Research on Application Scenarios of Terminal Communication Access Network Carrying Ubiquitous Service

An ZhiYuan[1, a,*], Wang Lei[1], Liu Yan[1], Wu Yangyang[1]

[1]State Grid Henan Information & Telecommunication Company, Zhengzhou, 450000, China

Keywords: Access Network, Multi-service, Application scenario

Abstract: Under the background of the in-depth construction of smart grid, the types and bandwidth requirements of power communication services have changed greatly. A large number of heterogeneous power communication service terminals are applied to the end of power communication network, showing generalization characteristics. Aiming at the ubiquitous service access demand of the terminal communication access network under the power industry scenario, the research on the ubiquitous service access application scenario of the terminal communication access network is carried out, and the service access adaptability analysis suitable for the terminal communication access network bearer is carried out to provide support for the development of ubiquitous service access equipment and prototype system of the terminal communication access network and solve the bearing problem of various services.

1. Introduction

Under the background of the development of smart grid, a large number of heterogeneous power communication service terminals are applied to the end of power communication network, showing generalization characteristics. At the same time, the technology of terminal communication access network also presents the characteristics of heterogeneity, which is unstable due to the diversity of access technology scenarios. However, the traditional terminal communication access network only focuses on the application of power distribution services. Therefore, in the newly developed services, the existing research lacks the analysis of the load adaptability of the terminal access network to these newly developed terminal services which limits the service scope supported by the future terminal communication access network. In addition to satisfying the end-to-end communication of the network, the terminal communication access network must also support end-to-end communication of various types of services. Different service types have different quality of service requirements, such as real-time services such as control services and video streaming services are sensitive to time delay and require high speed while state services and measurement information services can relatively tolerate longer time delay. Therefore, the ubiquitous service application carried by the terminal communication access network has research significance.

This template, modified in MS Word 2007 and saved as a “Word 97-2003 Document” for the PC, provides authors with most of the formatting specifications needed for preparing electronic versions of their papers. All standard paper components have been specified for three reasons: (1) ease of use when formatting individual papers, (2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and (3) conformity of style throughout a conference proceedings. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

  DOI: 10.25236/icbsis.2020.040

2. Evolution of Carrier Service in Terminal Communication Access network of Electric Power Industry

Under the background of the in-depth construction of smart grid, the number of substations and new energy power plants are showing an increasing trend, and the types and bandwidth requirements of power communication services are also undergoing great changes.

The services carried by the power communication network are developing from single service to multi-service and the service bandwidth tends to be more granular. The traditional 2M small particle service is developing to multi-granularity services such as high-definition conference and power consumption information collection, the bandwidth is expanding from 2M to high-bandwidth services (155M, GE, 2.5G, 10G and so on). The flow of services tends to be more diversified; the number of adjacent services is also increasing and the QoS level of services has also attracted much attention. At the same time, with the continuous construction of ultra-long-distance DC transmission lines, cross-regional and inter-provincial power communication services are increasing, and the safety and reliability requirements of the services are more stringent. With the full development of smart grid construction and the application of Internet of Things, the amount of data in the power industry has increased rapidly and has changed from TB to PB. Data sources are more diversified and data structures are more diversified.

3. Overall Architecture of Terminal Communication Access Network Carrying Multiple Services

The terminal communication access network is an extension of the backbone communication network. The boundary between the end of the backbone communication network and the terminal equipment is taken as the dividing point. Effective data transmission between the service master station and the terminal equipment cannot be achieved without the load of the access network. However, the characteristics of the access network, such as many bearer services, scattered distribution, and harsh environment, make it impossible to use a single technology to realize networking. Therefore, the access network needs to adopt a variety of communication technologies for networking design to form heterogeneous networks and solve the problem of carrying multiple services. At the same time, after the terminal equipment is connected to the access network, it needs to be connected with the backbone network to realize the information transmission and interaction between the terminal equipment and the background master station. The terminal communication access network access backbone network is mainly connected to the background master station through the local backbone network and the wireless public network. The overall architecture is shown in the figure.

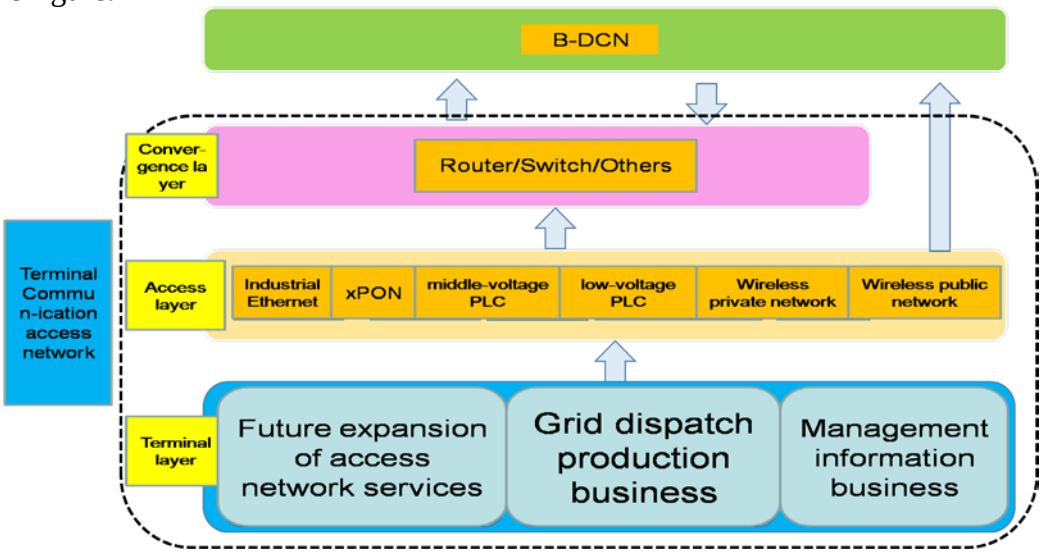

Fig.1. Overall Architecture of Terminal Access Network Technology

4. Establish Application Scenarios Suitable for the Terminal Communication Access Network to Carry Different Services

According to the characteristics of the power communication network, the services that can be carried by the power communication network access network are shown in the figure. The following application scenarios suitable for the terminal communication access network to carry different services are established for distribution automation services, video monitoring services and user electricity information collection services.

4.1 Establish a Communication Terminal Scenario for Distribution Automation Services

Distribution automation service is an important part of realizing intelligent distribution network. It is based on primary network frame and equipment, comprehensively utilizes various communication modes to realize monitoring and control of distribution system. It also realizes scientific management of distribution system through information integration with relevant application systems. The specific functions mainly include power distribution SCADA, data acquisition (support for hierarchical classification, call and test), status monitoring, remote control, human-computer interaction, anti-misoperation lockout, graphical display, event alarm, event sequence recording, accident recall, data statistics, report printing, online management of power distribution terminals and monitoring of power distribution communication network conditions. Interconnect with the upper level dispatching automation system (generally referred to as regional dispatching) and production management system (or grid GIS platform) to establish a complete distribution network topology model. Cooperate with power distribution terminals to realize fault identification, location, isolation and automatic restoration of power supply in non-fault areas. Implementation of power grid analysis application, model import/splicing, topology analysis, loop power flow solution, load transfer, state estimation, network reconfiguration, short-circuit current calculation, voltage/reactive power control, load forecasting and so on. Realize self-healing control of distribution network (including fast simulation, early warning analysis and so on.), economic optimization operation, interaction with other intelligent application systems, and other intelligent applications of distribution network.

Communication technologies applicable to distribution automation services include optical fiber xPON, PLC, industrial Ethernet, public network GPRS/CDMA/3G/4G, power wireless private network TD-LTE 230MHz, TD-LTE 1.8G, WSN and so on. The main equipment involved include all kinds of power distribution terminals, all kinds of information monitoring terminals deployed at power distribution automation service information monitoring points, heterogeneous communication terminals, access master-slave devices of all kinds of communication technologies, heterogeneous communication processors (heterogeneous communication gateways), transformer stations, power distribution master station systems and remote monitoring centers located at all levels of operation and maintenance control centers of smart grid. The technical structure of heterogeneous communication networking in the power distribution terminal scenario is shown in the following figure.

4.2 Set up Video Surveillance Communication Terminal Scenes

The video monitoring service mainly builds a video monitoring network, installs various video monitoring terminals at each information key node of the intelligent distribution power grid, monitors and monitors relevant data, parameters and images of each distribution power terminal equipment, and acquires video monitoring information to be able to understand and master the operation situation of the intelligent distribution power network in real time and directly, and to respond to the situation in time.

Communication technologies applicable to video monitoring service include optical fiber xPON, PLC, wireless public network 3G/4G, power wireless private network TD-LTE 1.8G, industrial Ethernet and so on which can transmit continuous video monitoring service data at high speed. The main equipment involved includes various video monitoring terminals, heterogeneous communication terminals, access master-slave devices of various communication technologies,

heterogeneous communication processors (heterogeneous communication gateways), transformer stations and remote monitoring centers located in various operation and maintenance control centers of the smart grid.

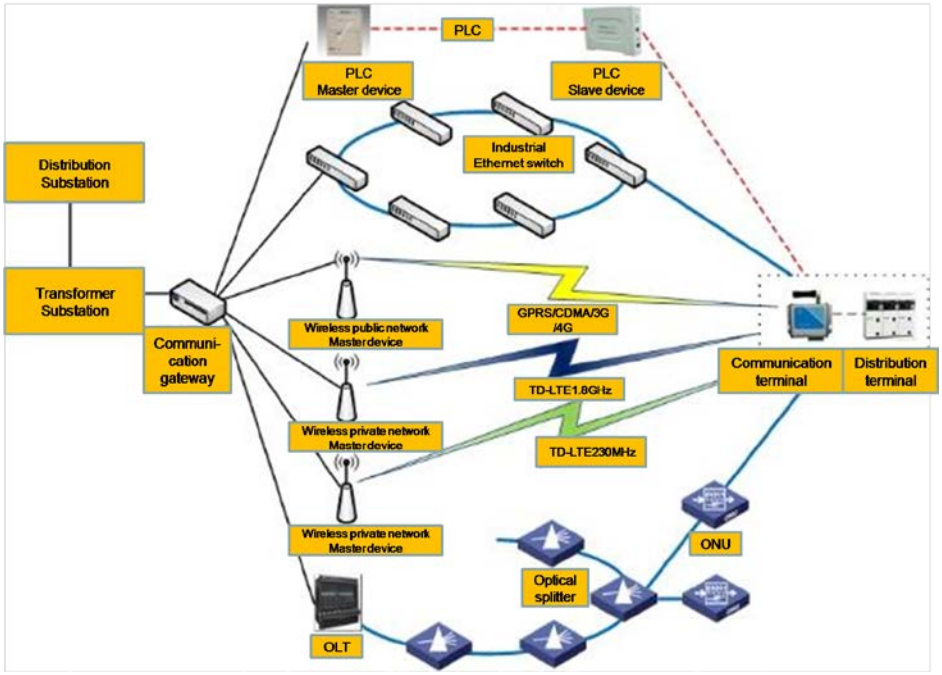

Fig.2. Technical Structure of Heterogeneous Communication Network in Power Distribution Terminal Scenario

4.3 Set up a Communication Terminal Scene for User Electricity Consumption Information Collection

The electricity consumption information collection service for users mainly includes the construction of a communication network for electricity consumption information collection, installation of smart meters, collectors, concentrators and other equipment, the collection targets are residential users, metering points of public distribution transformers, low-voltage single-phase and three-phase industrial and commercial users, etc. It mainly realizes the functions of power consumption information collection, user data analysis and data sharing. The specific functions include: real-time collection and processing of user power consumption information, user fee control, remote control of power consumption equipment, abnormal power consumption analysis, statistical analysis of power quality, management of power consumption collection equipment files, provision of collection data to marketing business management system and provision of data exchange services to other systems.

The communication technologies applicable to the user electricity information collection service include optical fiber xPON, PLC, public network GPRS/CDMA/3G/4G, power wireless private network TD-LTE 230MHz, TD-LTE 1.8G, WLAN, RS485 bus and so on. The main equipment involved include various types of electric energy meters represented by smart meters, collectors, concentrators, heterogeneous communication terminals, access main equipment of various communication technologies and remote power data management systems located at various levels of operation and maintenance control centers of smart grids.

5. Conclusion

There are many types of services supported by the access network and the demand difference is large. It is difficult to support a single communication mode. In practical application, multiple communication modes coexist in the access network. According to the ubiquitous service access requirements of the terminal communication access network in the power industry, the development trends of various services are summarized, different application scenarios are established for unused

services, the ubiquitous service access application scenarios of the terminal communication access network are studied, the overall architecture of the multi-service terminal communication access network is constructed, heterogeneous networks are formed and the bearing problem of multiple services is effectively solved.

References

[1] Zhao Bingzhen, Li Weiliang, Wang Yirong, et al. Construction of Terminal Communication Access Network[J]. Power System Communications , 2011, 32(5): 89-942.

[2] Zhao Bingzhen, Li Weiliang, Wang Yirong, et al. Construction of Terminal Communication Access Network[J]. Power System Communications , 2011, 32(5): 89-94.

[3] Meng Lingli, Wang Wei, Wang Wei, et al. Application of Analytic Hierarchy Process in Terminal Communication Access Network[J]. ELECTRICAL APPLICATIONS, 2015(S2):615-618.

[4] MA Ping, SHI Chen-xia, YU Zhao-hui. Discussion on Construction and Maintenance Management Mode of Power Communication Terminal.

[5]Access Network[J]. Electric Power Information and Communication Technology, 2014(5): 132-135.

[6] LU Wei, ZHOU Wei. Research on Risk Analysis and Security Access Technology of Power Terminal Communication Access Network[J]. Communication Technology, 2017(9).

[7] Hu Yang, Ding Chenyang, Jiang Suming. Analysis of Channel Security Technology for Power Terminal Communication Access Network[J]. Communications, 2016(20).

[8] Yu Xijun, Cui Weiguo, Zhong Wentao. Design of Communication Access Architecture for Power Terminals under Smart Grid[J]. China New Communications, 2015, 17(21): 124-124.

[9] Meng Fanbo, Zhao Hongwei, Wang Jie. Research on the Construction of Power Terminal Communication Access Network[J]. Power System Communications, 2012, 33(6).

[10]Jiang Wei. Research on the Construction of Terminal Communication Public Access Platform[J]. , Grid, 2017(4).

[11] Liao Qinwu. Research on Public Access Platform of Terminal Communication Access Network[J]. Electric Power Information and Communication Technology, 2016(11):93-97.

[12] Sun Yuanyuan. Research and application of communication access network technology in smart grid [D]. 2016.