

IP header translation protocol design and implementation to a post wireless network service

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Abstract— The use of wireless internet increased rapidly due to the wireless network technology development such as Wibro, LTE and the extension supply of wireless terminals. A special quality of wireless network that is used by many people in an Access-Point increased overhead and lowered the service quality. When we look at All-IP network realization based on a single protocol and transition of address system to IPv6[1], the problem becomes more serious. To address these issues, many header compression algorithms have been proposed over decades. However, the past Header compression algorithms are not suitable for the current wireless environment. The proposed ROHC has problems that an increased demand for computing power by increasing complexity of the compression algorithms.[6][7]

In this paper, our proposal is that we can reduce overhead and increase efficiency of network by contracting IP header through IP header translation in a gateway. In order to test this proposal, we implemented a Testbed in which we conducted the experiment in the 802.11b wireless with 11Mbps. Then we compared the results to efficiency along with IP payload size. The results shows that we can reduce the transmission delay time by 67.9% and improve network efficiency by 42.54%. In the event that this suggestion applies to IPv6, we can expect more positive effect. [1]

Keywords— IP header, ID header, gateway, IPv6, IP translation, wireless network

I. INTRODUCTION

As the type of wireless network changed from circuit switch(2G) to packet switch(3G), the type of voice transmission changed into data service. This enables a user having a wireless terminal to access the internet.

The extension supply of wireless terminals and provision of data service lead the way to the use of existing link resource more efficiently, such as bandwidth.

The proposed IP compression algorithms has reduced overhead(bandwidth savings) and increased network efficiency. Also, provided users with QoS by reducing packet loss.

Most of the IP compression standard which has been proposed in the past are in the wired network environment. The Header compression algorithms are based on one principle. That is to compress by removing redundancy field of header with respect to the reference header and the difference(delta) between the two headers only transmits. However, if the delta coded header is corrupted, all the following packets are erroneous. Therefore, these mechanisms are far from wireless environment.[6][7]

To address this problem, ROCH is proposed. However, ROCH increases demand for computing power by increasing complexity of the compression algorithms. In this paper, IP translation mechanism is used instead of IP compression.

WN transmits ID that is allocated through a server instead of IP to the gateway. The gateway translates ID to IP and transmits to external node. Through the above process, we can address overhead problem in a wireless domain. Furthermore, the proposed protocol can also address security problem by using 802.1x security protocol.

In order to test this proposal, we implemented a Testbed in which we conducted the experiment in the 802.11b wireless with 11Mbps. We designed HostAP that performs the role of gateway. Then we compared the result to efficiency along IP payload size. The result showed that we can reduce the transmission delay time by maximum of 67.9% and improve network efficiency by 42.54%. If this protocol adapts to IPv6 which makes the IP header twice as large as an IPv4 header, we can expect greater improvement in efficiency.

II. RELATED RESEARCH

A. An introduction to IP header compression

A payload of application is encapsulated by header including information for transmission and service. It is transmitted to the next hop.

The IPv6/TCP has a total of 60 bytes. If the payload having a small payload size is transmitted as in the sensor network such as 802.15.4[2], 60 byte headers added to payload is transmitted together. This creates an overhead problem and reduces network link resource.

Figure 1 shows a general concept of header compression.

On the sender side the compressor removes redundancy from the incoming packet with respect to a reference (base) header. This reference is also known at the receiver and allows the receiver to decompress the incoming compressed packet headers.

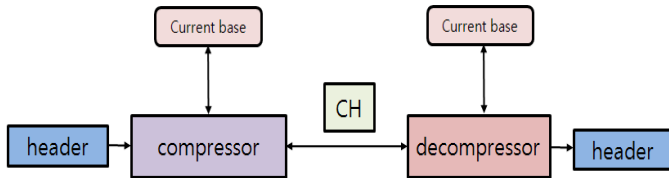


Figure 1. General concept of header compression

Most of the header compression algorithms are created based on the concept of header compression like as in figure 1.

Table 1 shows the steps in that evolution process of IP compression standard.

Table1. Evolution of IP compression standard

IETF standard	RFC1144 (VJ,CTCP)	RFC2507 (IPHC)	RFC 2508 (CRTP)	RFC 3095 (ROHC)
header	IPv4/TCP	IPv4,IPv6,AH,Minimal Encapsulation header, Tunnelled IP headers, TCP,UDP,ESP	IPv4,IPv6,AH,Minimal Encapsulation header, Tunnelled IP headers,UDP,RTP	IPv4,IPv6,AH,GRE,Minimal Encapsulation header, Tunnelled IP headers,UDP, RTP,ESP
link type (BER,RTT)	Dial-UP (Low,short)	Dial-up and wireless (Low to medium, short to medium)	Dial-up and wireless (Low to medium, Short to medium)	Wireless (High, Long)
Encoding	differential	differential	differential	Window-based Least Significant Bit
Error recovery (feedback)	TCP based	TWICE (Yes)	TWICE (Yes)	Local repair (Yes)
recommended in (standards)	-	UMTS Release99 onwards CDMA 2000 Release B onward	-	UMTS Release4 onwards CDMA 2000 Release B onward

As we saw in the table.1,[3][4][6][7], these header compression algorithms all have their respective focus on a certain combination of protocols, and

have evolved by considering the link type and error recovery and so on.

The majority of header compression standards have considered low BER environment with long RTT like as wired. To meet error-prone environment and real-time-service, ROHC is recently standardized. However, ROHC increased complexity of the compression algorithms which results in an increased demand for computing power.[6]

Our proposal has a simple protocol procedure as well as advantages that are possible to adapt to all of the protocols.

B. A Research on 802.1x security technology

The 802.1x is a standard for security – “standards for port based network access control.”[5] In order for WN to communicate with CN, it passes through AP having a logical port and it has to get an approval for authentication from the server. The 802.1x security technology is created to address vulnerability of the open security system. Unlike the open system using static key in the past, the present system allocated uses different keys for each session. Therefore, it is possible to control all users individually.

The 802.1x includes following components

- WN(supplicant) – mobile PC, laptop etc.
- AP(Access Point) – performs the role of relaying between WN and AS or enables WN to approach to external node.
- AS(Authentication server) – performs the role of admitting an authentication.

Figure 2 describes packet analysis and protocol procedure.

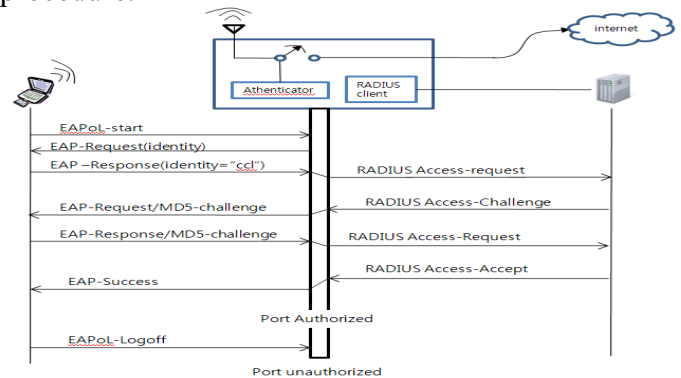


Figure 2.802.1x protocol procedure that success authentication

This shows that EAP protocol is used for authentication between WN and RADIUS with AP as the center.

General LAN packets are encapsulated with EAP header having information of user. AP only extracts EAP header of the packets. Then the packet transmits to Authentication server with RADIUS header. AS receiving the packet transmits the packet requesting the password with the proper encryption to WN. Then WN obtains the approval for the password from AS by transmitting the packet with EAP header again. If successful, WN can approach external node through a physical port of AP.

III. INTRODUCTION OF PROPOSED PROTOCOL

A. Terminology

- ID(identification) header – ID header is compressed header instead of IP header in wireless network. That is, we can communicate with another node by using ID header in wireless domain. As described in figure 3, ID header consists total of 4 bytes. The first byte is a field indicating next protocol header type. The rest of the bytes allocate ID that is used in wireless domain. Each ID uses 12 bytes.

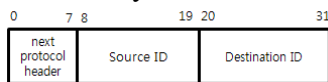


Figure 3.ID packet Format

- Authentication Server (AS) – It has 1:1 mapping table for translating IP to ID. It simultaneously performs the role of the authentication.
- Gateway (HA) – This has two roles.
 1. It connects between WN and Server (AS) that delivers ID used instead of the IP header to WN.
 2. When packets go out of the external node, Gateway (HA) translates ID to IP. When packets come in the internal node, it translates IP to ID.

B. ID request or allocation

This proposal is to transmit or receive packets by translating IP to ID or ID to IP. Here, we can reduce

delay and increase efficiency of network by translating IP header of 20 bytes to ID header of 4 bytes in a wireless domain.

Figure 4 shows the process of ID request and allocation.

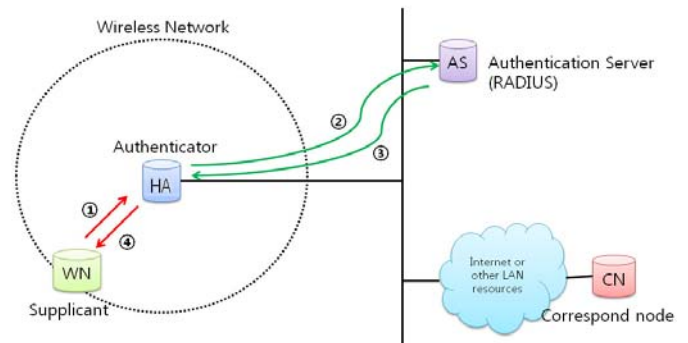


Figure 4.ID request or allocation

1. WN delivers IP header to HA to request ID allocation.
2. HA copies the receiving IP address and requests ID to AS.
3. HA receives ID from AS.
4. The receiving ID is delivered to WN again.

C. Communicate WN to CN

In order for WN to communicate with CN, WN delivers a packet which has ID header to HA. And ID header which was used in wireless domain translates to IP header in the HA. Afterwards, it communicates with CN. If HA receives a message from CN, IP header is translates ID header again and transmits to WN.

Figure 5 shows the process of communicating WN with CN.

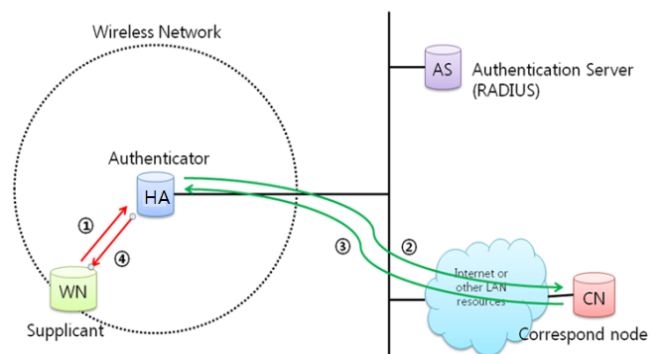


Figure 5.Communication WN to CN

1. WN creates a packet with ID and transmits it to HA.

2. HA which has received the ID packet transmits to CN by translating to IP header that is already copied.
3. If CN receives the IP packet, a message transmits to HA.
4. HA has received an IP packet with a message that translates to an ID packet again and transmits it to WN.

Through the above process, we can reduce IP header size. It can also reduce overhead (bandwidth savings) as well as reduce delay and increase network efficiency. Furthermore, in case that all of the access networks evolve All-IP based network, it is possible to naturally adapt to original infra and communication environments.

IV. IMPLEMENTATION OR A WAY OF EXPERIMENT

To validate this protocol, we created an experiment as described in figure 6.

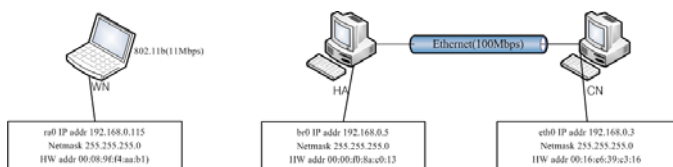


Figure 6. Experiment environment

This experiment can improve efficiency by using ID header instead of IP header in a wireless domain. Therefore, we omitted a server which allocates a dynamic ID and communicated by allocating static ID to HA and WN respectively. HA which performs the role of a gateway is created by a HostAP using Intersil PRISM2 11Mbps Wireless Adapter and Orinoco 11Mbit/s wireless PC card.[9] HA translates an ID packet to an IP packet and vice versa (IP to ID). Two interfaces of HA are also connected by a bridge. As a result, WN and CN can mutually communicate.

※ Terminology

- WN – Wireless Node
- HA – HostAP(gateway)
- CN – Correspond Node

Table 2 shows the Procedure of Our Experiment.

We made use of the linux system for this experiment and implemented the proposed protocol by modifying the open source.

Table2. Procedure of Our Experiment

	WN	HA	CN
OS	Ubuntu 9.04	CentOS 4.4	Ubuntu 9.04
Kernel	2.6.31.14	2.6.9	2.6.31.14
Network environment	802.11b (11Mbps)	•802.11b (11Mbps) •Ethernet (100Mbps)	Ethernet (100Mbps)

Through the packet analysis device operated by the Promiscuous mode, we observed the flows of ID packet and IP packet. We also made use of *time* command and *ping* program of linux and extracted data value along IP data size. A *time* command shows three times.

- real : Total operating time
- user : Activity time of CPU
- sys : Activity time of kernel

Here, *real* means the length of actual time. *User* indicates activity time of CPU which means total time that CPU spends for processing the command of computer program. The *sys* indicates activity time of kernel. The sum of *user* and *sys* represent the actual time performing ping program. It is the time the proposed protocol used by actual communication.

V. VERIFICATION OR ANALYSIS

Figure 7 shows time along IP payload size which is used by the actual proposed protocol when transmission forwarded 1000 packets to the receiver by using *time* command and *ping* program.

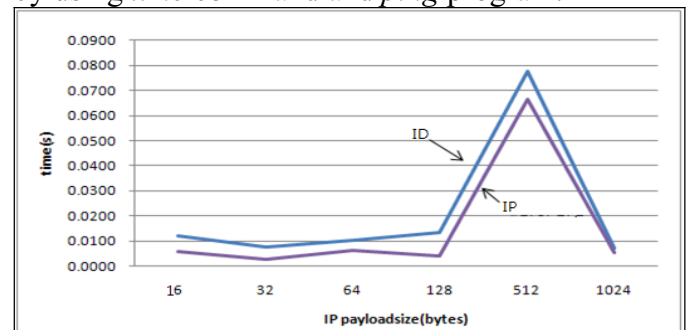


Figure 7. Actual communication time according to IP payload size(bytes)

As described in the graph, by using the proposed ID header instead of the IP header that is currently used, we were able to reduce transmission time by 67.9% in 128 bytes and 54.54% in 16 bytes. In the case of 512 bytes, we reduced transmission time by 14.65%.

Figure 8 shows network efficiency along IP payload size.

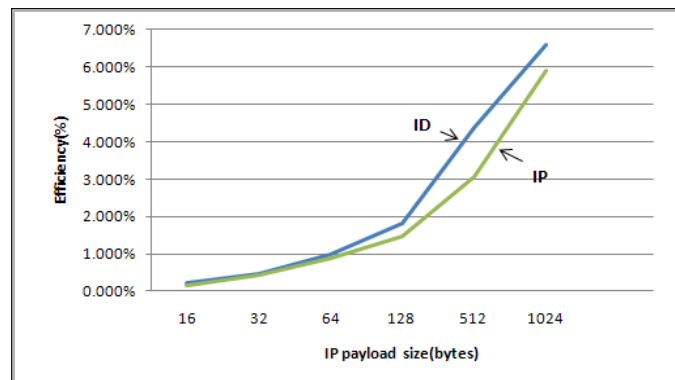


Figure 8. Network efficiency according to IP payload size (bytes)

As described in Figure.8, ID converted IP address in the wireless network shows better efficiency. Compared against the original case, the efficiency improved a maximum of 42.54%, a 20.12% average improvement. We can expect greater improvement in the case of adapting IPv6 that is post communication network.

VI. CONCLUSION AND FUTURE DIRECTION OF RESEARCH

As we stated in our proposal, we can reduce overhead and increase efficiency of network by constraining IP header through IP header translation in a gateway. In order to test this proposal, we created a Testbed in which we conducted the experiment in the 802.11b wireless with 11Mbps. Then, we compared the result to efficiency along

with IP payload size. The result showed that we can reduce the transmission delay time by maximum of 67.9% and improve network efficiency by 42.54%. If this protocol adapts to IPv6 which makes the IP header twice as large as an IPv4 header,[1] we can expect greater improvement in efficiency.

This paper aims to cover the case of using ID packets in a wireless network. Therefore, in order it to be applied in the actual network, we are improving the research for allocating a dynamic ID in the subject area.

This research is possible to be applied to the IPv4 as well as all of the IP based network. Therefore, It is expected to positive results in the post wireless networks.

ACKNOWLEDGMENT

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