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Reliability and Cost Performance Ratio Analysis on EPON Protection Networking of Power Distribution Communication Network Access Layer

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Keywords: Availability; Power Distribution Automation; Ethernet Passive Optical Network (EPON); Protection Networking; Reliability; Cost Performance Ratio

Abstract. Based on the reliability theory of power communication network, reliability analytic methods arc proposed for Ethernet passive optical network (EPON) protection networking of the power distribution communication access layer. By using the system availability theory the reliability and cost of EPON protection networking arc quantitatively analyzed for the access layer of four kinds of power distribution communication network, i. c., tree-type network of single power supply redundancy protection, hand-in-hand network of whole chain protection, dual-power dual-T network of full link protection, and ring-type protection network. The optimal networking solutions arc discussed and summed up for the EPON protection networking schemes of power distribution communication network in current operation.

Introduction

Distribution communication network is the intelligent distribution automation system is an important component of its reliability is to determine the distribution automation system reliability critical factor is to ensure power quality and security and stability operations, network performance evaluation and management level of an important indicator of construction and development of the smart grid is to achieve an important basis.

This paper studies the distribution communication network access layer, the actual project is mainly the access layer Ethernet Passive Optical Network (EPON) access. EPON technology uses a multipoint passive optical network structure alignment and clients to connect the central office, the international standard IEEE 802.3ah was published in 2004, its solutions and the corresponding products are becoming increasingly sophisticated. EPO is based on redundancy protection networking technology based on the EPO to improve network reliability and proposed new technologies. EPO significantly superior protection network, can greatly enhance the reliability of the network has been basically communication network access layer to adapt power distribution reliability requirements, will become the mainstream distribution of networking communications access networks. However, EPON protection and its networking technology is still in its infancy, however there are many scholars the means to achieve propose a solution, in practice there are still many problems to be solved, such as the reliability of the measurement, reliability and cost balance problems.

Power Distribution Network Access Layer Network Mode EPON Protection

With EPON technology continues to mature, multi-use distribution network communication system EPON networking technology. Since the special needs of distribution network reliability, redundancy protection currently EPON network communication technology in the power distribution network of the new project has been started. EPON network redundancy protection, although it will increase the cost of the network, but in order to improve network reliability, EPON redundancy protection has become a distribution network communications network future trends. This paper studies the EPON system for power distribution communication with redundancy protection function of the more complex forms of networking.

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According protected form, EPON business protection can be divided into trunk fiber (OFM) protection, dual passive optical network (PON) for OFM protection, full protection and hybrid fiber protection and other protective network forms. OFM protection costs are lower, OLT to a splitter to achieve redundancy, which can be avoided under OFM into a piece of business lost, but after switching fiber, ONU need to re- initialize the distance and other parameters. To solve this problem, there has a double protection of PON OFM, OFM connected to the same OLT, PON port 2, so that the ONU in the same device without re-initialization. But the OFM protection from double PON optical splitter to ONU -side optical fiber is not protected and therefore appeared full fiber protection scheme that switchover without re- ranging, businesses can recover within 50 ms, but its construction cost is slightly higher. Mix in the other three kinds of protection based on the hybrid network protection with low construction costs.

Distribution communications network EPON access layer used to protect network communications network practical engineering structures include : single power supply redundancy protection tree network, the whole chain protecting hand in hand nets, full link protection dual power double T network and ring network protection.

Single Supply Redundancy tree network is a multi- stage 1: N splitter network sharing (POS) connected to the tree structure, and the topology shown in Figure 1. Figure : OFB indicates slip fiber ; subscript 1 indicates normal communication link ; subscript 2 indicates communication link redundancy protection. With electronic stop in place OLT, through the OLT PON port 2 are connected to two splitters, each forming redundancy protection, each three way splitter to connect staggered ONU, in order to achieve overall communications network redundancy protection.

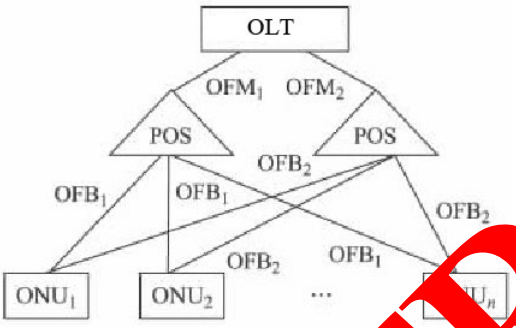

Fig. 1. Tree-type network of single redundancy protection power supply

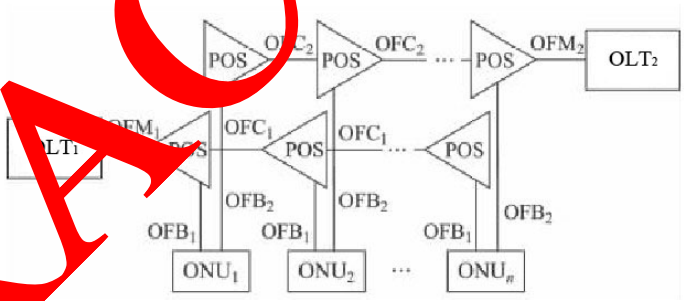

Fig. 2. Hand-unhand network of whole chain protection

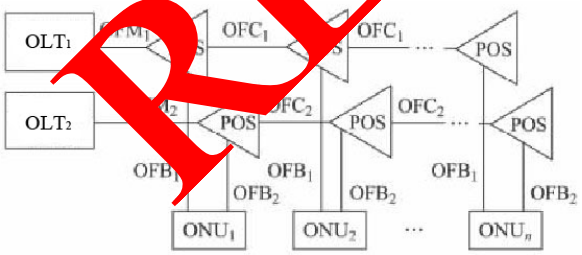

Fig.3. Dual-power dual-T network of full link protection

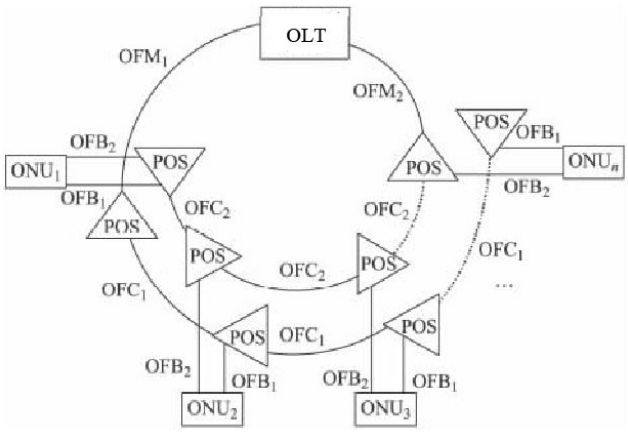

Fig.4. Ring-type protection network

Hand in hand full chain protection ring network topology shown in Figure 2. The network structure respectively, in two stations with electronic placement OLT, the direction of light through two cascaded using a 1:2 splitter extension, each ONU PON uplink port to achieve through dual link "1 +1" redundancy I protected. Figure: OFC said optical splitter network, the subscript 1 and 2 represent the same meaning as in Figure 1.

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Full link protection dual power double T network topology is shown in Figure 3. Placed in the same site two OLT (or a piece of equipment 2 PON port), in accordance with the structure of the double T-shaped cable network, ONU equipment, two uplink ports are connected to the OLT belong to two splitter. This topology hand in hand with the whole chain protection OLT topology difference is consistent with the direction of the light and the device location and equipment, laying the same state.

Ring protection network topology shown in Figure 4. OL with electronic station through two PON ports into the direction of light from two different access n-ONU with dual optical interface devices to achieve the ONU and the OLT between the "1 +1" link protection. Suppose when the ONU equipment branch fiber break, ONU device PON port ONU equipment damage or power outage, during which all ONU devices can still communicate properly. But radiation large area distribution network, fiber resources are relatively small and difficult to form a ring network. This article only for comparative analysis.

The Power Distribution Network EPON Protection Network Reliability Analysis

In any network, the network component can be used to describe the basic concept of reliability. Reliability is a change with time and is used to describe the component or system is not the probability of failure state. In the communications network EPON access layer networking environment, in addition to outside of the fiber length, are using the same network elements, which also compared this analysis study provides a unified standard. In this paper, system reliability and availability analysis theory analysis methods measure the reliability of network analysis.

EPON system is the main fiber-optic communication physical medium, according to the literature, a centralized distribution subnet average length of cable distribution is as follows: OFM is 20 km, OFB is 0.5 km, OFC is 0.2 km. Communication subnet distribution used in reference to a centralized distribution of the average length of a cable and engineering products used, the failure rate by the general optical communications, network elements calculate the availability of fiber, as shown in Table 1.

Table 1 Network component failure rates and availability

Element	λ_{MTBF} / h	λ_{MTTR} / h	Reliability
OTL	87[illegible]0	4	0.9999500
ONU	17520[illegible]	2	0.9999800
Optical splitter	5714286	12	0.9998518
Optical fiber	[illegible]00000	6	0.9999979

General EPON equipment in each PON port is 20 km of fiber length, the only connection 32 ONU (PON standards by the light intensity and the various manufacturers PON chip decision). This article references the actual situation of power distribution network engineering communications, communication network set up for each distribution sub-station communication system connecting EPON ONU units 10, 20 respectively, the reference ONU nodes: 5,10,10 were taken as the reference node for availability of comparative analysis. Four kinds of networking, more complex network protection from the OLT to the ONU-side network availability, calculated results are shown in Table 2, the visual comparison of the histogram in Figure 5. In the drawings: networking 1-4 correspond to single-supply redundancy protection tree network, the whole chain protecting hand in hand nets, dual power full link protection and circular double-T network protection network (the same below).

Table 2 EPON protection network availability of power distribution communication network access layer

Networking mode	Different number of ONU's availability		
	10	20	30
Single power supply redundancy protection tree network	0.9999299136	0.9999299136	0.9999299136
The chain type protection net, hand in hand	0.9997994729	0.9997978388	0.9997957663
All link protection double power supply a double T network	0.9997995703	0.9997981458	0.9997981458
Ring net	0.9997495534	0.9997459948	0.9997459948

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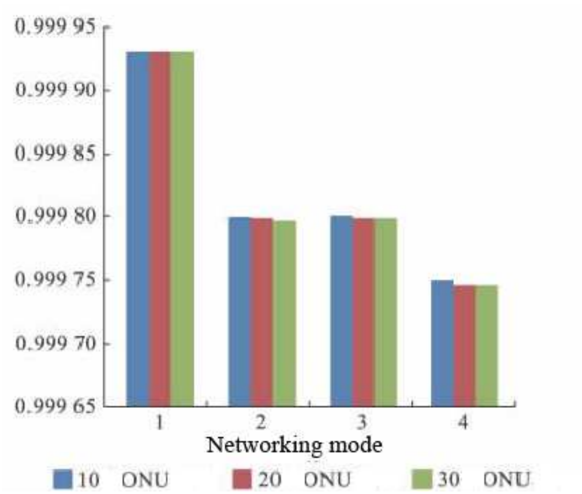

Fig.5 FPON protection network availability comparison of power distribution communication network access layer

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Conclusion

In this paper, system reliability and availability analysis theory as a measure of the reliability of the distribution of several commonly used communication network access layer networking EPON redundancy protection for comparative analysis of reliability, and networking for various protection the cost analysis, the construction of the various networking options recommendations. I hope this EPON network redundancy protection quantitative reliability and cost analysis conclusion, for the distribution EPO communication network access layer network protection engineering design and renovation project design has a certain reference value.

References

[1] LUO Pengcheng, JIN Uuang, ZH... Jinglu, et al. Research summary of communication network reliability[J]. Small Micro computer System, 2000，21(10):1073-1077.

[2] YANU Xu. Application analysis of EPON technology in the intelligent distribution network communications of Guangdong power grid[J]. Study on Optical Communications, 2011(5):16-18.

[3] ROBERT I. ...E, DILEEPAX...A R S, VARY U B. A view of reliability and quality measurements for telecommunications systems[J]. IEEE Journal on Selected Areas in Communications, 1990, 8(2) : 219-223.

[4] LI ..., MA ...ghong, WAND Yirong. EPON protection architecture and its cost performance analysis [J]. Optical Communications Technology, 2010(3):40-43.

[5] Information on http://www.weld.labs.gov.cn