Implementation of network management software for HINOC

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Abstract

HINOC (High performance Network Over Coax) is Coaxial cable access technology with independent intellectual property rights in China. In the structure of network management software, network topology discovery and maintenance plays an important role in the system. By analysing the traditional algorithms of topology discovery, this paper introduces an algorithm based on SNMP trap and polling. On the basis of test results, the algorithm which has been implemented in HINOC proved to be reliable, efficient and with low-burden.

Keywords: network management, topology management, HINOC, SNMP

1 Introduction

These HINOC (High performance Network Over Coax) is the transport solution to network access between fibre-optic network and home network. It is acknowledged that making use of cable TV network is a good broadband access technology. On one hand, cable TV network has the characteristics of a large covered range and low cost so that we can use the cable television networks as access network to avoid the negative impact of home construction. On the other hand, coaxial cable has good transmission characteristics, such as large capacity and high quality of transmission [1].

The structure of HINOC is shown in Figure 1. It consists of HB (HINOC Bridge) as bridge device and HM (HINOC Modem) as terminal equipment. HB is connected with optic equipment. It can transmit data as the only interface of optic equipment. Meanwhile it can be used as a control node to monitor HM. HM connects with HB through coaxial cable inside the building, and the other end of HM connects with the terminal devices such as television and computer [1].

This paper introduces topology management in the network management software (NMS) of HINOC. The NMS is based on SNMP (Simple Network Management Protocol) and running on the network manager. The remaining of this paper is organized as follows: in Section 2 we will give an overview of the NMS. Algorithm of Topology Management will be illustrated in Section 3. Section 4 presents the experiment results. Finally, conclusion will be given in Section 5.

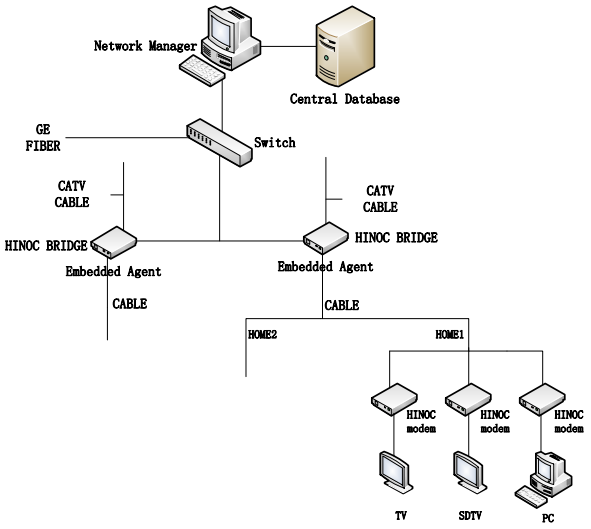

FIGURE 1 HINOC network scenario

2 Network management software of HINOC

The network management software of HINOC is based on the SNMP. The management agents are embedded in the HB and HM. NMS can manage HB and HM with the IP addresses of devices. Every HB is regarded as a unit. It constitutes a subnet with the HM connected with it. The central management software can collect information of HB and HM in a subnet only by the HB instead of communication with the HM directly [2, 3].

Figure 2 is the framework of the central network management based on HINOC. The top-level mainly consists of user interaction interfaces, including management interface and service provided for the WEB. The graphical interface used in the system is developed

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mainly by the Qt Graphical Interface Library. And interface layer responses for analysing the user operation. It concludes the management of topology, performance, fault, configuration and escalation in the NMS (network management system) engine. The NMS engine correspond the operation to the performance function of SNMP, displays the responded data on the GUI and saves them to the database. The FTP is in charge of the system updating management. It is used to storage the latest network management central software and embedded agent of HB/HM.

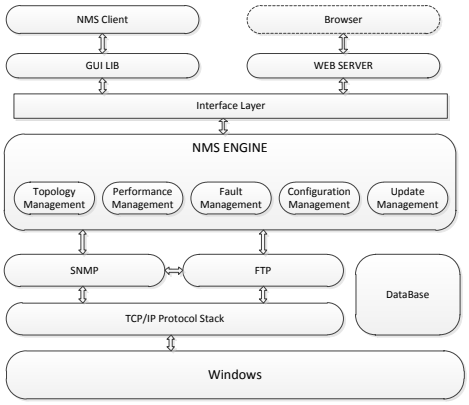

FIGURE 2 Structure of network management software

3 Algorithm of topology management

Text Topology management consists of the process of building topology and maintaining. Considering the importance of topology management, a complete topology management must have 3 aspects: accuracy, commonality and low-burden [5]. We will introduce the traditional algorithm of network topology discovery and the method we used in HINOC.

3.1 TRADITIONAL ALGORITHM OF NETWORK TOPOLOGY DISCOVERY

Current topology discovery methods are shown as follows:

1) ICMP-based method;
2) ARP-based method;
3) Router-protocol (RIP) based method;
4) SNMP-based method [4, 5].

Because of particularity of HINOC network, the traditional algorithm of network topology discovery based on IP network cannot be applied to this system. Firstly, the downlink data is sent by the MAC layer, which has special mechanism of data processing, and we cannot build HB and HM connection by access equipment, for the access equipment does not have routing table. However, the connection built by address forwarding table between MAC addresses cannot meet the demand of management requirement. In this situation, it is impossible to manage the HM by using the IP address. Although polling with broadcasting can build the topology, it can only be used on the same network segment, and will have a huge burden on the network. Therefore, the algorithm of topology management needs to combine with the characteristics of HINOC MAC layer protocol [6, 7].

3.2 ALGORITHM OF TOPOLOGY MANAGEMENT IN HINOC

The star topology of HINOC is made up of HB and HM. Since the system uses the embedded agent to manage access device by IP address, topology management needs to establish the correspondences between device and IP address. The network management system is implemented by SNMP trap and polling at the network layer. Considering the HM access protocol, this mechanism is designed with 5 notifications of HB's online, HM's online, HM's online reported by HB, HM's offline reported by HB and the shutting down of embedded agent.

Devices that go online have to send SNMP trap with the message composed of node ID, type of device, MAC address, and community. The trap oid of HB's online is 1.3.6.1.3.2.9.1 while HM is 1.3.6.1.3.2.10.3. EMS (Element Management System) receives the trap from HB or HM, acquires the basic information of the device that goes online and saves the source address of the trap. Meanwhile, if the device is HM which has been adopted by a HB, its node ID and MAC address has also been achieved by the HB. HB will send message to EMS to report that the HM belongs to this HB. The trap oid of HM's online reported by HB is 1.3.6.1.3.2.9.4. In this case, EMS will receive two traps which have the same MAC address form HB and HM. As a result, correspondences between HB and HM can be established. Table 1 shows the comparison of different algorithms of topology discovery [4, 5].

TABLE 1 Comparisons of different topology discovery methods

Method	Speed	Accuracy	Burden
ICMP	quick to the alive while slow to others	middle	high
ARP	Quick	low	low
RIP	Middle	middle	low
SNMP	Quick	high	low
Algorithm in HINOC	Quick	high	low

While HB or HM is running, EMS polls periodically to get information of network traffic and output power. If a device does not replay 5 times continuously, EMS could come to a conclusion that the device is offline and modify its state. Besides, information of the device can be saved until it is back online. Figure 3 shows the complete process of topology management.

Even though the traditional algorithm based on SNMP also has the characteristics of accuracy, low-burden and quick-response as we saw in Table 1, it has to send lots of message to every device. With the increasing of devices quantity, the number of messages grows rapidly which can add load on the network [8, 9]. By contrast, the trap sent by embedded agent can avoid this problem and be more efficient. Meanwhile, polling ensures real-time updating of network topology [8-10].

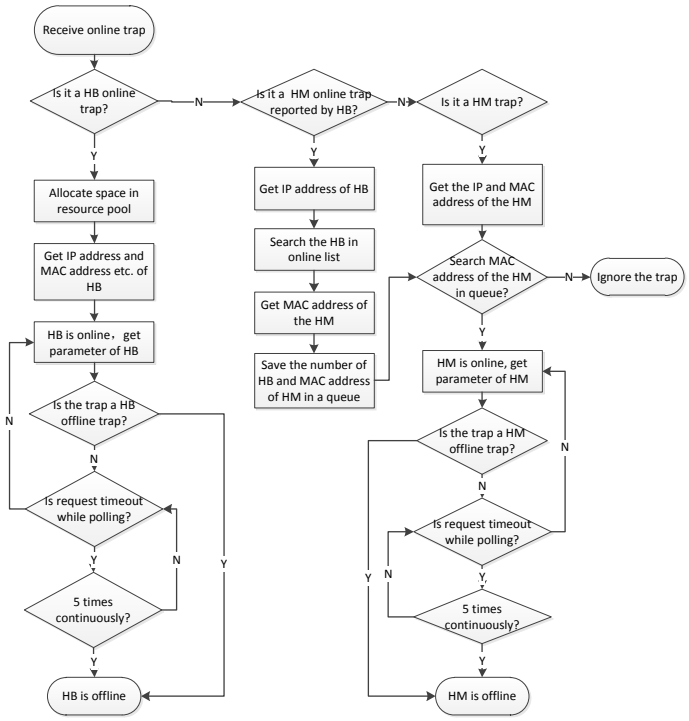

FIGURE 3 shows the complete process of topology management

4 Experiment result

The test environment is shown in Figure 4 and Table 2. Network Management Centre runs on the host computer, and uses the HMD301 Cable Bridge terminal of Shanghai Broadband as Internet access device. The coaxial interface of HB is connected with HM, and the network interface connected with PC. The debugging device connects to HB/HM through the serial port of the host computer, and realizes it with hypertermina.

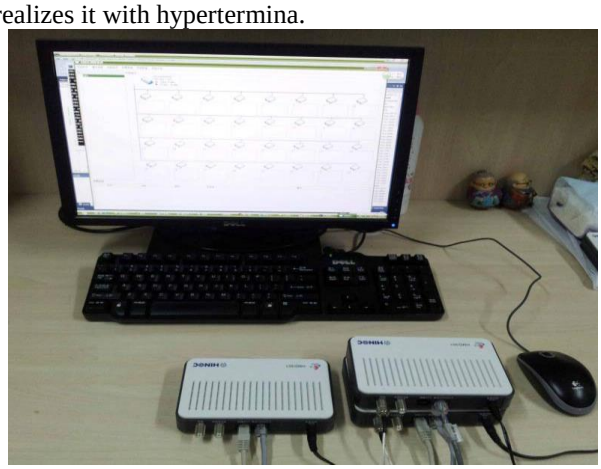

FIGURE 4 Testing environment

TABLE 2 Parameters of devices

PC	CPU	Intel Core2 DUO E7500
	RAM	2G
	Operating System	Windows XP
HMD301	RAM	32M
	FLASH	32M
	KERNEL	Linux version 2.4.21

4.1 TEST OF ESTABLISHMENT

The Figure 5 shows the process of topology establishment. As shown in the device list on the left, a HM is mounted on the No.1 HB. The right part of the picture shows the basic information of the No.1 HB. From the picture, we can see that both the topological relation and basic information are correct.

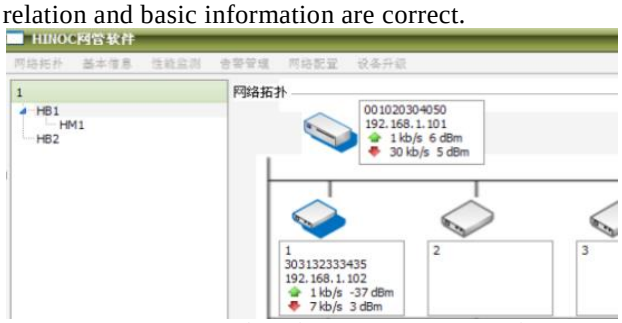

FIGURE 5 Main interface of network management software

4.2 MANAGEMENT SCALE TESTING

The Figure 5 shows the testing scale of the Network Management System. Because of the limitation of the testing environment, we cannot test all the 32 HMs actually. So we test with one HB and HM (Table 3). HB and HM sends on-line notification every 15s and the ID of HM increase by one each time to simulate the circumstance that 32 HMs are online. As shown in the Figure 5, when all the 32 HMs are running, the Network Management System is operating smoothly, and we can get the basic information, network flow and output power of the device.

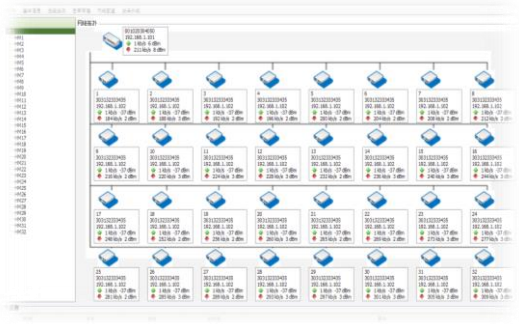

FIGURE 6 Main interface of network management software

TABLE 3 Total time of polling

Parameters	Number of HB/HM	Total time of polling
Network Traffic and Output Power	1/32 225/7200	8.6 sec (measured) 30 min (estimated)

5 Conclusion and future work

The network management software is developed synchronously with HIONC and it is not complete yet. The network topology based on the MAC layer protocol and HB/HM network structure realizes the management and maintenance of HINOC network. The direct ratio between rotation time and equipment number is still a crucial issue to solve.

Taking the expandability and portability of the network into consideration, the existing C/S architecture cannot meet the requirement that one system could be used anywhere. It could be improved to the B/S architecture in the future and will be able to increase flexibility, shield realization details, provide general interfaces to more manufacturers, and cut down the cost of the system with the help of the Web network management system.

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