Information & Communication Convergence for the Promotion of Electric Power Enterprise Informationization

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Abstract—With the start of industrialization and informationization convergence in our country, information & communication industry is converged and transformed in faster speed, which will create favorable conditions to drive rapid growth of electric power informationization. The paper introduces the recent development of information & communication from the perspective of 3G, FMC, high speed of access to broadband network as well as FTTx and the potential influence on electric power industry informationization and the development of power grid intelligence from the perspective of mobile office automation, mobile video monitoring, intelligent meter reading, intelligent inspection tour and intelligent load scheduling.

Index Terms—3G, FMC, Power grid, FTTH

I. INTRODUCTION

Electric power industry is the economic lifeline of our country, which is playing a very important role in the development of national economy [1]. Strengthening electric power informationization can help increase the monitoring, scheduling and management of power grid, improve the control and regulation of electric power enterprises and their efficiency, profits and productivity to build the world-class power grid and facilitate the development of our national economy. The great progress has been made on the electric power informationization in recent years. State Grid has made remarkable achievements in SG186 engineering with information level of its own rated 4th in Class A by SASAC. With the growth of the national economy, the social progress and the reform of electric power system, facilitated by information technology, electric power enterprises must establish standardized modern enterprise system, improve labor productivity and scientific management and increase automation and intelligence of power grid to shift from traditional pattern to highly intensive intelligent pattern by taking advantage of information technology that is characteristic of wide coverage, strong penetration and immediate impetus.

Electronic information industry is one of the pillar industries in the national economy with the strategic,

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fundamental and pioneering significance. At the 17th Party Congress, the strategy of "Promoting industrialization by informationization" has been putted forward, which objectively requires telecom carriers to promote the transformation from communication service to integrated communication service. In face of the challenges and opportunities of our economic development by global financial crisis, the State Council has approved electronic information industry rejuvenation program that gives priority to the construction of electronic information infrastructure and puts greater investment on information & communication field to effectively push forward industrialization and informationization convergence and our national economy. The start of industrialization and informationization convergence of our country and the transformation and convergence of information & communication will create favorable conditions to drive rapid growth of electric power informationization.

II. BUILD HIGH-SPEED AND SEAMLESS BROADBAND NETWORK FOR THE DEVELOPMENT OF SOCIAL INFORMATIONIZATION

Today, people can not been separated from information & communication network, including broadband network and mobile phone, changing the way of live and work and promoting economic growth and social progress. Communication technology and service are evolving towards mobility, broadband, IP and multi-media and with the restructuring of telecom industry and the issuing of 3G (The third generation mobile communication) license, Chinese telecom industry is heading for the era of full service operation. With the support of national preferential industrial policies, three telecom carriers are pressing on the convergence of mobile and broadband networks to build new high-speed seamless broadband network so as to meet the demands of all circles in information technology application and the common people in life and entertainment.

A. Development of 3G mobile communication

Wireless mobile communication has become one of the communication services, featuring rapid growth, wide application and great influence, the critical field of information technology application of our country and the essential part of modern society, making positive contribution to economic and social development and the improvement of people's life. It has been applied to many

information technology projects of electric power industry, such as office automation, auto meter reading, web-based inspection tour and monitoring & scheduling. Taking the opportunity of the new round of telecom industry restructuring, 3G development will be promoted in the positive, down-to-earth and rapid manners.

3G is most characteristic of multi-media service offering over broadband with large transmission capacity and high flexibility. In recent years, with the popularization of GPRS (General Packet Radio Service) and CDMA (Code Division Multiple Access) 1X, mobile communication subscribers put forward higher requirements to data service, such as high bandwidth and low delay. Backed by 3G that supports new high-speed mobile data service, telecom carriers can provide a wide range of fast and convenient value added services. 3G network is distinguished with data service, because its data loading capability achieves qualitative leap, compared to GPRS/EDGE (Enhanced Data rate for GSM Evolution).China Unicom adopts HSDPA (High Speed Down Link Packet Access) and HSUPA (High Speed Up Link Packet Access) technologies in WCDMA (Broadband CDMA) network, which increases packet peak data rate to 14.4Mbps/5.76Mbps and significantly improves QoS (Quality of Service). Thanks to the substantial rise of data transmission speed, mobile broadband is been realized indeed. It can process multiple medias such as image, music and video stream, offers a variety of information services such as webpage browsing, teleconference & video conference, video monitoring and E-business as well as many new one way and interactive multi-media and multi-call services. With high resource utilization rate, 3G is able to provide cost effective services. 3G that is developed in line with industrial characteristics can be widely applied to information and intelligent construction in all circles, effectively promoting their production and management efficiency and information technology application.

B. The development of FMC

FMC (Fixed-mobile convergence) is the way based on the combination of fixed and mobile technologies [3]. Subscriber can seamlessly roam between fixed network and mobile network with one terminal and one bill to enjoy various high-quality services of communication, information and entertainment. The development of FMC will phase out the separation of mobile phone number and broadband account to provide integrated solution based on fixed and mobile service.

FMC consists of service convergence, terminal convergence and network convergence.

——Service convergence: Provide fixed and mobile integrated services for subscribers with different types of access over the unified service creation/transport platform based on the unified service standard.

——Terminal convergence: The ability to access single terminal device such as fixed and mobile dual mode handset and TV handset over multiple networks. One terminal can access and seamlessly switch between fixed network and mobile network, accessing other wireless networks to provide subscribers with integrated service.

——Network convergence: The unified loading of fixed and mobile broadband access service over the unified transmission network and IP network, the unified database that enables converged management of customer data and the unified call control platform. All can guarantee new services and are implemented in the fast, effective and unified manners.

As the restructuring of telecom industry comes to an end, the three carriers have full-service operation licenses and will quicken the pace of FMC development with service convergence to be done first to meet the demands of subscribers, especially the demands of enterprises and industries on information technology application. Generally, there are 3 steps to take.

Firstly, service bundling. Bundle multiple services of fixed voice, broadband data, mobile 2G/3G SMS, call, WAP, video and streaming media to be a specific package. It allows subscriber to enjoy multiple services with one bill.

Secondly, service convergence. It allows subscriber to enjoy the unified and integrated service such as unified information and CRBT with one number and bill over the service platform that combines the characteristics of fixed network and mobile network.

Thirdly, People can enjoy converged service over one terminal. At the present, the carriers carry out service convergence in the way of service bundling, which is necessary, though it is superficial. They can offer a package of custom services including information solutions for enterprise and industry subscribers. Therefore, the subscribers can enjoy one stop service with a favorable price.

C. Higher speed of access to broadband network and FTTx

To conform to the development of social informationization, the telecom carriers are upgrading fixed broadband network for higher speed of access. With a view to the demands of broadband subscribers, DSL (Digital Subscriber line) should have access speed rate of 2Mbps, common digital TV requires 2Mbps when receiving H.264 standard definition television (SDTV) programs and high definition television (HDTV) requires 6 to 8 Mbps. Based on two TV programs per household, together with broadband high-speed Internet access and online game, 20Mbps bandwidth is required per household. Following the blowout of the demand of enterprise subscribers for bandwidth early this century, the progress of industrialization and informationization convergence will spur a sharp increase of such demand again. Promoting the speed of access to broadband can meet the growing demand of social informationization for bandwidth.

The promotion of the speed of access to broadband network depends on the development of optical access network. Though copper cable access is still adopted by a majority of the new added broadband subscribers now, only optical access is the future of broadband development to support high definition video and IPTV. The all optical access should be realized progressively for both home and enterprise subscribers. Currently, optical access is approaching subscribers through the replacement of copper cables with optical fiber cables and with the support of government to information industry, the building of optical

network is underway to meet the demands of personal, enterprise and industry subscribers in different areas and in different ways.

Optical access FTTx (Fiber To The x) consists of FTTH (x= Home), FTTB (x= Building) and FTTC (x= Curb)[2]. FTTH is an ideal choice, while cost and demand are the key factors for rapid development of FTTH. The carriers use different strategies in different areas in the process of "The replacement of copper cables with optical fiber cables". FTTB is fast growing in recent years for office buildings, FTTC is used for the newly built residential communities and all optical access is used for industry subscribers. The promotion of the speed of access to broadband network will be accelerated, because of the progress of PON (Passive Optical Network) technology, the sophistication of EPON and GPON technologies and the fall in the price as well as the favorable policies of government on FTTH.

III. INFLUENCE OF THE DEVELOPMENT OF NEW COMMUNICATION & INFORMATION SERVICES ON ELECTRIC POWER INFORMATIONIZATION

The high speed seamless broadband network will bring people the new broadband multi-media service experience through combining the advantages of fixed communication and mobile communication. It allows people to not only make calls, send short messages and conduct data communication by handset anytime and anywhere, but also enjoy various broadband multi-media services over PC with high speed internet access anytime and anywhere, changing the way of people to live and work. China Unicom, as the all-service carrier, has the most adequate fixed network resources in the north and has the proven 2G network around the country. 3G license is based on the WCDMA format that features the most sophisticated technology, the most subscribers and the sound industrial chain. The synchronous introduction of HSDPA and HSUPA in the entire network can enable high-speed streaming media, interactive service and downloading and distribution at the back end and video session. For example, a range of HSPA terminal products and notebooks with built-in HSPA functions are available on the market. In the preliminary stage, China Unicom provides a number of broadband and mobile information solutions for electric power industry and other trades and is first rated 2nd in Class A by SASAC in its own information technology application among telecom carriers. Next, it can offer a variety of tailed information solutions through combining fixed broadband network with mobile 2G/3G network resources to support electric power informationization.

A. The mobile office environment that enables Internet access anywhere

After using office information system, the electric power industry increases working efficiency, regulates work procedure and saves operating cost. Because of its own characteristics, a part of personnel need to work outside and some leaders and executives at different levels are often on business travel and more and more issues need to be solved in a quick and timely manner when they are out of the office, which requires creating the mobile office environment.

With 2G and 3G mobile communication networks[4], the telecom carriers can offer industry information application services based on handset, notebook or other mobile terminals for electric power industry to create seamless broadband mobile office environment.

- WCDMA based on the synchronous introduction of HSDPA(High-speed downlink packet data access) and HSUPA(high-speed uplink packet data access) technologies in the entire network, which come up in WCDMA 3GPP R5/R6, can increase peak data rate to 14.4Mbps and 5.75Mbps respectively, and will make mobile office easier with high speed and stable mobile Internet access [5,6].
- VPDN/APN-based industry application platform-- It allows subscribers to make data communication with Intranet or service server by wireless terminals such as handset or notebook anytime and employees to enter enterprise's office system anytime and anywhere.
- Industry short messaging/multimedia messaging as effective supplement of mobile office-- It is the short message (multimedia message) receiving and sending service with additional functions of personal memo and mobile short messaging PUSH, especially for group enterprise subscribers. They can conduct conference notification, work scheduling, calendar reminder and interactive query with employees by text, voice and picture.
- Subscribers can carry out internal application management via portal, such as terminal access and authority management.
- For enterprise subscribers, internal authentication and hosting authentication are needed.

B. Real-time dynamic high-definition power grid video monitoring

The widespread transmission network of electric power system and a large number of transformation and distribution equipments and equipment rooms impose great pressure on maintenance. With the downsizing electric power system for efficiency and the development of video monitoring technology, more and more substations and equipment rooms are unattended. In order to increase security and reliability, video monitoring system is evolving towards high definition and intelligence, which requires high accessibility of transmission channel and high bandwidth. The combination of fixed broad band and mobile 3G technologies can enable the transmission of real time dynamic high definition video signals for real time video monitoring of power grid.

At present, China Unicom's 3G-based unified management platform of video monitoring service will be established soon. The WCDMA 3GPP R99/R5/R6 standard is used to increase the uplink and downlink stream rate, which will support the access and data transmission of cable and wireless high definition camera, watched and manipulated by terminals such as PC and handset. Up to November 2008, there have been about 1,500 WCDMA terminals and 963 HSPA terminals all over the world, of which, 264 HSDPA terminals support 7.2Mbs download rate. With sophisticated WCDMA terminals, the personnel can easily carry out monitoring and maintenance, no matter inside or outside the

central monitor room.

C. Accurate and efficient intelligent meter reading

The electric meter reading is troublesome for a long time, because manual meter reading not only wastes manpower and material resources, but is weak in accuracy and promptness. With the development of mobile communication, an increasing number of GPRS and CDMA1X-based wireless meter reading solutions are applied to auto electric meter reading.

GPRS and CDMA1X are data packet communication technologies of 2G GSM and CDMA respectively with wide area wireless IP connection enabled. The wireless module, which is embedded remote meter reading terminal, is used to acquire electric meter data and then send them to electric data center by SMS that will store, analyze and process the uploaded data in the unified manner.

Such real-time and accurate way can be widely used in urban and rural areas. Mobile network is very suitable for transmitting small amount of electric data from scattered sites with few network resources occupied, low cost and saving of manpower. The simple network structure adopts the pattern of VPDN or APN to ensure system's security and stability.

D. Efficient and intelligent line inspection tour

In terms of work safety of electricity, technical personnel are required to have an inspection tour for specified equipments regularly to identify problems early and eliminate potential hazards for guaranteeing safe operation of power grid and superior service for the public. Inspection tour of electricity mainly involves transmission lines, transformation and distribution and power plants. Because transmission lines extend widely, the technical personnel have to make inspections in the fields, which are time consuming, exhausting and challenging in face of changing environment. Adopting information technology to change the traditional way of inspection tour is helpful to increase working efficiency, standardize inspection tour process, improve maintenance and management and guarantee the security and reliability of the entire network.

In electric power system, there are a lot of cases of improving inspection tour intelligence by means of mobile communication, such as palm computer, barcode scanning technology and RFID technology now. The inspectors can record data on the site in the real-time manner and upload them instantly, effectively securing the efficiency of inspection tour and the accuracy and completeness of onsite data. There are many networks and terminals available based on the third generation mobile communication WCDMA, showing the rich experience in industry application platform. They can enable handset Internet access based on web, wap and j2ee, short messaging, multimedia messaging and Pushmail as well as high-speed wireless Internet access. The inspectors can send texts, pictures and videos of on-site inspection to the inspection tour centered by palm computer, handset and PC in the real-time manner and the center can get the complete and accurate information and designate the appropriate personnel promptly to solve line failures on the site as well as standardizing inspection tour process and having real information about inspectors' performance to

effectively increase management capability and ensuring the safe and stable operation of power grid.

E. Precise and timely load scheduling management

To meet the demand of all circles for real-time power consumption, the electric power system is required to have timely network load scheduling management through visualizing and controlling power load in the specific area, effectively monitoring planned power supply and staggering power consumption and realizing electric power peak load shifting and industry power load transfer to reduce temporary brownouts for reaching the goal of "Maintaining productivity by staggering power consumption and keeping in service while restricting power consumption". Power grid scheduling mainly depended on phone with the lack of visibility and accuracy before, especially in the case of the failure of the power system, which doesn't satisfy the demand for timely scheduling, effective command and quick emergency response. The wireless communication and the combination of 2G and 3G technologies allow the personnel to carry out overall monitoring of power grid by short message, video and high definition video to have an insight into power load of the entire network and the feature of information sharing can enable multi-department linkage to strengthen coordination and speed up information circulation for remote monitoring and operation, realize accurate and timely load and workforce scheduling, lower personnel cost and higher response speed so as to precisely control power load. The mobile terminal can be used to greatly reduce operating time and increase emergency response capacity. Particularly in the case of snow disaster in the south of China in 2008, it can be very helpful to get the information of power grid damage promptly, increasing command and scheduling capabilities on the site and improve power grid anti-disaster performance for reducing the influence of the disaster.

IV. CONCLUSION

The building of third generation mobile communication, broadband network and the transition to all-service operating pattern will be very helpful in the development of power enterprise informationization. With information infrastructures of mobile and fixed broadband networks, efforts must been made in line with electric power enterprise informationization. Power grid maintenance and the construction of intelligent power grid will give a strong impetus to the growth of electric power industry.

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