Performance Analysis of Network Technologies to support Reliable Database System for Home Environment

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Abstract

This paper presents performance evaluation of commercially available 200 Mbps power line communication and IEEE 802.11g & n products for supporting multimedia database system for home environment. UDP and TCP protocol were used to measure the throughput of each technology. The Homeplug AV product shows highest UDP and TCP throughput results and all products provide full connectivity for all measurements.

Keywords: *multimedia, power line communication, wireless LAN, Home network, database, IPTV*

1. Introduction

Power Line communication (PLC) is considered as one of leading candidates for home networking infrastructure for internet access, HD TV distribution and so on. The traditional Ethernet network with QoS enabled switches can support high bit rate and reliable communication. However the Ehernet is not appropriate for existing building because new Ethernet cable should be deployed around house for this network. The wireless network especially for IEEE802.x technology has been interesting for home network because of it's convenience of installation.

Recently demand for supporting High Definition (HD) Multimedia service over home network is extremely high. To satisfy this demand infrastructure for home network should support the data rate over 30Mbps at application layer because HD multimedia content is usually encoded in 25Mbps

Figure 1 shows flow of HD contents in IPTV [1,2] service system. IPTV service is widely used for providing HD multimedia contents in accordance with customer's request at any time. The Multimedia contents of IPTV are supplied by contents provider and these contents are managed by multimedia database. The customers of IPTV service search the multimedia content in database and buy the contents. Therefore database for HD multimedia contents is designed and managed well for numerous customers' demand. As shown at figure 1 the final step to support HD contents distribution to customer is home network. So the convenience and quality of home network infrastructure can affect customer satisfaction of HD multimedia contents in IPTV service.

The home network infrastructure for HD multimedia traffic should fulfill not only QoS requirement but also convenience of user. This paper shows performance evaluation for supporting HD multimedia database system for home environment. For the power line communication technologies, Homeplug AV[3], UPA-DHS[4] and HD-PLC [5] technologies are evaluated. Also for Wireless LAN technologies, IEEE 802.11g&n [6, 7] technologies are evaluated.

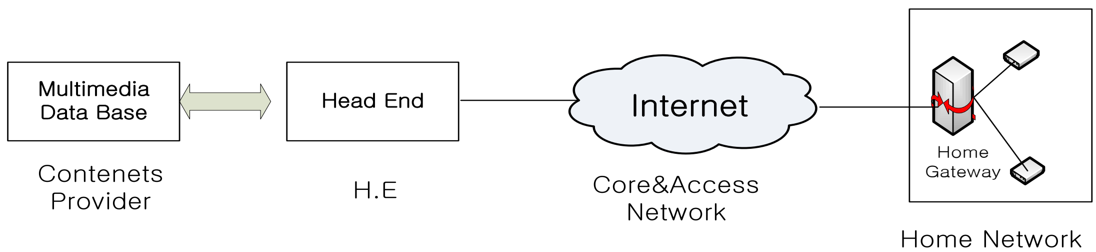

Figure 1. HD Multimedia Contents in IPTV System

2. Test Setup

The performance of several power line communication and wireless LAN technologies have been evaluated. The experiment has been conducted at 2200 square feet, 1story house to get data of real home environment. The interior wall of this house is composed of wood. So the wireless LAN technologies can show much better performance result comparing to the result of performance in brick or concrete wall environment.

The performance of Power line commendation and WLAN technologies has been evaluated using both TCP and UDP protocols. 64240 byte segments were sent for the TCP test and 1472 byte packet were used for UDP test. Each test was continued for 60 seconds and this test was performed 10 times for each path to get meaningful performance result.

We used 200Mbps Power line communication modems using Homeplug AV, UPA-DHA and HD-PLC standards. Table1 shows description of power line communication modem used in this experiment.

Table 1. PLC Modems

Maker	Standard	Modem Model	Chipset	Speed
Intellon	Home Plug AV	RD 6300	Intellon	200Mbps
Netgear	UPA-DHS	HDX101	DS-2	200Mbps
Panasonic	HD-PLC	BL-PA100	Panasonic	190Mbps

PLC modem HDX101 from Netgear and BL-PA100 from panasonic can be found in market however RD6300 Homeplug AV modem is a reference design supplied from Intellon cooperation. Two power line modems were used to make connection between two computers. The test setup for power line communication is shown at figure 2. For wireless LAN experiment WUSB300N, Linksys USB wireless network adapter was used. Antenna was placed randomly and the manufacturer's default setting is used in this experiment. An ad –hoc configuration was used to send and receive packets. Figure 3 shows test configuration of wireless LAN.

Figure 2. PLC Test Configuration

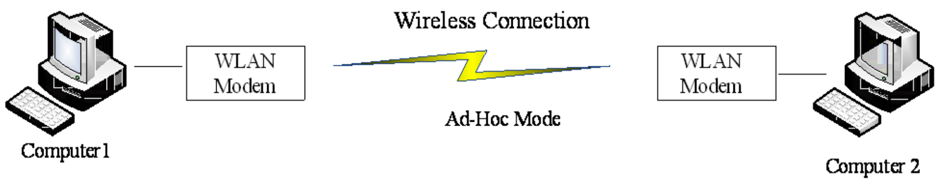

Figure 3. Wireless LAN Test Configuration

3. Performance Evaluation

The performance tests of PLC and wireless LAN were conducted in 2200 square feet house. 18 paths of PLC and IEEE 802.11 technologies in the house have been evaluated. We used 64240 bytes segment for TCP protocol test and 1472 bytes packet for UDP protocol test. A computer sent UDP or TCP packets for 60 seconds to the other computer. This experiment was conducted 10 times for each path. Average of 10 times experiment result is used for performance comparison in this paper. Netgears's PLC modem HDX101 use amateur radio band otherwise other PLC modems does not use this radio band. The throughput result of HDX101 was reduced by 20% to correct for the usage of amateur radio band.

The UDP throughput versus link coverage is shown at figure 4. The value of Y-axis shows that the link percentage that exceeds the throughput value described at the X-axis. The Intellon's PLC modem with Homeplug AV standard, RD6300 has maximum and minimum UDP throughput among PLC and wireless LAN standards. The 77% of Intellon's RD 6300 connections were operated above 64 Mbps and the minimum throughput observed in the experiment was 57.65 Mbps. The Intellon's RD6300 PLC modem shows highest UDP throughput for all paths.

For Netgear's PLC modem, HDX101, 77% of connections have over 36 Mbps of throughput for UDP protocol test. The minimum throughput of HDX101 is 25.99 Mbps .This value is average of 10 test result and this product has big deviation from average. It means that this product is vulnerable to be affected by interference from power loads. The 77% of connections with Panasonic PLC modem, BL-PA100 operated above 36 Mbps. The 77% of IEEE802.11n connections operated over 42 Mbps. The maximum UDP throughput of BL-PA100 is higher than that of IEEE 802.11n. However IEEE 802.11n has higher minimum throughput than that of Panasonic's BL-PA100. As shown at figure 4, the IEEE802.11g has lowest throughput but this gave the most stable throughput. The difference between maximum and minimum UDP throughput is only 1.07 Mbps.

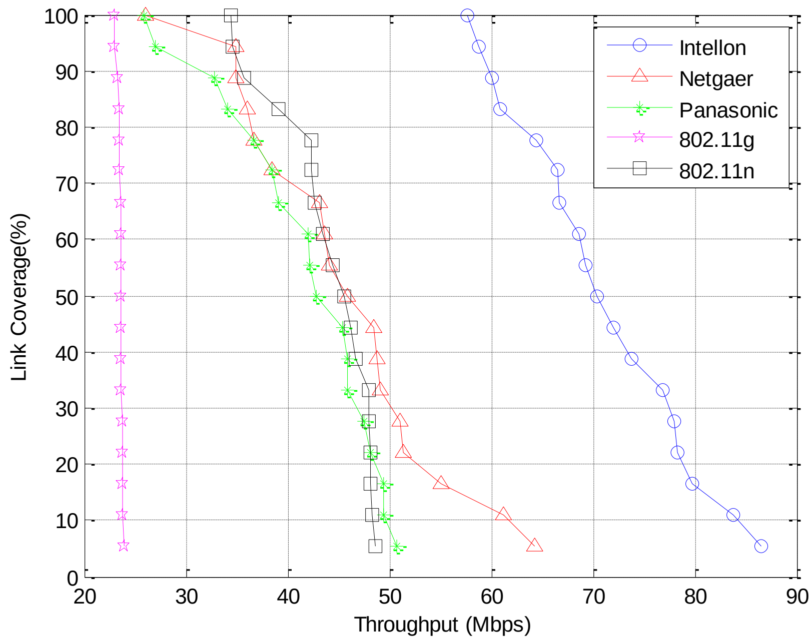

Figure 4. Link Coverage versus UDP Throughput

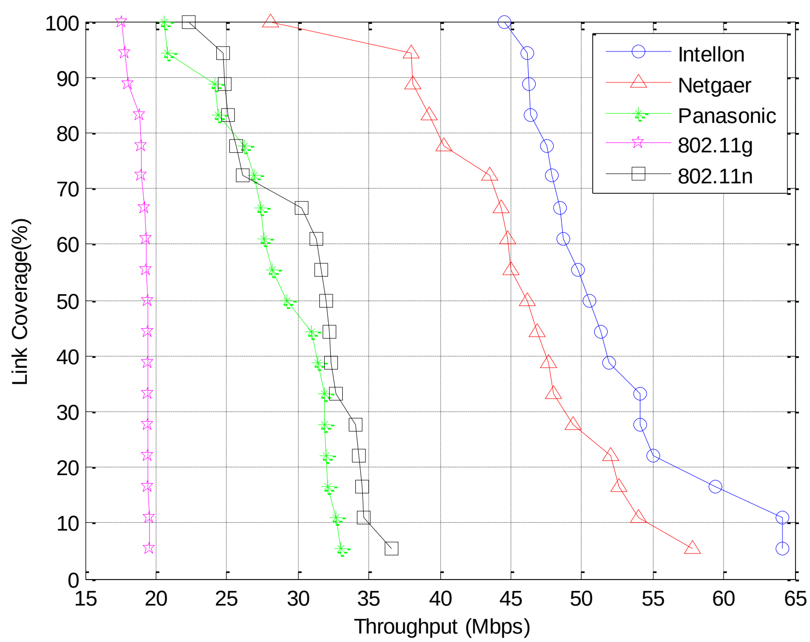

Figure 5. Link Coverage versus TCP Throughput

The experiment result of TCP throughput is shown at figure 5. As same with UDP test result, Intellon's RD 6300 has the highest maximum TCP throughput. Around 77% of connections with RD 6300 modem operated at more than 47 Mbps. The 77% of connections with netgear's HDX101 product operated over 40 Mbps. For Panasonic's PLC adapter BL-PA100 and IEEE 802.11n ad hoc mode , 77% of connections operated over 25 and 26 Mbps respectively. Though IEEE 802.g has lowest TCP throughput comparing with other technologies it shows most stable output.

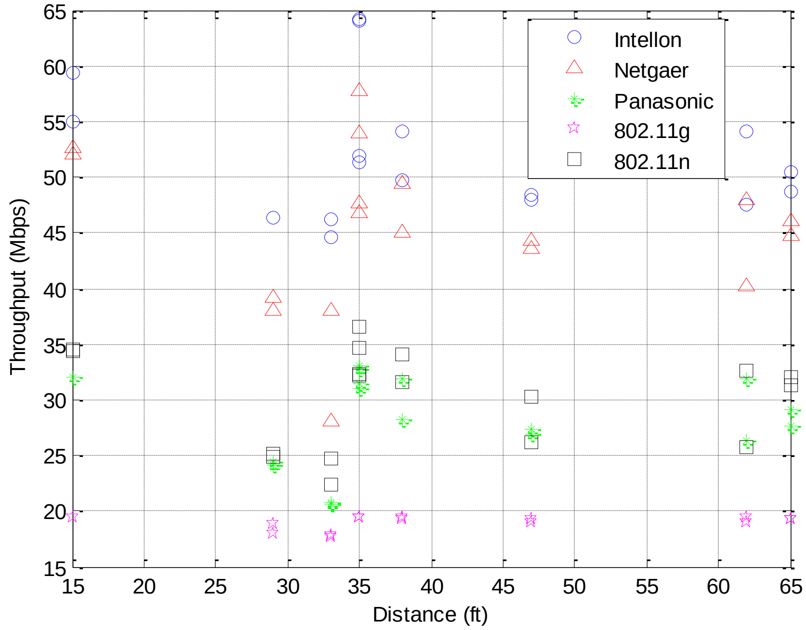

Figure 6. TCP Throughput versus Distance of Direct Path

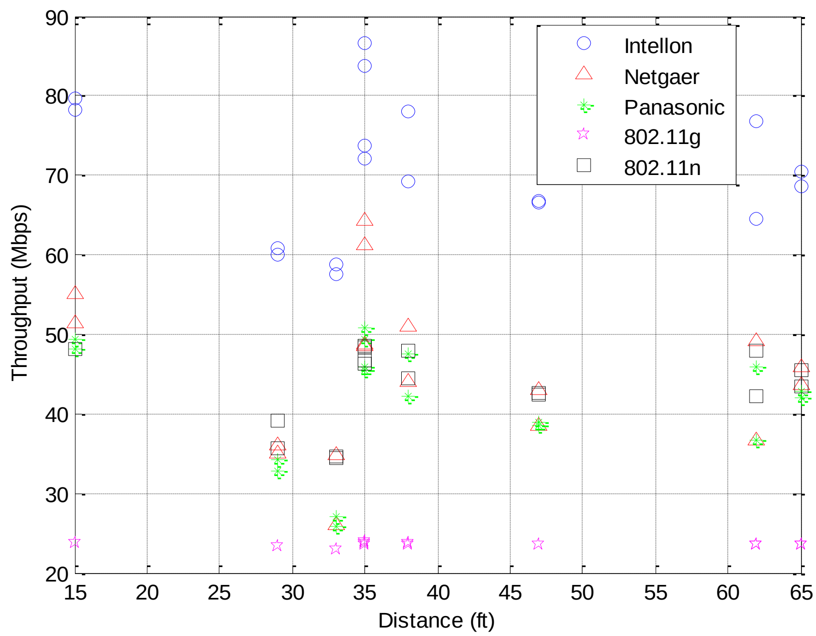

Figure 7. UDP Throughput versus Distance of Direct Path

The relationship between throughput and direct distance is also evaluated. Figure 6 shows result of TCP test and figure 7 shows result of UDP test. We can not find any relationship between throughput and direct distance for wireless LAN and Power line communication. Especially IEEE 802.11 g technology shows almost stable result irrespective of distance of path.

4. Conclusion

This paper presents performance measurement result of several power line communication technologies and IEEE 802.11 g and n specifications for supporting multimedia database system. The real throughput of each technology was measured with both UDP and TCP protocols. The result shows Homeplug AV product has most high throughput and all products provide full connectivity for all paths. The Homeplug AV product would be best choice for home network infrastructure for supporting multimedia database system among the tested power line communication and wireless LAN products.

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