

The Power Communication Access Application of Radio Over PON

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Abstract. This paper describes the demand of wireless communication technology from the perspective of development trend of electric power communication construction. And then this paper describes the advantages and disadvantages of micro base station and macro base station. At last, this paper put forward the communication access method on radio over PON, which is based on the Ethernet passive optical network technology and wireless communication technology. The technology of Radio-over-PON reasonably balance the the communication efficiency, flexibility and security of the power communication access network.

Introduction

With smart grid construction vigorously promote, optical fiber coverage rate has been greatly improved in the field of electric power communication. Ethernet passive optical network (EPON) technology has lots of advantage especially in power distribution communication system[1], such as the diversity of its network topology, high rate, large-scale application in IP service, mature terminal equipment and low networking cost. But the power fiber laying cost is very high.

Wireless communication technology is widely used for large of terminals flexible accessing[2], and micro base station technology has the advantages of small size, convenient installation, short cable and low loss. It is very suitable for the wide area coverage of urban area, such as indoor, deep coverage and less capacity requirements of rural areas, towns, roads. And micro base station technology can also greatly shorten the construction time, and reduce construction costs.

The technology of Radio-over-PON is the integration of micro base station wireless technology and EPON Technology. Therefore, it not only can compensate the disadvantage of the inconvenient to maintain for the micro base station , but also can improve the flexibility of Ethernet passive optical network (EPON) technology.

Power chain topology for EPON

EPON is general based on a tree topology to consist of an Optical Line Terminal (OLT), fiber splitter, and Optical Network Units (ONUs)[3]. But due to the chain topology of Power transmission, the EPON's application in power communication network also is chain topology, as shown in Fig. 1. As to improve the reliability of EPON system in power distribution network, . It can strongly support the construction of Unified Strong Smart Grid.

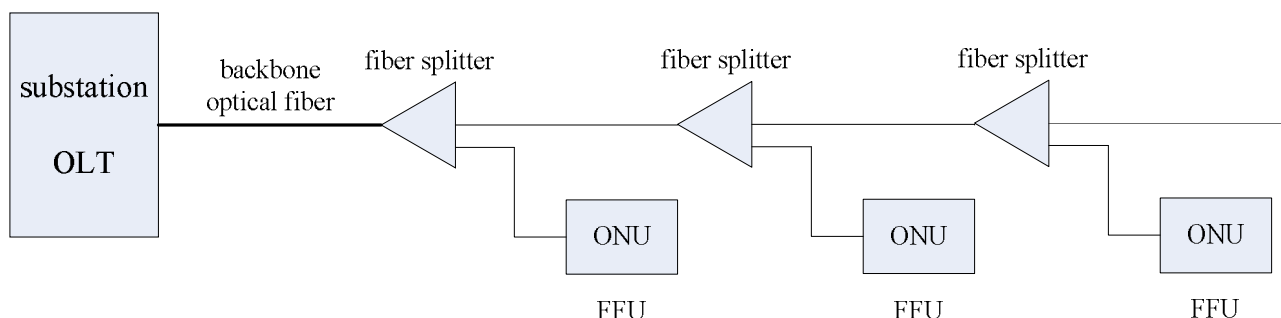


Fig. 1 power chain topology for EPON

Maybe there is only one transformer somewhere in power distribution communication network. As to support communication with the transformer, we must lay one optical fiber to the transformer. Many optical fiber core idle. So some last mile access is not suitable for EPON in power distribution communication network.

Power communication wireless access

At present, in power communication access network, the wireless communication technology mainly includes 230MHz transmission radio, TD-LTE, micro power wireless, wireless public network and so on.

Especially, Power LTE230 system is the fourth generation mobile communication network architecture based on the entire IP data transmission network. It takes into account the frequency spectrum of the 230MHz band, and the characteristics of the use of the spectrum of the 230MHz spectrum, the new definition of the physical layer protocol. The system can meet the needs of users, has the advantages of strong coverage, low cost, convenient operation and maintenance, safe and reliable, small time delay and fast response. As shown in Fig. 2, power LTE230 has been applied in the distribution network automation, load management and electricity information collection and other business.

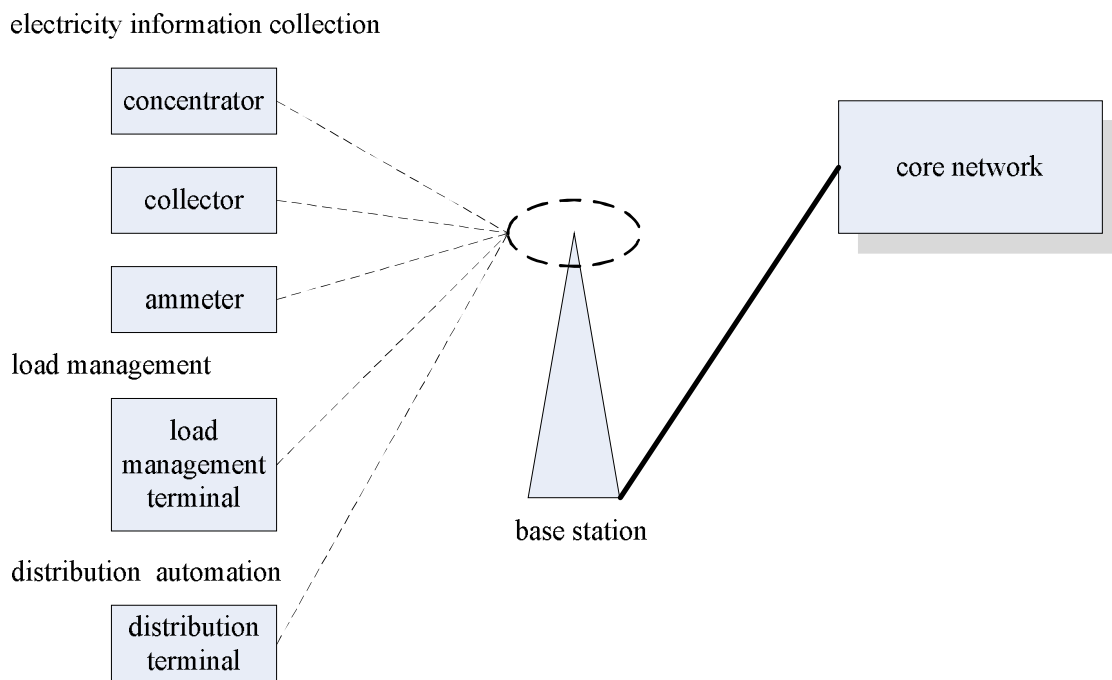


Fig. 2 power LTE230 system architecture

In power system, WiMAX technology has been successfully applied to electric power emergency command, power mobile office, power line inspection, and other systems. However, due to the WiMAX in 2-11 GHz band, its diffraction ability and anti occlusion is poor. So WiMAX technology is mainly used in relatively flat terrain open area in power automation system

There are also many applications of wireless public network communication in power communication access network. Electrical terminal device access to the wireless public network through the wireless communication module, and then access to the master system through the optical fiber special network. At present wireless public network communication mainly includes such as GPRS, CDMA and 3G. Wireless public network technology has the characteristics of no need to apply for a special wireless network band, low construction cost and convenient maintenance, which is very suitable to be applied for the electrical automation business with no high real-time requirements in wireless public network covering the complete and excellent signal wireless city.

But the information security of power communication wireless access is not good. So we spend a lot of resources to establish a wireless network protection system, as shown in Fig.3.

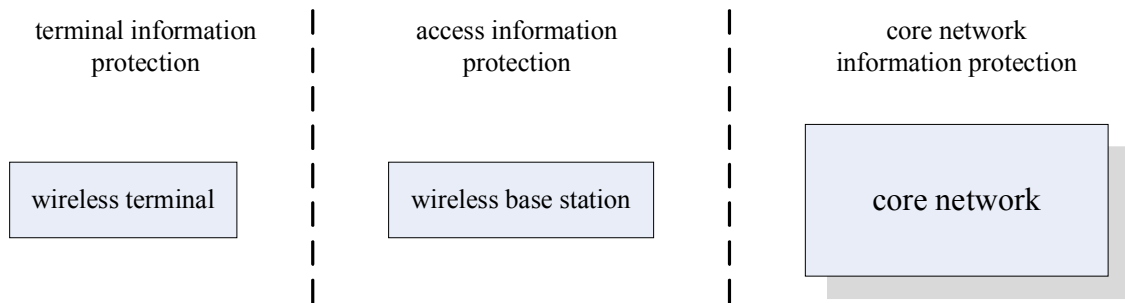


Fig. 3 information security of power communication wireless access

Comparison between micro base station and macro base station

Macro base station generally has a dedicated frame, can provide large accessing capacity and has strong coverage ability. But the cost of macro base station equipment is more expensive. Macro base station also need especial room. Installation and construction of macro base station is more troublesome. At last, macro base station is lack of flexibility, which is not easy to move. So macro base station is quite suitable for city wide area coverage and dense urban areas coverage.

Micro base station can be seen as a miniature of the base station. The micro base station device is concentrated in a relatively small box, which can be easily installed. Micro base station can be installed nearby in the vicinity of the antenna, such as the top of the tower and roof directly using the jumper transmitted signals connected to the antenna terminal, which need shorter feeder cable and less signal consumption[4][5].

Communication Access on Radio Over PON

As to reasonably balance the the communication efficiency, flexibility and security of the power communication access network, this paper put forward the communication access method on radio over PON, as shown in Fig.4.

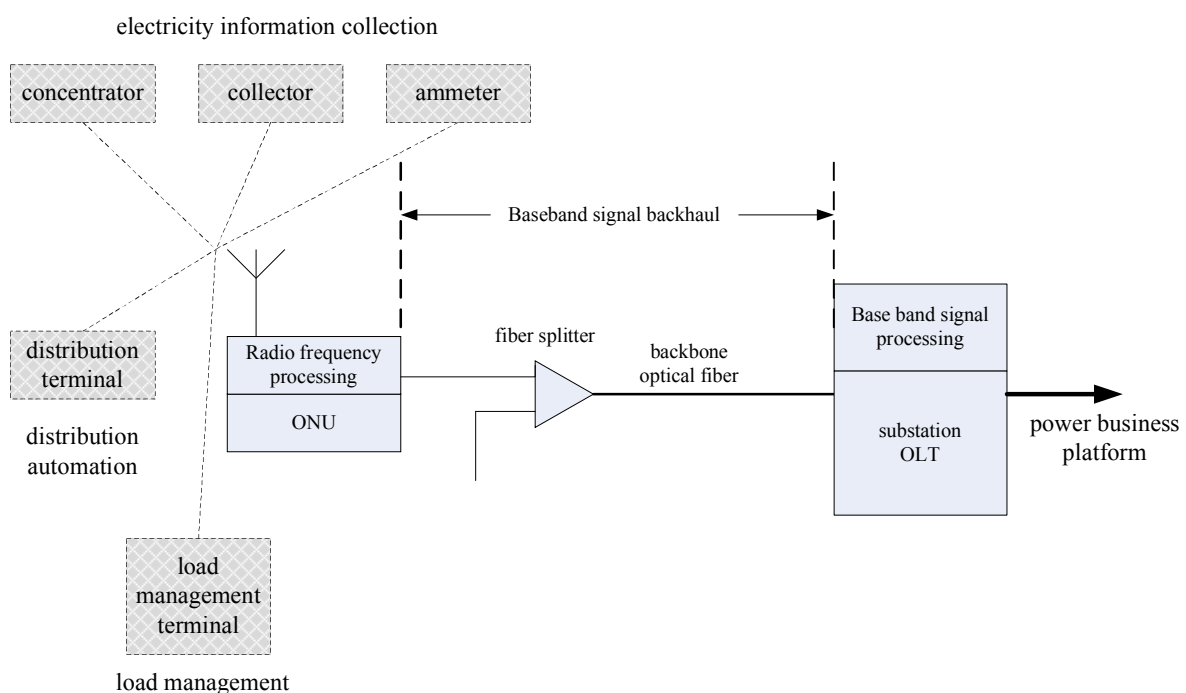


Fig. 4 Communication Access on Radio Over PON

The wireless RF processing unit is integrated with the ONU as the one module. And then the base band signal from the radio frequency processing unit transmit to OLT through the EPON system , which is deployed in the substation. OLT integrated base band signal processing unit, which can convert the base band signal into IP packet and sent to business background. ONU and wireless RF processing unit is in the presence of a micro base station, which can be flexible deployment, and cover the large of terminals' area , and complete communication access of the last one kilometer.

The communication architecture proposed in this paper has the following advantages:

1.The construction of micro base station need not occupy arable land, which is in line with the national land policy and which reduce the construction cost.

2.The security of electric power information should be greatly ensure, because data transmission over backbone optical fiber.

3.This electric power communication architecture proposed in this paper support for multi-service integration, which would improve the utilization rate of power communication assets.

Summary

This paper proposed one novel communication architecture, and the specific design still need further study. The data bandwidth, transmission delay and clock synchronization in this communication architecture should be meet the requirement of electric power business, which is of most concern in electric power system.

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