한국산학기술학회논문지
Vol. 10, No. 2, pp. 280-286, 2009

Performance Test and Evaluation of Voice Traffic in Wired and Wireless Integrated Network

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유무선 통합망에서의 음성 서비스의 성능 테스트 및 평가

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Abstract The NGN(Next-Generation Network) structure has been considered from various points of view as all IP wireless-wired integration network and its performance is one of the main issue in these days. In this paper, various wired and wireless integrated networks with voice service are designed and simulated to obtain problems and factors affects the network performance using OPnet simulator. The characteristics only showed in the wired and wireless integrated networks are measured and analyzed compared with the single networks such as a wired or wireless networks. Especially, in the wired and wireless integrated networks showed degrading performance even if there are few transmissions in the network and furthermore, the various networks of increasing numbers of the nodes and transmission are simulated and evaluated.

Key Words : NGN, BcN, Wireless-Wired Network, Network Performance, QoS, IPv6

요 약 NGN(Next-Generation Network)의 구조는 전 IP 유무선 통합망으로서 다양한 관점에서 연구되어져왔으며 이러한 네트워크의 성능은 가장 중요한 쟁점의 하나이다. 본 연구에서는 다양한 유무선 통합망에서 음성 서비스를 제공할 때에 발생할 수 있는 문제점과 요인들을 발견하기 위하여 OPnet 시뮬레이터를 활용하여 성능분석을 수행하였다. 단일의 유선망이나 무선망과는 달리 유무선 통합망에서만 보이는 특성을 측정하고 분석하였다. 특히, 유무선 통합망에서는 네트워크의 전송이 빈번하지 않은 환경에서도 전반적인 망의 성능이 저하되는 결과를 측정하였으며 그 밖에도 노드수의 증가와 전송량의 변화에 따른 망의 성능을 비교 분석하였다.

1. Introduction

The technological advancements in telecommunication network are forcing a trend towards unification of networks. It sets up a stage for the emergence of Next Generation Network-NGN by integration of voice and data traffics, along with the development of packet handling technology of voice traffic due to the Internet_based technology

development[1]. And the vital issue of an NGN is the separation of the transport and service layer. The ultimate design objective for the transport layer is cost-efficiency achieved by establishing a unified transport platform based on packet switching technologies such as IP and Ethernet.

NGN is essentially an IP based network that enables any category of customers to receive wide range of services such as voice, data and video over the same network. The forthcoming trends of network evolution has become one_packet_network, called NGN by integration of voice and data traffics, along with the development of packet handling technology of voice traffic due to the Internet based technology development. While the forthcoming NGN will cope with the new or alternate

This work was supported by the SKTU Institute of Next Generation Wireless Communications funded by SK telecom (SKTU-07-OO7).

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Received October 8, 2008 Revised(First November 19, 2008 Second January 22, 2009) Accepted February 18, 2009

services, like fast video services by expanding IP network through optical Internet, and NGN has been developed through wire/wireless integration, and through integration of network, platform, and contents. The VoP (Voice over Packet) network has been required to handle the voice traffic efficiently, While, traffic management of ATM/IP, control of flows, bandwidth, buffering of IP are prerequisites to guarantee QoS(Quality of Service). To use the IP network with forthcoming NGN backbone and to become all IP network, IP network should guarantee the network QoS and should evolve into the NGN[2].

In chapter II, the NGN evolution architecture is summarized, wireless integration in NGN is explained in chapter III, then in chapter IV, Designing and simulation of Integrated Wireless-wired Network is discussed, and finally, in chapter V, we conclude this topic.

2. NGN Evolution Architecture

2.1 NGN definitions and Characteristics

The NGN can be explained as the one_packet_network for all services, and has the following characteristics[3]:

- Packet_based network using new control, management and signal technologies for providing all kinds of services
- Voice network and data network are not separated each other
- Voice, data and multimedia services are transferred through IP_based packet network, and reliable QoS are offered for each defined traffic type as voice, video, Internet access, and private line.

Currently, telecommunication operators should create new benefit and decrease operation cost by supplying various multimedia services through existing network. Therefore, NGN market will lead the growth of future telecommunication markets.

The NGN can be divided into integrated access network for access of various subscribers, packet transmission network for fast handling the huge of traffic, and application network for call control and supplying various services.

2.2 Open Network Structure

The open network structure of NGN has a merit to win strategy to telecommunication operators and equipment vendor. For inter-operation between NGN components, protocol stability and network capacity are very important factors.

During communications between NGN components, the communication contents of one component should be translated into another suitable contents according to the standard protocols, then it can make capacity decreasing problems. So, existing operators should develop their own standard protocols or set up the NGN with one manufacturer's equipments, if they do not want to have the operation and capacity problems.

2.3 Single Packet Network

The core network for the NGN will be a packet network, but there are still arguments on whether it will be ATM backbone or IP router backbone. ATM backbone has a merit of QoS assurance, but IP backbone is cheaper than ATM backbone, and will have QoS assurance soon almost same as ATM backbone. Now, for the technologies of VoIP/VoATM for packet conversion of voice traffic, DiffServ, RSVP(Resource Reservation Protocol) of IP layer and CR-LDP, RSVP-TE of MPLS layer are being proposed for QoS assurance[4].

Telecommunication operators will consider the backbone network by evaluating the problem_solving ability of QoS, security, network management in view of IP network , and the performance, and price in view of ATM network, and will finally decide one between IP router and ATM.

2.4 Integrated Access Network

The core equipment of integrated access network in NGN is the access gateway that is under control of softswitch. The V5.2 function for voice traffic handling in most of access gateway was developed and commercialized. However, the function of ATM/IP interconnection, subscribers' O&M, and interconnection with existing equipment under softswitch are under development.

2.5 Standardization Organization

Standardization organization is focusing on required

standard protocols under open network structure. Each organization shows a little difference in necessary technologies and fields of interest. For example, ISC(International Switching Consortium)[5] concentrates on IP_based protocols and control layer, MSF(Multiservice Switching Forum)[6] focuses on ATM_based protocols and structure, and JAIN(Java APIs for Intelligent Networks) and Parley[7] handles on the service_based layer. These organizations are accomplishing their own standards by comparing and complementing the merits and demerits.

2.6 Wireless/Wired Integration

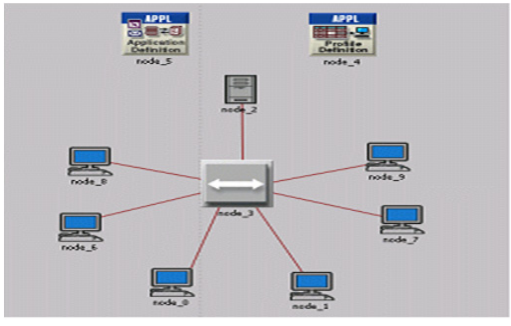
The wire/wireless integration service of PSTN can be defined as follows. The integration view of the relationship between wire and wireless domains[8]. In the network, same network management, QoS, mobility are offered to subscribers by connecting to common core network.

Currently, main wire/wireless integration services in Korea are personnel number service, voice mail box integration service, integration messaging service, wire/wireless VPN and portal services, high speed wireless internet service, and wireless telephone service. The wire/wireless integration service has been improved to seamless network by network integration.

3. Designing of Wireless and wired Network

3.1 Designing of Wired Network

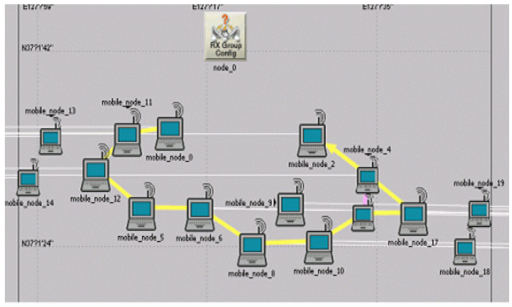
[Fig. 1] shows a LAN which uses a hub with 6 terminals designed in the OPnet simulator. The core network protocol is an ethernet with IPv6.



[Fig. 1] IPv6 based Wired Network Structure

3.2 Designing of Wireless Network

[Fig. 2] shows a MANET(Mobile Ad-Hoc Network) consists of many wireless mobile terminals. The node_0 transports ftp data through many intermediate nodes to the node_2. Various routing protocols can be applied in this network and the AODV routing protocol is applied at this network.



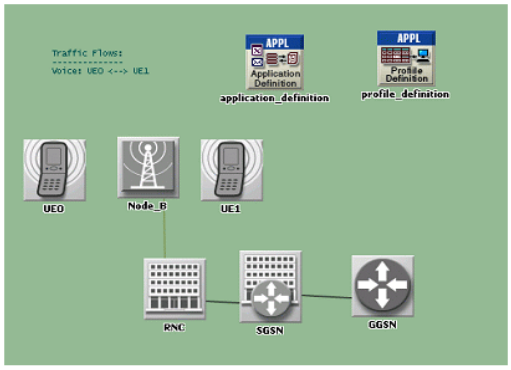
[Fig. 2] IPv6 based Wireless IPv6 Network Structure

4. Designing and simulation of Integrated Wireless-wired Network

4.1 Simulation and evaluation of Wireless Network

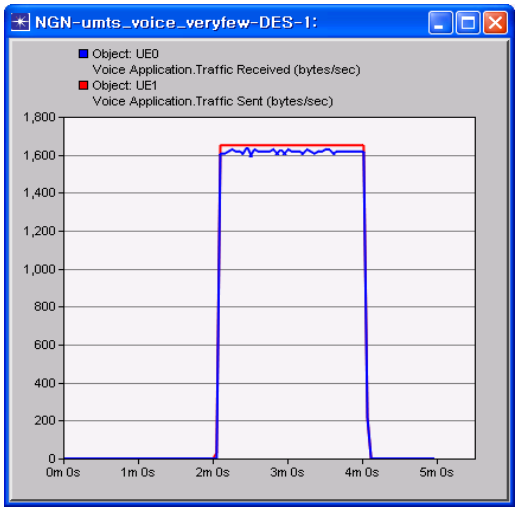
4.1.1 Few transmission in a Wireless Network

[Fig. 3] shows a network that it has just one voice transmission from UE0 to the UE1 mobile terminal in the UMTS Network. And it simply has a transmission in a single mobile communication network. The voice service applied in this paper is all voice over IP and interactive conversation, and the quality of the voice is GSM level.



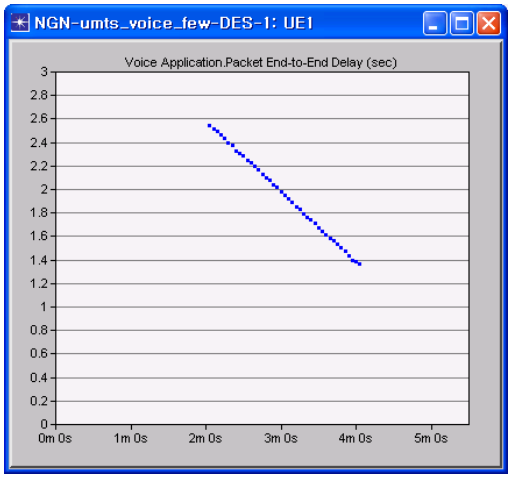
[Fig. 3] Few Voice data transmission in mobile network

[Fig. 4] shows the result of the network shown in [Fig. 3]. The result shows that there are almost no delay and very few data loss in the network.



[Fig. 4] Data transmission rate between UE0 and UE1

We have also experimented for the various parameters such as packet end-to-end delay as shown in [Fig. 5]. However, we just discuss only for the data transmission rate on this paper.

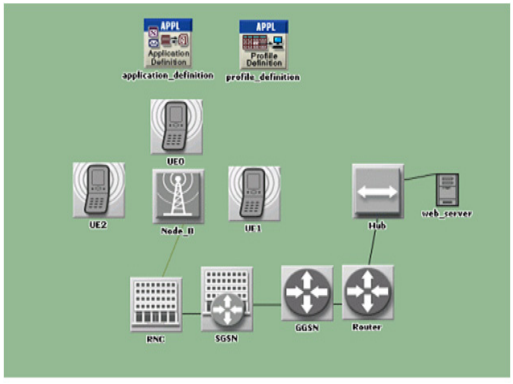


[Fig. 5] Packet End-to-End delay

4.2 Simulation and evaluation of Integrated Wireless-Wired Network

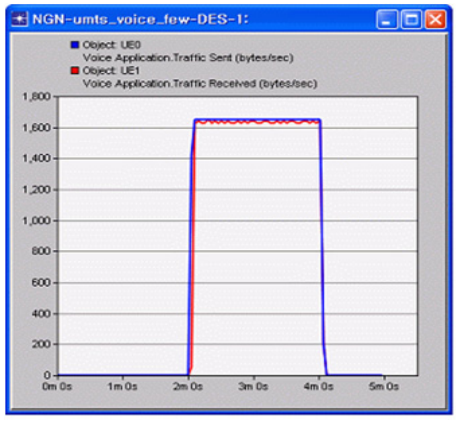
4.2.1 Few wireless transmission

Fig. 6 shows an Integrated Wireless-Wired network consisting of a wireless mobile communication UMTS network connected with a web server in an ethernet LAN. The network is for a local area that has small number of communications and low level of communication rate. The network has just one voice transmission from UE0 to the UE1 mobile terminal of the UMTS Network. And it simply has a transmission but in the integrated wireless-wired network.



[Fig. 6] Few Voice data transmission in mobile network

[Fig. 7] shows the result of the network shown in [Fig. 6]. The result shows that there are few delay and data loss in the network. Even though the delay and the data loss is minor, it has more delay than the one shown in [Fig. 4]. In other words, even the data traffic is in a single wireless network, the result of the integrated network shows worse than the wireless network since there is more network control traffic in the integrated one.

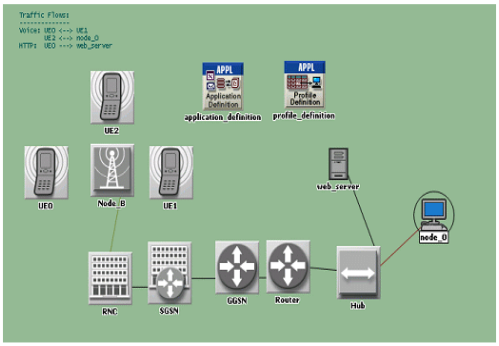


[Fig. 7] Data transmission rate between UE0 and UE1

4.2.2 Few wireless and wired Transmission

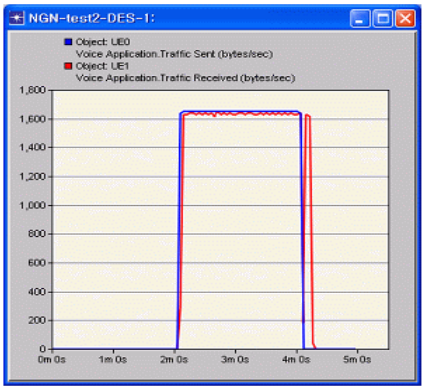
[Fig. 8] shows an integrated wireless-wired Network consists of UMTS and IP based web server. The services providing in this network is inter network communication between wireless and wired network. More specifically, those transmissions between the two networks are as follows:

- Mobile wireless service : Voice between UE0 and UE1
- Inter network service:
- Voice between UE2 and node_0
- HTTP between UE0 and web_server



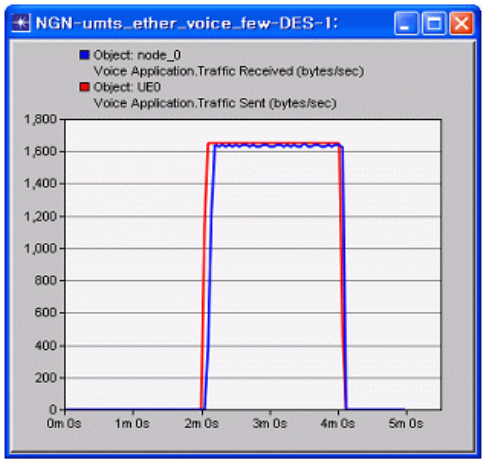
[Fig. 8] Few Inter-network Communication Network

[Fig. 9] shows the result of voice communication between UE0 and UE1. The result show that there are more data delay and loss than then one in [Fig. 7] even though with small numbers of communication nodes. Futhermore, the communication is held only in the wireless network the delay and loss affects the network performance quite a bit. Especially, the last moment of the simulation time, the delay occurred.



[Fig. 9] Data transmission rate between UE0 and UE1

[Fig. 10] shows the result of voice communication between UE0 and node_0. Likewise, as [Fig. 9], the result show that there are more data delay and loss than then one in [Fig. 7] even though with small numbers of communication nodes.



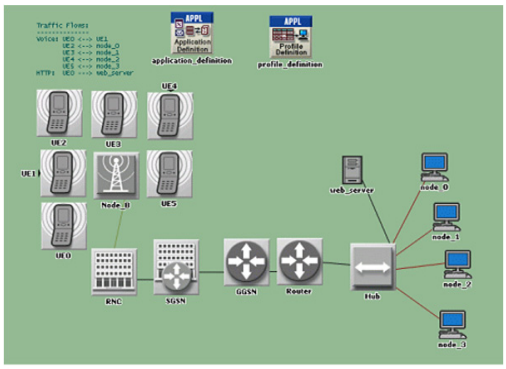
[Fig. 10] Data transmission rate between node_0 and UE0

4.2.3 Many wireless and wired Transmission

The network shown in [Fig. 11] can be considered as a city area network like a downtown. There are many wireless users and wired users connected each other. The traffic load of both the UMTS and wired devices are all set to the heavy traffic mode. More specifically, the communication services are as follows:

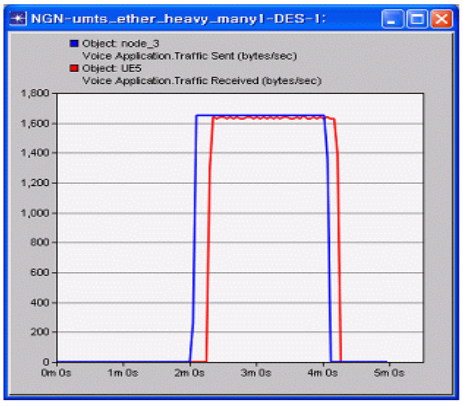
- Inter network service: Voice between , UE2 and node_0, UE3 and node_1, UE4 and node_2, UE5 and node_3
- Single network service: Voice between voice UE0 and UE1, node_4 and node_5

As the simulation result, [Fig. 11] is basically the same as [Fig. 8] except there are many communication nodes and voice communications.



[Fig. 11] Many Inter-network Communication Network

As intuitively, the network performance gets much worse than the few nodes and transmissions. However, the extent of performance worseness in the integrated wireless-wired network is much greater than the single wireless or the wired network as shown in [Fig. 12].



[Fig. 12] Data transmission rate between node_0 and UE0

5. Conclusions

We have designed and simulate the various network systems in the OPNET simulator on the perspective of single network such as wireless and wired, and the integrated wireless-wired network. As a result, we have found that the integrated network performs much worse than the performance in a single network even though the data traffic is not inter-network communication. As intuitively, the network performance gets much worse than the fewer nodes and transmissions. However, the extent of performance worseness in the integrated wireless-wired network is much greater than the single wireless or wired network. For the next research, we will design an integrated wireless-wired network using a network architecture with softswitch that reduces the performance constrains than the network system we have designed on this paper.

References

[1] Kenji Rikitake, and Koji Nakao, “NGN AND INTERNET: FROM COEXISTENCE TO INTEGRATION”, KINGN.2008, 12-13 May 2008

[2] Liu, R.P., et. al., "IP/ATM QoS Solutions for VoIP Traffic", APCC, Aug. 31 2006

[3] Kyung-Hyu Lee, et. al., "Architecture To be Deployed on strategies of Next Generation Networks", ICC 2003 IEEE COMM.

[4] Achim Autenrieth and Andreas Kirsyadter, "Engineering End-to-End IP Resilience Using Resilience-differentiated QoS," IEEE COMM. January 2002 Vol.40 No. 1

[5] International Softswitch Consortium, http://www.softswitch.org, 2002

[6] Multiservice Switching Forum, http://www.msforum.org, 2002

[7] Parlay, http://www.parlay.org, 2002

[8] Kyung-Hyu Lee and etceteras, "A study of Next Generation Network," ETRI-Report, Nov. 2002.

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Ad-Hoc (Sensor) Network, VANET, ITS(Intelligent Transportation System)

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TCP/IP, wireless sensor network, ad-hoc network