Based on Small Cell business network coding technology, multi-interface control panel transmission protocol can

be realized. Therefore, it can bring some significance for mobile communication security.

5. Conclusion

With the development of mobile communication network technology, the upgrade from 4G to 5G will be realized in the future. But in this process, must realize the technology upgrade from the green communication Angle. The key technologies of ultra-dense heterogeneous network deployment are adopted to realize the deployment of Small community stations with low energy consumption and high energy efficiency. The Small Cell wake-up/sleep mechanism is adopted to optimize the network topology structure and realize the optimization of network coding technology, so as to better meet the green communication requirements of future mobile networks.

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