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Comparison of Transmission Media for Next Generation Home Network

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Abstract Transmission media for the next generation home network (NgHN) are compared. Interference from microwave ovens is measured for wired/wireless transmission. Characteristics of optical and metallic cables are also compared. It is concluded that optical cable is the most promising medium for the NgHN.

1. Introduction

The number of FTTH (Fiber-To-The-Home) users is increasing, but their number in Japan is exploding. At the end of 2005, the number was over 4 million and at the end of Sept., 2006, it was over 7 million. The number will exceed 30 million by 2010. The rate of acceptance is significantly higher than for any other broadband medium such as ADSL (Asymmetric Digital Subscriber Line). The major service is the triple player of video, Internet, and VoIP [1]. The new players will be broadband services such as a higher resolution video and on line gaming.

Next generation home network (NgHN) will accommodate high resolution video/TV, a variety of home appliances/terminals, VoIP (Voice over IP), and plenty of sensors [2]. Research is rapidly advancing in several areas [3]. We consider here the broad classes of transmission media i.e. wired/wireless with various bandwidths.

Video applications create burst traffic with steep peaks and idle periods. DVTS (Digital Video Transport System), which will become common in the home, outputs peak traffic of more than 100 Mbit/s while its average is around 30 Mbit/s [4]. In order to maintain the required QoS (Quality of Services), wired, or optical fiber transmission is indispensable for NgHN.

The NgHN configuration that uses optical fibers to the fullest extent has been not adequately discussed because the kinds of terminals/appliances and their QoS requirements have not been settled yet. The authors presented the characteristics of transmission cable in terms of cable length for an NgHN house [5].

This paper first compares the transmission characteristics of both wireless and wired transmission by evaluating the interference from microwave ovens, a common home appliance. Wired media are also compared.

2. Comparison of wireless/wired transmission

The average home has several appliances that emit electromagnetic waves. This may cause electro-magnetic interference (EMI) problems for the transmission medium configuring NgHN. The EMI from a microwave oven, a very common appliance, was measured. Figure 1 shows the experimental set-up. A data quality analyzer (Anritsu, MD1230B) transmitted 54Mbit/s IP traffic with packet size of 1508 Bytes. The traffic was returned to the analyzer via wireless LAN (IEEE802.11g) access point and a wireless bridge. The distance between the commercially available microwave oven (600 W power) and the access point was 7m considering the maximum room size. The wireless bridge was located on concentric circle: Positions a, b, c.

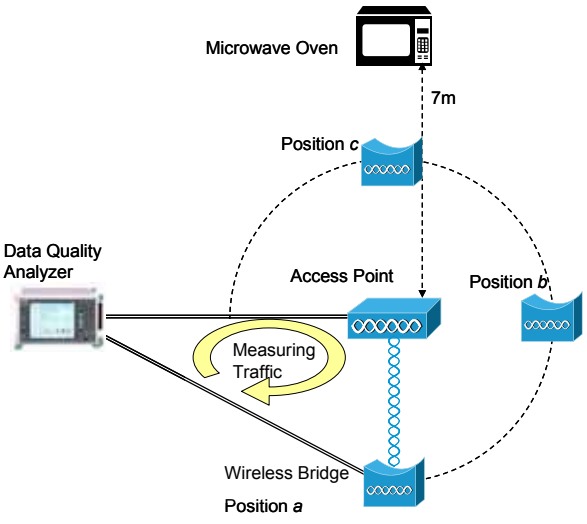

Fig.1 Experimental set-up

Packet loss was measured while changing the distance between the access point and wireless bridge. Figure 2 shows the measured results. The result clearly shows that packet loss varies from several percent up to 30 percent depending on the location of the wireless devices.

The EMI from the same microwave oven on optical or metallic cables was also measured using 1 Gbit/s IP traffic with the same analyzer as shown in Fig.1. Optical cable used was plastic optical fiber (POF) [6] while the metallic cable was Ethernet category 5e. No packet loss was observed for these cables.

The quality of the video streaming application, which will be a dominant NgHN service, is degraded by packet loss. Therefore, wireless transmission is impractical for NgHN use.

3. Comparison of optical and metallic cables

To compare optical and metallic cable, bandwidth and cable length are important points. Video terminals have the highest demands, ranging from several Mbit/s to several tens of Mbit/s depending on the quality. Future video terminals may have much higher demands. The video application creates burst traffic with steep peaks and idle periods. The DVTS (Digital Video Transport System) outputs peak traffic of more than 100 Mbit/s with average rate of around 30 Mbit/s [4]. The total bandwidth needed will be around a few Giga bit/s. Both optical and metallic cables satisfy this requirement, but metallic cable offers a transmission range of only 100m. Optical fiber is superior in terms of transmission range and bandwidth and by using WDM (Wavelength Division Multiplexing), more effective broadband transmission can be realized [5].

Cable weight and diameter are also important points in implementing the NgHN. UTP (Unshielded Twist Pair) cable weight for Ethernet is 34 g/m, and its diameter is 6 mm. Multi-mode optical fiber cable weighs 10 g/m, and its diameter is 4.6 mm. General duct diameter in an average home is 24 mm. Therefore, more than 20 multi-mode optical fiber cables can be installed in a duct, while only several UTP cables could be. Therefore, optical fiber has much higher scalability than UTP cable to expand the network.

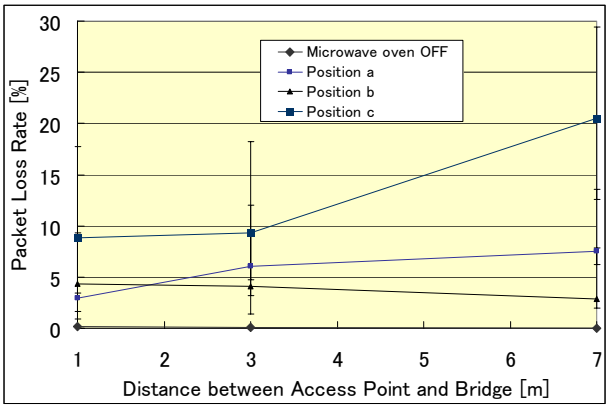

Fig.2 Influence of Electromagnetic Wave

Considering the cable length needed, traffic characteristics and cable characteristics, optical fiber will be preferred for the NgHN. Metallic cables might be used, however, depend on the length, bit rate used, and the number of cables installed in a duct. Other considerations such as connectivity, cost, and ease of installation should be examined to choose the optimum medium.

4. Conclusion

The transmission medium for the next generation home network (NgHN) was discussed. Interference from microwave ovens on wired and wireless transmission was measured. Wireless transmission suffered high bit error rates and so is problematic for the NgHN.

Traffic characteristics for the dominant NgHN application, video, were elucidated. Some cable characteristics were compared. Considering all of the requirements, optical fibers are the most promising medium for the NgHN.

References

[1] NTT-East, “Optical Triple Players”, http://flets.com/pr/triple/internet/

[2] K. Oguchi, “Next generation home networks and relevant technologies”, OECC2005, Paper 8B2-1, pp.782-783, Seoul, Korea, July, 2005

[3] ”Special session: Plastic Optical Fiber”, OECC2005, Seoul, Korea, July, 2005

[4] K. Tojo, T. Murooka, and K. Oguchi, ”Measurement of burst traffic characteristics of next generation home network”, OECC2005, Paper 6A4-6, pp.166-167, Seoul, Korea, July, 2005

[5] K. Oguchi, T. Okodo, K. Tojo and K. Okada, “Transmission Medium of a Next Generation Home Network”, OECC2006, paper 6E1-1-1, Kaohsiung, Taiwan, June 2006

[6] T. Taniguchi, H. Sueyoshi, T. Kawakami, and K. Oguchi, “1-Gbps home network link system with plastic optical fiber cable”, submitting to OECC/IOOC2007, Yokohama, June 2007