

Traffic Information Based Power Saving Mechanism

Ju No Han*, Seong Gon Choi*

*College of Electrical & Computer Engineering, Chungbuk National University, South Korea

juno8003@cbnu.ac.kr, sgchoi@cbnu.ac.kr

Abstract— This paper proposes the standby power saving mechanism that the user can terminate home network appliance (i.e. Personal Computer) power and standby power at the remote site. Generally, for the power management of the home appliance, it has to be put through the physical contact. In the proposed mechanism, the smartphone is offered the power on/off state information of the home network appliance on a real-time basis. The user can transmit the power-termination order to the home network appliance through the smartphone. If the home gateway receives the power-termination order from the smartphone, the power-termination order is sent to the home network appliance and the standby power is blocked. Its power and standby power can be blocked through the method to be proposed even through the user is not physically contacted with the home appliance. That is, the proposed mechanism gives convenience to the user in electric power management aspect. In addition, the power saving can be done, because reducing the unnecessary operation time and blocking the standby power of the home network appliance.

Keywords— Traffic Information, Standby Power Saving, Home Gateway

I. INTRODUCTION

Following picture shows the structure of the Home Network(HN). Devices in the home are connected to the Home Gateway (HG), and the HG is connected to the Core Network (CN) [1].

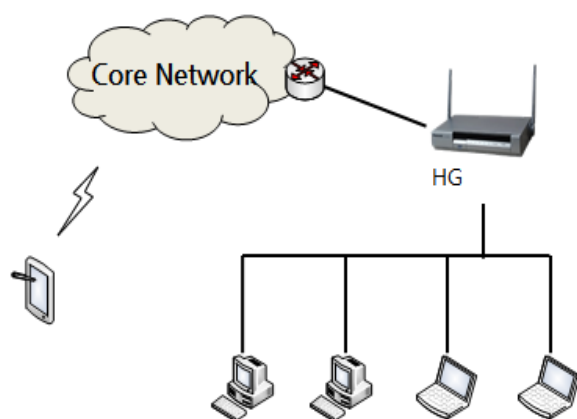


Figure 1. Conceptual diagram of proposed mechanism

Generally, when using Personal Computer (PC), we download the high-capacity contents through the network. Occasionally, we leave PC in the operation state even if the

use of the contents is finished when we use the high-capacity contents through the network. Accordingly, the power consumption of PC is generated according to the standby state of PC.

To solve this problem, the various methods for reducing the power waste are introduced. The research was the power circuit in order to reduce the power consumption in the power-off state of PC. In the condition where PC power is turned off, cut off the power supply for the unnecessary chips, except that power which is necessary for the chip needed to wake up the system. In addition, this research used the existing power controller chip instead of another low-power chip which is used to control the system power status [2].

As shown in [2] research, it is the critical issue in the energy saving side to reduce the power dissipation in the power off state of PC. Therefore, we propose the power saving mechanism that the HG can block the standby power of PC.

In proposed mechanism, the HG provides the network use information of PC to the smartphone. Next, the smartphone sends the power-termination message to HG [3], [4]. Finally, the HG sends the power-termination order to the PC and block the PC standby power.

To evaluate the performance, we program the expected application in smartphone, and estimate the power consumption of PC through the proposed method. As a result, we can reduce both the power consumption and the unnecessary operating time in the PC.

This paper is organized as follows. The section 2 is the related work. The section 3 presents the flow chart and procedures related to the proposed method. The section 4 shows implementation result. Finally, we conclude this paper in section 5.

II. RELATED WORK

A. The packet analytical method in the home gateway

There is existing research that analyze and classify the packet come into the HG for energy saving. In this research, the energy saving is performed with the method controlling the processing time of HG. The packet which comes into HG is analyzed and it is classified as UDP and TCP. The TCP packet which is relatively not sensitive to the processing time is buffered. This research suggested the energy saving mechanism by using HG sleep time to obtain through the packet buffering [1].

The mechanism proposed in this paper uses the packet analytical method that [1] proposes. The proposed mechanism monitors the packet come into HG and it senses the packet meaning the termination of service among the TCP packet.

B. The packet transmission via socket from smartphone to PC

Existing research introduces the application of client-server mode, the concept and the programming principle of the socket based on client-server. The method of software design for the communication between the client-server processes using the socket mechanism is mainly analysed, and gives examples of connection oriented service program [3].

Another existing research operation under Symbian OS such as socket communication is researched and realized. With the result of the research, the file or document transmission from smartphone, based on Symbian OS to PC is realized [4].

In this proposed mechanism, communication among smartphone, HG and PC is made through the socket communication. Even if the Operating System between devices to communicate is different, if the socket communication is used, the smooth communication is possible.

In the proposed mechanism, the socket communication is used in giving and taking the message between the devices.

III. PROPOSED METHOD

This section explains the proposed method by using flow-chart and procedure of the system operating.

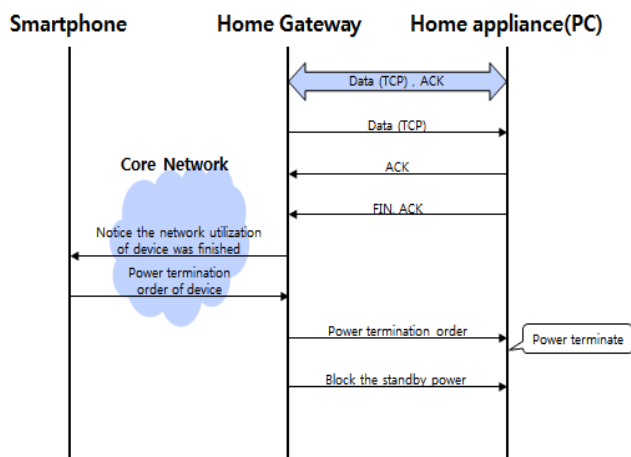


Figure 2. System operating structure of the proposed mechanism

Fig.2 shows the system operating structure of the proposed method. In the proposed system, the smartphone plays the role that it provides the network utilization information of PC to the user and it delivers the power-termination order to the PC. That is, the smartphone plays the agent role that delivers the message instead of the user. The HG is the device of being important in the organization of the HN for connecting CN to the PC of the HN. The HG monitors the traffic between CN and PC. If 'FIN' is sensed, the HG sends the notice to the

smartphone when it confirms that network utilization of the device was finished. The smartphone delivers the power-termination order to PC through HG. HG blocks the standby power of the relevant PC after delivering the power-termination order.

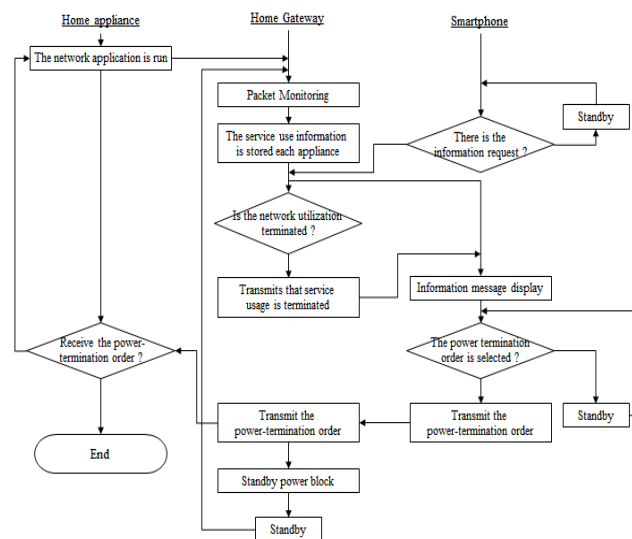


Figure 3. System flow-chart of the proposed mechanism

Fig. 3 is the flow chart of the proposed method. This algorithm is initiated when download of the high-capacity contents such as FTP and so on. HG monitors the traffic of home appliance (PC). Also, HG analyzes the traffic of home appliance. If HG senses the specification field of traffic and confirms that the network utilization is finished, the notice is sent to the smartphone. If the user sends PC to the power-termination order, HG does the mediator role delivering this order. When the delivery of the Power-termination order succeeds and the power of PC is terminated, HG blocks the standby power of the relevant PC.

In the proposed mechanism, HG does the role for organizing HN with the condition where it is always turned on and the role of being very important in the energy saving side.

The HG supports the PC up to 4-ports. In fig. 3, HG is independently operate about each ports. For example, PC connected to the port 1 is terminated. Still, PC connected to the port 2 is not terminated and operates continuously along the flowchart.

Fig. 4 shows the result of monitoring the packet which it exchanges when PC downloads the huge file through internet. The Wireshark program is used for the packet monitoring. The file transmitter sends two TCP packets to the destination for the file transfer at a time. If the receiver receives the packet successfully, [ACK] is sent in order to inform acknowledge to the transmitter. This process is repeated and huge file of one is transmitted.

No.	Time	Source	Destination	Protocol	Length	Info
29845	208.658013	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22610469 win=65700 Len=0
29846	208.658021	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29847	208.658214	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29848	208.658225	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=2261929 win=65700 Len=0
29849	208.658236	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29850	208.658427	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29851	208.658437	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=2261389 win=65700 Len=0
29852	208.658446	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29853	208.658452	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29854	208.658460	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22614849 win=65700 Len=0
29855	208.658468	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29856	208.658468	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29857	208.658674	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22616309 win=65700 Len=0
29858	208.658680	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29859	208.658682	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29860	208.658687	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22617769 win=65700 Len=0
29861	208.658691	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29862	208.658697	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29863	208.658884	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22619229 win=65700 Len=0
29864	208.658890	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29865	208.659077	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29866	208.659084	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22620689 win=65700 Len=0
29867	208.659081	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29868	208.659094	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29869	208.659096	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22622149 win=65700 Len=0
29870	208.659102	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29871	208.659282	210.125.147.219	210.125.147.232	TCP	1494	[TCP segment of a reassembled PDU]
29872	208.659302	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22623609 win=65700 Len=0
29873	208.659312	210.125.147.219	210.125.147.232	TCP	74	[TCP segment of a reassembled PDU]
29874	208.659318	210.125.147.219	210.125.147.232	TCP	677	[TCP segment of a reassembled PDU]
29875	208.659336	210.125.147.232	210.125.147.219	TCP	54	54229 > 4365 [ACK] Seq=1 Ack=22624253 win=65056 Len=0
29876	208.659336	210.125.147.232	210.125.147.219	TCP	8175	[TCP segment of a reassembled PDU]
29877	208.659372	210.125.147.219	210.125.147.232	TCP	60	4365 > 54229 [ACK] Seq=22624253 Ack=2 win=5840 Len=0
29878	208.696674	210.125.147.219	210.125.147.232	TCP	77	10021 > 54207 [PSH, ACK] Seq=4813 Ack=1150 win=5840 Len=2
29879	208.701487	210.125.147.232	210.125.147.219	TCP	76	54207 > 10021 [PSH, ACK] Seq=1150 Ack=4836 win=65340 Len=2
29880	208.706720	210.125.147.219	210.125.147.232	TCP	82	10021 > 54207 [PSH, ACK] Seq=4836 Ack=1172 win=5840 Len=2

Frame 29876: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface 0
Ethernet II, Src: Asustek_A2:44:01 (54:04:a6:a2:44:01), Dst: Eumicor_08:08:62 (00:1c:85:08:08:62)
Internet Protocol version 4, Src: 210.125.147.232 (210.125.147.232), Dst: 210.125.147.219 (210.125.147.219)
Transmission Control Protocol, Src Port: 54229 (54229), Dst Port: 4365 (4365), Seq: 1, Ack: 22624253, Len: 0

Figure 4. The result of monitoring the packet

We can confirm that [FIN, ACK] packet is sensed in the No.29876 in Fig. 4. If [FIN, ACK] packet is sensed in HG, HG can know that file download of PC is finished. By using this packet, HG confirms that network utilization of PC is finished and HG can notice to the user.

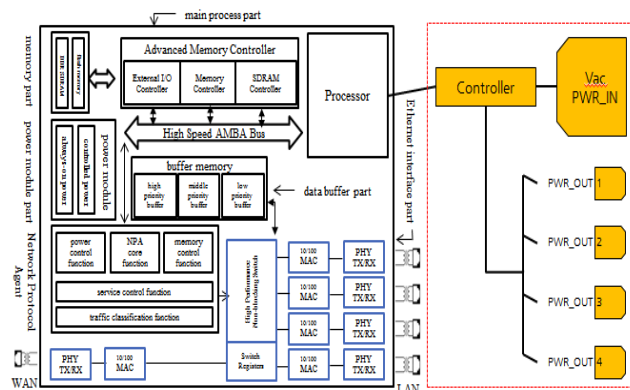


Figure 5. Added power control unit with the existing home gateway structure chart

The Fig. 5 is configuration of HG diagram adding the power control unit to the existing circuit of HG for the cutting off standby electric power of PC. The Power Control Unit (PCU) added to HG is the part indicated on Fig. 5 as the red quadrangle. The PCU is organized of the controller and one ac power input terminal and four output terminals. When connecting PC with HG, the number of the output terminal and LAN port has to be connected equally.

The PCU gets the AC power supply input from the outside and uses the output port and provides the AC power supply to PC. If HG receives the power-termination order, PCU plays the role of blocking the target appliance power.

IV. IMPLEMENTATION RESULT

This section shows the expected outcome and expectation effectiveness by using the proposed method.



Figure 6. Expected appearance of the smartphone application

Fig. 6 shows the expected appearance of the program implemented in the smartphone. The 'Eth x' of figure is port number of the home gateway. That is, the arbitrary number is given for the division of PC connected to the home gateway. The various file transfer programs, which including FTP, P2P, and etc. are the example of the program which they can download the high-capacity contents. The figure of the triangular shape shows the network active condition. It is the indication that the blue triangle is network activation. The user can confirm the network active condition of PC through this program.

In the Fig. 6 (B) shows the notice which it sends when the home gateway sensed 'FIN'. If the user presses the OK button, the smartphone sends the power-termination order to PC. (C) shows that power of the 'Eth 1' PC is terminated and it is indicated as the off.

Store No.	Date	V-E1	A-E1	W-E1
1	2012/05/16	197.32	0.47	79.53
2	2012/05/16	197.34	0.47	79.55
3	2012/05/16	197.34	0.47	79.80
4	2012/05/16	197.37	0.47	79.60
5	2012/05/16	197.36	0.47	79.52
6	2012/05/16	197.31	0.47	79.53
7	2012/05/16	197.36	0.47	79.55
8	2012/05/16	197.33	0.47	79.62
9	2012/05/16	197.32	0.47	79.57
10	2012/05/16	197.27	0.47	79.56
11	2012/05/16	197.25	0.47	79.80
12	2012/05/16	197.29	0.47	79.57
13	2012/05/16	197.25	0.47	79.61
14	2012/05/16	197.24	0.47	79.58
15	2012/05/16	197.25	0.47	79.55

Figure 7. Result of measured PC power consumption

Fig. 7 shows the result of measured power consumption of desktop PC. The PC doesn't operate the other program except OS in the power measurement. Fig. 7 shows that power consumption of PC is about 80W. That is, the electricity which is wasted in the standby state after PC finishes the use of network is about 80Wh.

Table 1. The power consumption of PC

The power consumption of standby state PC		
Standby state 1 hour	24 hours	1 month
80 W	1.92 kW	57.6 kW

TABLE 1 shows the power consumption per hour of PC in standby state. The unnecessary standby state time of PC can be reduced by using the proposed mechanism in this paper. That is, the waste of electricity can be reduced.

V. CONCLUSION

This paper proposes the power saving mechanism that the user can terminate power of Personal Computer (PC) at the remote site and Home Gateway (HG) can block standby power of PC. Because terminating power of PC is terminated at the remote site, the unnecessary operation time(the time when there is no work while performing, the power is turned on) of PC is reduced and the standby power is blocked, so the waste of the electric power can be reduced. To verify justification of the proposed mechanism, we program the expected smartphone application, and measure the power consumption of PC. As a result, we can effectively reduce not only the power consumption of PC but also provide the user expedience by enabling PC control at the remote site.

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Corresponding Author : Seong Gon Choi (sgchoi@cbnu.ac.kr)

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