

Research of Power Wireless Private Network Technology in the Terminal Communication Access Network

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Abstract—The terminal communication access network is an important part of the power communication network and is the extension of the backbone network, which will provide a comprehensive communication support for the smart grid construction. Firstly, in this paper, technical characteristics of TD-LTE power wireless private network is described. Secondly, comparison of the wireless technologies, such as TD-LTE, McWill, GPRS and CDMA, is analyzed in detail. Lastly, Construction scheme of the power wireless private network system is given in Shanxi province.

Keywords—wireless private network; TD-LTE; real time; transmission rate; base station

I. INTRODUCTION

State Grid Corporation proposed for the first time in the 12th five-year plan report: the power communication network is composed of the backbone network and the terminal communication access network (hereinafter referred to as access network). The access network is an important part of the power communication network and is the extension of the backbone network, which will provide a comprehensive communication support for the smart grid construction[1].

II. TECHNICAL CHARACTERISTICS OF TD-LTE POWER WIRELESS PRIVATE NETWORK

In the private network construction, MIIT(Ministry of Industry and Information Technology of the People's Republic of China) issued successively the file 59(2015) and 65(2015) and approved radio frequency of TD-LTE private network in power industry. The broadband TD-LTE smart city network has been built in Beijing and Nanjing. Moreover, TD-LTE power private network has also been built in Zhuhai and Guangzhou city. Therefore, safety and reliability are fully

verified in these construction. Specific advantages are as follows:

A. Safety Advantage

Specific safety reinforcement will be used in the core network, base station and other power nodes from characteristics of electric power industry, which can improve the wireless communication security. In addition, there is no security risk with access to the Internet in the power private network.

B. Construction Environment

According to the present condition of Shanxi Power Company, fiber laying is all used in the power substation of 35kV and above. In other words, the new base station is full use of existing channels. Moreover, there is communication computer-room in the power station, which has natural advantage for building wireless base station.

C. National Policy

The file 65(2015) of MIIT clearly pointed out that TD-LTE 1785-1805MHz private wireless mode can be used in the power or oil industry. Therefore, in order to seize the initiative and output better smart grid standards, the power industry needs to speed up frequency resource application.

D. Project Standard

In 2013, Chongqing power company finished the application and approval of TD-LTE 1.8GHz and EMC(Electro Magnetic Compatibility) analysis work. TD-LTE 1.8GHz private system is built later for transformer monitoring and emergency communication information transmission.

In 2015, TD-LTE 1.8GHz power private system is built in Nantong city of Jiangsu province for distribution automation, transformer monitoring and distributed power control information transmission.

Until now, TD-LTE 1.8GHz private wireless network has been built in Huaian, NanJing, Tangshan, Caofeidian, Fuzhou and Changsha by State Grid Corporation, which all Achieved good demonstration effect[2].

E. Cost Advantage

The private network adopts the similar technical system to the public. Compared to the fiber communication, the investment cost is lower and the construction speed is faster.

III. COMPARISON OF THE DIFFERENT WIRELESS TECHNOLOGIES

In the following chapters, A comprehensive comparison of TD-LTE, McWiLL, GPRS and CDMA is showed from the real time, reliability, security, rate and covering capacity[3].

A. Real Time

Owing to the limitation of technical system, public network load and terminal distribution etc., the real time of GPRS and CDMA is generally 0.6s-2s. Moreover, network optimization management is out of power company's control. On the other hand, the transmission delay of wireless private network is much lower than of public network, so the real time performance is better. At present, the real time of TD-LTE1800 and McWiLL in the pilot power construction projects is about 300ms.

TABLE I. COMPARISON OF REAL TIME FOR THE DIFFERENT WIRELESS TECHNOLOGIES

Wireless technology	TD-LTE 230	TD-LTE 1800	McWill	GPRS	CDMA
Real time	30-300ms	30-100ms	150-300ms	0.6-2s	0.6-2s

B. Reliability

The reliability index in the power business is strictly required. For the public network, its performance is easily affected by topography, climate, same frequency interference and other uncontrollable factors. Therefore, the reliability is difficult to guarantee[4].

From the below table, the bit error rate of the newest TD-LTE technology is less than 10E-5. Meanwhile, telecom grade standard is generally used in the mainstream equipment so as to improve the reliability performance greatly.

TABLE II. COMPARISON OF RELIABILITY FOR THE DIFFERENT WIRELESS TECHNOLOGIES

Wireless technology	TD-LTE 230	TD-LTE 1800	McWill	GPRS	CDMA
Equipment reliability	Industrial standard	Industrial standard	Industrial standard	Basically satisfying industrial standard	Basically satisfying industrial standard
Network reliability	Higher	Higher	High	lower	lower
Channel reliability	Bellow 10E ⁻⁵	Bellow 10E ⁻⁵	-	Bellow 10E ⁻³	Bellow 10E ⁻³

C. Security

From the below table, in the wireless access technologies, TD-LTE, achieving the protection of the main station and terminal, is better than MaWill, GPRS and CDMA in security performance.

TABLE III. COMPARISON OF SECURITY FOR THE DIFFERENT WIRELESS TECHNOLOGIES

Wireless technology	TD-LTE 230	TD-LTE 1800	McWill	GPRS	CDMA
Channel security	Higher	Higher	High	Lower	Lower
Security protection mode	Bidirectional encryption	Bidirectional encryption	Unidirectional encryption	Unidirectional encryption	Unidirectional encryption
Secret key strength	AES, ZUC, SNOW 3G	AES, ZUC, SNOW 3G	Unpublished	A3, A8, GEA	CAVA, CMEA, ORYX

D. Transmission Rate

From the below table, the rate of TD-LTE 1.8GHz is much higher than GPRS and CDMA.

TABLE IV. COMPARISON OF TRANSMISSION RATE FOR THE DIFFERENT WIRELESS TECHNOLOGIES

Wireless technology	TD-LTE 230	TD-LTE 1800	McWill	GPRS	CDMA
Transmission rate	1.76Mbit/s of uplink peak rate and 0.5Mbit/s of download peak rate in 1M frequency band	5Mbit/s of uplink peak rate and 26Mbit/s of download peak rate in 5M frequency band	5Mbit/s of uplink peak rate and 15Mbit/s of download peak rate in 5M frequency band	Generally about 100Kbit/s	Generally about 200-300Kbit/s

E. Covering Capacity

According to the radio frequency characteristics, the lower the frequency band, the wider the covering capacity. Therefore, TD-LTE 1.8GHz technology needs more base stations[5].

TABLE V. COMPARISON OF COVERING CAPACITY FOR THE DIFFERENT WIRELESS TECHNOLOGIES

Wireless technology	TD-LTE 230	TD-LTE 1800	McWill	GPRS	CDMA
Network mode	Flexible	Flexible	Flexible	Flexible	Flexible
Covering capacity	Below 3km in the city proper and below 20km in the suburbs	Below 1km in the city proper and below 5km in the suburbs	Below 1km in the city proper and below 5km in the suburbs	Depending on the public network capacity	Depending on the public network capacity

IV. CONSTRUCTION SCHEME OF THE POWER WIRELESS PRIVATE NETWORK SYSTEM

There is about 533 wireless alternative base stations in the power wireless private network of Shanxi province, shown in the following figure.

TABLE VI. ALTERNATIVE NUMBER OF BASE STATION OF SHANXI PROVINCE

Number	City	Alternative number of base station
1	Changzhi	60
2	Jincheng	30
3	Shuozhou	30
4	Datong	45
5	Jinzhong	55
6	Linfen	65
7	Lvliang	25
8	Taiyuan	64
9	Xinzhou	73
10	Yangquan	20
11	Yuncheng	66
In total		533

In this project, the wireless core network EPC will be deployed separately in each of 11 cities of Shanxi province, collecting the wireless base station information. Meanwhile,

one core switch and network management system is deployed in the dispatching building of Shanxi power company in order to manage the whole network operation better. Moreover, each OMC client will also be used in 11 cities and other part country companies for daily operation and maintenance.

V. CONCLUSION

In present, the foundation of the access network is relatively weak compared to the backbone network, and most of power businesses rely on the public network for data transmission. However, data security, reliability and real time can not be guaranteed by transmission in the public network. According to the characteristics of the electric power business transmission, the research of a new type of TD-LTE wireless private communication technology will greatly facilitate the development of power communication networks.

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