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A NETWORK MANAGEMENT SYSTEM FOR EPON BASED ON SNMP

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ABSTRACT

Now, the PON technologies become the preferred broadband access technology all over the world. In this paper, a network management system is designed for EPON. In Manager and Agent, the "simple and shortcut" protocol SNMP is adopted to develop the application program. As the Agent runs on the embedded system, protocol choice and database design are critical to the system. The paper focuses on the structural characteristics of the agent side, and achieves network communications management of agent side. Finally, the system is tested on the development board, and achieves better results. The system is real-time, timely capture of the trap, protect EPON network running well.

Keywords: *EPON, Network Management, SNMP, Agent, Trap*

1. INTRODUCTION

In recent years, the global raise a big wave of broadband speed, FTTx access become mainstream, and grow rapidly. Ovum's research report shows that in 2009, FTTx occupies 11% of the broadband connection, and is expected to reach 29% by 2016. China will become the fastest growing country using the FTTx, and is expected in 2016 50% of FTTx subscribers from China, while in 2009 the figure was 20% [1].

Now PON technologies become the hot broadband access technology all over the world. In this stage, 10G EPON has become the first choice of the broadband technology evolution. In China, China Telecom has made clear direction of the development of the 10G EPON. Rate demands more than 20M directly select 10G EPON. Network management is an integral part of modern communication system; it is an important guarantee to provide high stability and high-quality service for the system.

As the Agent runs on the embedded system, protocol choice and database design are critical to the real time and robustness of system. The system selects the embedded Linux systems to develop. Database MIB selects embedded database system BDB, which was developed by Berkeley University. The BDB not only saves the storage space, enhance query efficiency, but makes the design of program simple.

2. EPON TECHNOLOGY AND SNMP PROTOCOL

2.1 EPON Structure and Principle

EPON is the abbreviation of Passive Optical Network Based over Ethernet. At the same time, it is a new access network technology adopting point-to-multipoint topology structures, using optical fibers and optical passive devices for transmission to provide various services on Ethernet [2].

EPON is a point-to-multipoint system which is comprised of OLT (Optical Line Terminal), ONU (Optical Network Unit) and ODN (Optical Distribution Network). The downlink (from OLT to ONU) adopts the way of broadcasting, in this way, every ONU will receive all the information from downlink and extract the useful signal according to their MAC addresses; the uplink (from ONU to OLT) uses time-division mode to share system, and each ONU can be accessed through accessing to the control mechanisms[3]. The information rates of uplink and downlink both are 1.25 Gb/s, and using a single fiber with WDM makes the full-duplex communication come true. The EPON structure is as figure 1.

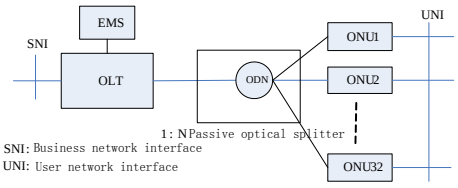

Figure 1: EPON Structure

OLT is placed in the center of the system, distribute and control the connectivity of

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information channels, so it plays a function of real-time monitoring, management and maintenance functions. ONU is placed on the user side and connect with OLT through passive optical/splitter. EPON can deal with the bi-directional signaling transmission at the same time using WDM technology [4, 5]. The signals in uplink and downlink have different wavelengths, but transmit in the same fiber. EPON just make the necessary changes in the Ethernet frame format of IEEE802.3, for example, adding Time Stamp, LLID (Logic Link Identification) and so on. The Downlink principle is as figure 2.

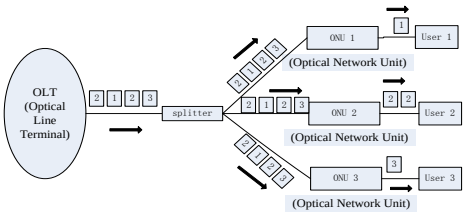

Figure 2: Downlink Principle

2.2 The Choice of Network Management Protocol

In the selection of network management protocol, SNMP protocol is the most suitable choice of the system. First of all, SNMP is common and mature internet management protocol at present and supported by majority of vendors. Running on the network, there won't be any incompatibly problems. Secondly, EPON uses P2MP logical topology which is very suitable for SNMP manager/agent architecture. Thirdly, the Ethernet frame structure of EPON is based on IP, and SNMP is built on the base of TCP/IP network at the beginning. This provides a good support for variety of IP-based business management in EPON [6].

Figure 3 Describes the SNMP protocol environment. GetRequest, GetNextRequests and SetRequest issued three categories of SNMP management applications from the management station [7]. 3 messages are responded by proxy with GetResponse message, the message was handed over to the management application. In addition, the agent can be issued Trap news, events report to the managers of MIB and management resources.

SNMP rely on UDP and UDP is a connectionless type protocol, SNMP is connectionless type protocol too. Online connection between the management station and the agent does not need. Each exchange between the management and agent station is an independent transmission.

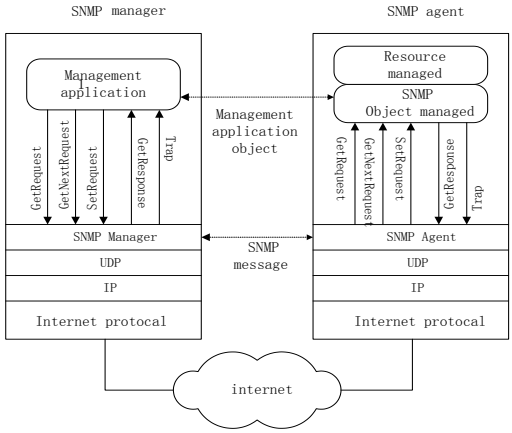

Figure 3: SNMP Protocol Environment

3. THE DESIGN OF EPON AGENT

3.1 The Overall Structure Block

According to the needs of EPON system, Figure 4 shows the overall structure of EPON network element management system.

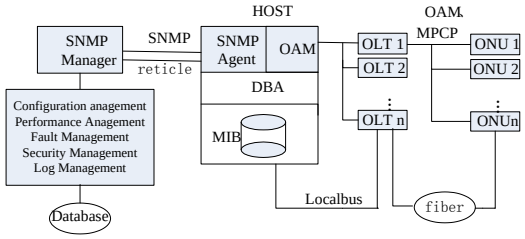

Figure 4: Structure of management system

The figure shows that on the hardware level, EMS management end communicates with agent application HOST through network cable, Localbus connect HOST and OLT together, and the transmission between OLT and ONU is through the optical fiber. On the software level, the management station and the HOST keep protocol communication through the application layer SNMP. SNMP Manager Program is running in the management station and HOST includes SNMP Agent program, OAM client program and the DBA program, also contains the MIB database through which data can be exchanged between the three programs. HOST is a software carrier based on OLT. OLT and ONU keep communications through the link layer OAM protocol and MPCP protocol. HOST can drive multiple OLT and each OLT can connect a number of ONU.

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3.2 The Agent Framework

3.2.1 Introduction to OAM layer

Ethernet as a second layer of the OSI protocol needs to have the ability to monitor network performance in the second layer, and traditional IP/ SNMP management is not competent operational management and maintenance of function. IEEE802.3 committee formulate OAM standard to in new Ethernet access standard 802.3ah. The OAM can monitor the network, detect the cause of the error and can help operators effectively manage the network [8, 9].

The EFM OAM defines the three main events: the OAM link monitoring, error alarm, remote loopback [10]. The link monitoring defines the basic run error used for the site detects an error occurs or deterioration link; error alarms provides a series of mechanisms for local site reports the remote site local error; remote loopback allows a site the remote site is set to loopback state.

3.2.2 The agent workflow

The agent OLT system was commissioned agents, on the one hand, and the management station to respond to the request of the management station, and send traps to a management station when the event is generated by the SNMP protocol communication. On the other hand, by the OAM protocol communication and ONU. By the conversion between SNMPDU and OAMPDU, control management ONU equipment, and receives the ONU transmission over the event notification and serious error. Figure 5 shows the workflow of agent.

Agent client software includes SNMP Agent, OAM Client and dynamic bandwidth allocation procedures DBA. Dynamic bandwidth allocation can be little cost-sharing system bandwidth, broadband integrated services access. EPON dynamic bandwidth allocation target is fair and efficient allocation of the system bandwidth to each ONU and various businesses. The software running on the embedded operating system, used to OLT and ONU management control of the operating system to use the self-development of embedded Linux system. The host processor (Host CPU) uses AT91ARM9200 chips.

SNMP protocol frame is transmitted on the UDP161, 162 port. Agent side and the management side communication, the agent with the well-known port 161 to receive a get or set the message and send a response to the response message (this port communication management end the use of temporary port). From the top-down process: when the agent end receive SNMPDU frame, first verify the Community. Community here has played the role of certification services, the management station to agent message contains a Community, if verified, that the source is reliable. Then to resolve the SNMPDU package, if it is to get the frame, directly view the MIB database return RESPONSEPDU frame to manage end parsed view the priority of the parameters set frame, if it is urgent data is written to the MIB library and call notification function to notify the OAM sublayer also generate RESPONSEPDU frame to manage end. From the bottom-up process: If the following alarm events, OAM call notification function to notify the SNMP Agent, Agent constructor TrapPDU, and sent to the management end of the well-known port 162 port, management-side after the police received information analysis and processing.

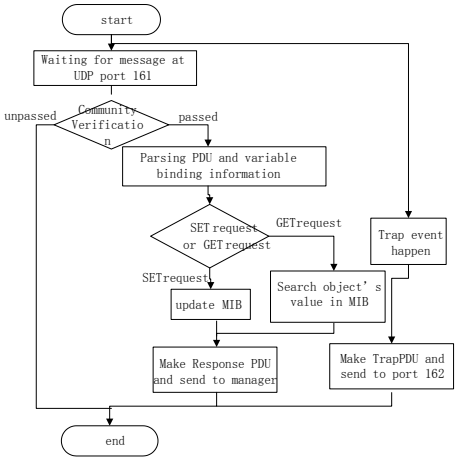

Figure 5: Agent Workflow

4. THE DESIGN OF MIB DATABASE

MIB is a collection of all the managed objects in a network data structure, the only object in the MIB is the SNMP managed [11]. So the MIB library of design is an important part of the network element management. Database MIB selects embedded database system BDB, which was developed by Berkeley University.

First user-specific management information, write to standard MIB files, these MIB is privately held MIB, should be placed in the corresponding enterprises subtree (1.3.6.1.4.1), in order to separate MIB and other enterprises, must use a unique identifier (application) can go to the website, said the enterprise MIB information group.

MIB library of the system includes system information (OLT, ONU), port, VLAN, Trap information content. Agent side programming is the

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OID MIB library object programming. Listed below is a small part of the MIB library. Table 1 includes tables in the MIB database. Table 2 is express table.

Table 1 : Table Parameters

Name	Function	Type	RFC
system	Host device info.	private	RFC1213
onu_info	Onu info.(including ID, version etc)	private	RFC1213
onu_port	Port flow info.(including count of receive and send byte, count of error byte etc)	private	RFC1213
vlan	Virtual local area network	private	RFC1213
trap	Trap alarm info.	private	RFC1213
dba	Dynamic bandwidth allocation	private	RFC1213

The information in the system tables, including system name, contact, location, system uptime, the firmware version. ONU_Port table defines traffic information of each ONU port.

Table 2: Table Parameters

OID	Data type	limits
x.1.1	DisplayString	RW
x.1.2	DisplayString	RW
x.1.3	DisplayString	RW
x.1.4	DisplayString	RW
x.1.5	INTEGER	RW
x.1.8	TimeTicks	RO

MIB table object includes single variables and table variables. Table 2 is an example of single variable. Table ONU_Port is table variables. ONU_Port table tree structure is as follows:

ONU_Port
.1.3.6.1.4.1.2021.3
|---- pNumber
.1.3.6.1.4.1.2021.3.1
+---- opTable
.1.3.6.1.4.1.2021.3.2
+---- opEntry .1.3.6.1.4.1.2021.3.2.1
|---- opIndex .1.3.6.1.4.1.2021.3.2.1.1
|---- upRecBytes .1.3.6.1.4.1.2021.3.2.1.2
|---- opFCSError .1.3.6.1.4.1.2021.3.2.1.8
|---- opHECError .1.3.6.1.4.1.2021.3.2.1.9

5. ACHIEVING RESULTS

5.1 Snmpset Function

The old value “system_syslogsize” from MIB library is stored in the variable old_intval. Key and data are DBT type, and the new value is assigned to data field of structure variable. Lastly BDB interface write_DB is called to write a new value in MIB library. Figure 6 shows the function SET. Using snmpset command can change the value of an object.

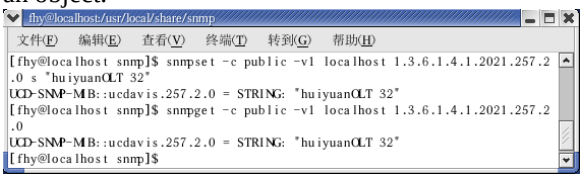

Figure 6: Snmpset Results

5.2 Trap Function

In Agent MIB library specific value change or a specific value exceeds threshold snmptrap is sent [12]. So in Linux executive snmpset instruction to OID 1.3.6.1.4.1.2021.260.8.0, it will automatically generate a trap event. In Figure 7 shows that snmpset operation when modifying the OID value of 1.3.6.1.4.1.2021.260.8.0 produce trap. From the graph, we can see trap information is "onu 10 is shut down".

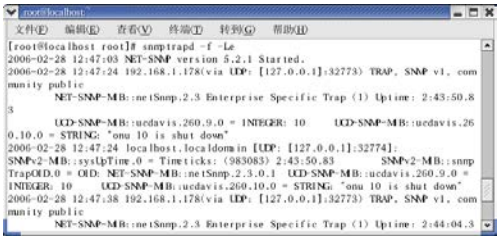

Figure 7: Snmptrap Results

6. CONCLUSION

Network management is an integral part of modern communication system; it is an important guarantee to provide high stability and high-quality service for the system. Based on EPON, in the specific needs of the system, the paper designs the applicable SNMP network management solutions. In the system agent side runs in embedded systems, this article focuses on the research of agent side, and as agent works on the embedded systems, there designs a small database. In the last part of the paper the communication function of the agent side is tested, the system can effectively manage the entire system. It not only improves the robustness of the system, but also supports the dynamic expansion of the system.

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REFERENCES:

[1] WU Guo-dong, ZHAO Xiu-ming, "Typical Scheme for Intelligent Community PFTTH Networking Based on EPON Technology", *East China Electric Power*. Vol. 40, No. 7, 2012, pp. 1196-1198.

[2] Sun Wenyan, Guan Shaopeng, Wang Bin, Wang Yuling, "Upstream Synchronization and Simulation of EPON", *JDCTA*, Vol. 5, No. 6, 2011, pp. 24 ~ 29.

[3] Gang Wang, Tianshu Huang, Zenggang Xiong, Yaogai Hu, "EPON Upstream Capacity Sharing with Auction Mechanism", *JCIT*, Vol. 7, No. 2, 2012, pp. 108 ~ 115.

[4] IEEE 802.3ah EFM, Draft D3.1 of IEEE P802.3ah, IEEE 802.3ah Ethernet in the First Mile Task Force Draft Documents, Fub 2004.

[5] http://www.ieee802.org/

[6] Yang-Guangchi, Lei-Lei, "EPON Technology and Application", *Network and Application*, May, 2010, pp. 35-38.

[7] Pengshou Xie, Zhiyuan RUI, Jie CAO, "A Software System Infrastructure and Integrated Service Implementation Model of Manufacturing Integrated Service Platform", *JCIT*, Vol. 7, No. 9, 2012, pp. 136 ~ 146.

[8] Zhang hao, Pu Xiande. "Application of EPON Technology in Power Fonsumption Information Collection System", *Telecommunications for Electric Power System*, Vol. 31, No. 213, 2010, pp. 42-45

[9] Kong Fanxi, Wang Shengda, "Comparison Analysis of EPON and GPON Techniques on Medium-Low Voltage Communication Access Network", *Telecommunications for Electric Power System*, Vol. 33, No. 232, 2012, pp. 30-32.

[10] G. Kramer, B. Mukherjee, and G.Pesavento, "Ethernet PON (ePON): Design and Analysis of an Optical Access Network, Photonic", *Network Communications*, Vol. 3, No. 3, 2001, pp. 307–319.

[11] Wang Huizhong, Zhang Qixia, "Application of WiMAX and EPON Convergence Access Network in Power Communication", *Electrical Automation*, Vol. 34, No. 1, 2012, pp. 77-79.

[12] Tian Xiaoyan, "Network Design Based on EPON Technology for Villas", *Electrical Technology of Intelligent Buildings*, Vol. 6, No. 3, 2012, pp. 80-83.