

Overview and Future Trends of the Japanese Wireless Access Systems

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ABSTRACT

Broadband access system is now rapidly growing in Japan. In this presentation, overview and future trend of the Japanese wireless access systems are introduced comparing with the wired broadband access systems. Also the overview of the technologies and application areas are introduced. In the final part, some new technologies are proposed.

INTRODUCTION

Broadband access system is now rapidly penetrating into the home and small office applications. For the supplement of wired system, wireless systems are going to introduce and also new systems are being developed. In this presentation, overview and future trend of the Japanese wireless access systems are introduced comparing with the wired broadband access systems. [1] Japanese wireless access are roughly divided by three categories, one is narrow band access that is based on the mobile phone services, another one is high speed access systems those are based on the microwave wireless LAN, and the other is ultra high speed wireless access systems based on the millimeter band. Over view of the technologies and application areas are introduced for these categories. In the final part, the Radio Agents are proposed to utilize radio spectrum flexible and high efficiency. Also the Wireless over IP (WoIP) is proposed to establish full IP wireless networks.

VARIOUS ACCESS METHODS IN JAPAN

(1) WIRED BROADBAND ACCESS SYSTEM

Number of subscribers of the broadband access systems are shown in Figure 1. Subscribers of the public switched telephone network (PSTN) is about 50 millions, and it is now decreasing 5 millions/year. Subscribers of ISDN service is about 10 million. These systems has 64kbps to 128kbps and 10 yen/3 minutes. Some carrier provides flat rate service, i.e. 2,900yen/month. This service area is almost all part of Japan. Dial up internet access user is 20 millions.

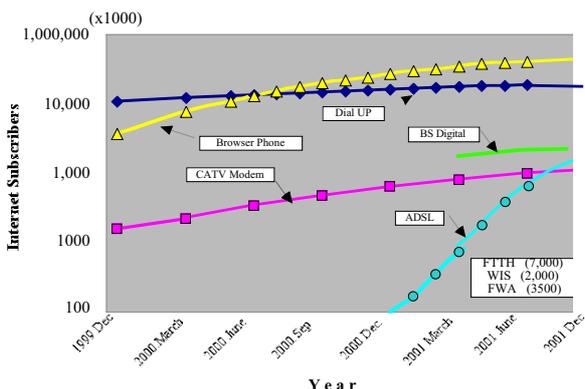


Figure 1. Subscribers of the various access methods

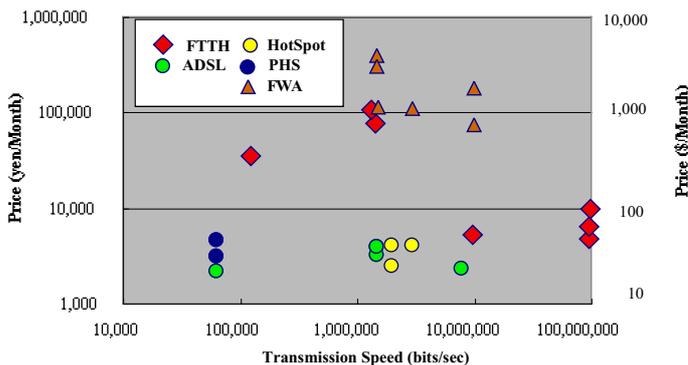


Figure 2. Price and transmission speed of various systems

Another access system is ADSL, that transmission speed is maximum 8Mbps for down link and 300kbps for up link. This speed depends on the distance between subscriber and end office, and the interference from other subscribers especially from ISDN services, because Japanese ISDN has different standard. From the field trial, more than 80% users that has less than 2km distance from telephone office can use 6Mbps. Price is about 3,000 yen/month excluding provider access charge. This service is available for large city. Subscribers are now rapidly growing and reached to 2 millions.

FTTH service is now available in the major part of metropolitan area, and has more than 10Mbps for the shared access, and more than 100Mbps speed for non-shared access. Price is about 4,000 to 5,000 yen/month for family use, and about 8,000 yen/month for business use, excluding provider access charge.

Price and transmission speed of various systems are summarized in Figure 2.

(2) WIRELESS ACCESS SYSTEMS

Wireless access systems are roughly divided by three categories, one is narrow band access that is based on the mobile phone services, another one is high speed wireless access system that is based on the microwave wireless LAN, and the other is ultra high speed wireless access system based on the millimeter band or higher part of microwave band.

(a) Mobile Phone System

First category is mobile phone system, 2nd generation PDC system has the bit rates of 10 to several 10s of kbps, and service area is all part of Japan. 3rd generation system has bit rate of 64 to hundreds kbps, however the service area of 3G system is now limited Tokyo and Osaka metropolitan area. Mobility of this system is very high speed, such as vehicular speed.

Price plans are very complicated. Basic fee is 2,000 to 8,000 yen/month, and some plan include speech communication fee and data communication fee, however they has no flat rate plan because of spectrum limitation. Packet services are also available. Subscribers are more than 65 millions. Internet access users are 47 millions, and the access basic fee of few hundreds yen is required to access to the internet service, and data fee is about 1yen/packets. Browser phone systems are named i-mode, EzWeb, J-sky, supports e-mail and compact HTML or WAP web browsing. Figure 3 shows the block diagram and protocol stack for the i-mode system. In this system, TCP/IP is not fully supported by the mobile networks, in spite of the mobile packet service DoPa supports TCP/IP in their terminal.[2]

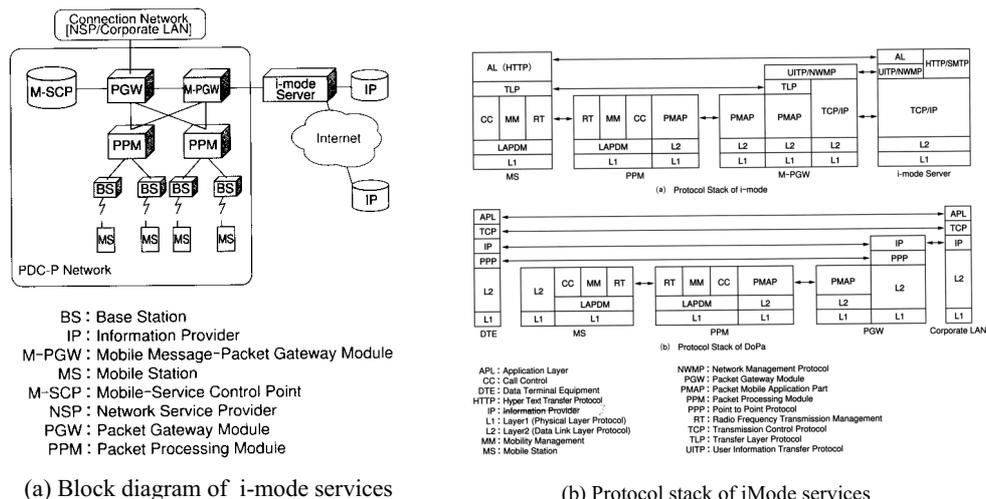


Figure 3. Block diagram and protocol stack for the i-Mode system

PHS system in Japan is unique system and that has 32 to 64 kbps speed, and access fee is 10yen/min. Some PHS carrier provide flat rate service at the charge of 3,000 yen/month. Subscribers are 5.7 millions.

(b) Wireless LAN system

IEEE 802.11b Wireless LAN system operating in 2.4GHz band is now gathering the population for the indoor wireless computer networks. Maximum speed is 11 Mbps, and the service area is about 100m when omni antenna is used. Using this standardized user premised equipment, hot spot access system experiments for outdoor are now conducting by the ADSL service providers. Extra charge is not certain, however the extra fee is none or few when the users are subscribed ADSL service in their home.

Another wireless LAN based on IEEE 802.11a and HiSWAN is now in test in Tokyo Area, and the system has maximum speed of 54 Mbps and utilize 5.2GHz. This system is restricted to use indoor only, to protect interfere to satellite sensor and meteorological radars. For outdoor use, new microwave bands are studied for allocation.

Wireless internet access system (WIS) is provided by several providers. These provider uses IEEE802.11b standard now and cannot use 11a, as the results subscriber capacity is low and number of subscribers are small for flat rate home access applications.



Figure 4. Hot spot application experiments "Bi Portable" in Tokyo area

(c) Fixed Wireless Access system (FWA)

High speed wireless access system is now mainly implemented to the point to point system use. This system is applied for the large business office networks, and compatible to FTTH access speed. Number of users are a few of about 3500, as same as FTTH. Point to multipoint system is now planned for small office or home use. This can support more than 30 M bps and support video service. Quasi millimeter and millimeter bands of 23/26/38GHz are allocated for FWA operator, and also 50GHz millimeter bands are allocated for private use, and 60GHz bands are allocated for unlicensed use at indoor and outdoor. These operation policy is similar to LMDS in USA, which utilizes 28GHz and 31GHz, without auction process. Figure 5 shows the spectrum allocation to FWA in Japan.

Another application area is radio access networks (RAN) between mobile base stations (BS) and mobile switching center(MSC) for 3G mobile services. For such networks, metallic cable was used in 2G system, however the high speed access system such as optical fiber is required for 3G, which is not easy to implement for wireless operator and not cost effective. Figure 6. shows such applications. These frequency bands are promising band for home networks in near future and also used for intelligent transportation systems(ITS), such as dedicated short range communication(DSRC) and electrical tool corection (ETC).

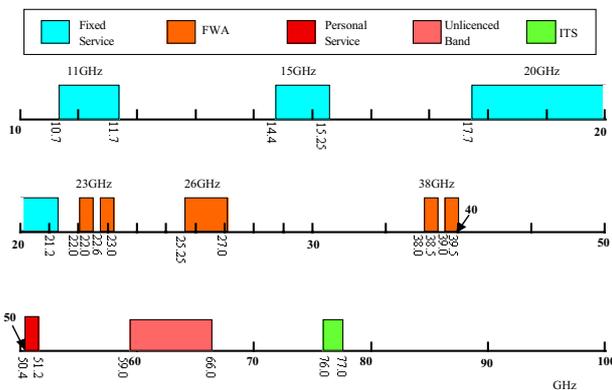


Figure 5. Spectrum plan for Japanese FWA system

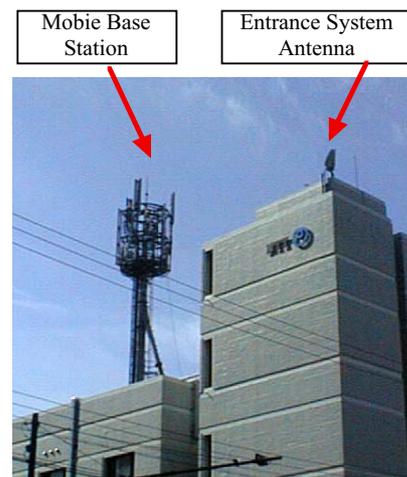


Figure 6. FWA applied for mobile access networks.

TECHNOLOGY TRENDS

High speed and high functional FWA and wireless home networks are now developed in Communications Research Labs. Japan (CRL) etc. [3] Figure 7 shows the block diagram and frequency plan. In these system, network considerations are necessary to enhance the spectrum utilization efficiency to much future internet traffic. Radio agents shown in Figure 8, will be necessary in near future, to enhance network flexibility and spectrum efficiency and inter connection capability of heterogenous mobile and wired networks.[4]-[6] Figure 9 shows the concept of wireless over IP (WoIP) networks that supports full IP services from mobile terminals.

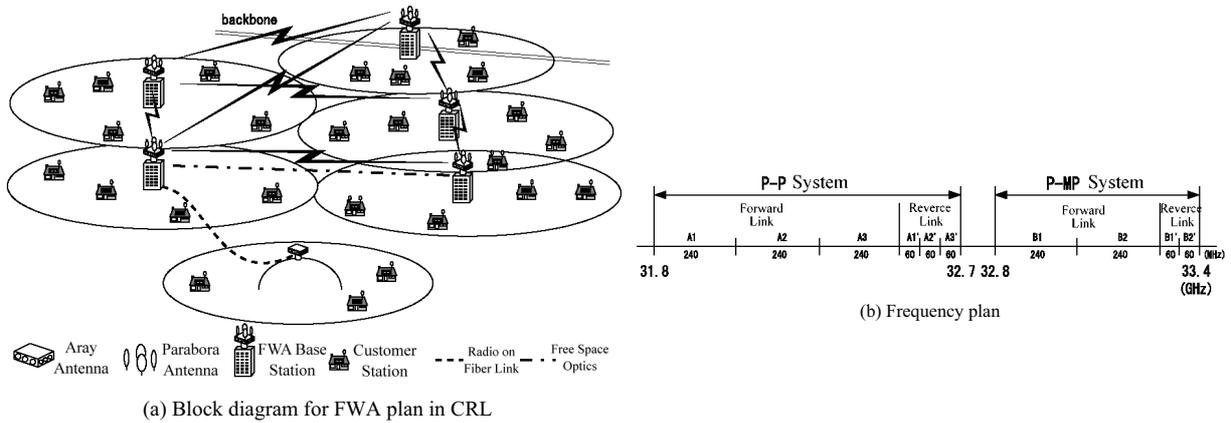


Figure 7. FWA system planning in CRL

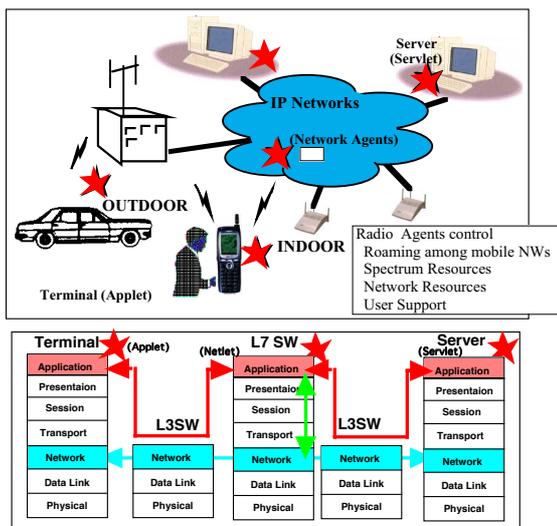


Figure 8. Radio Agents

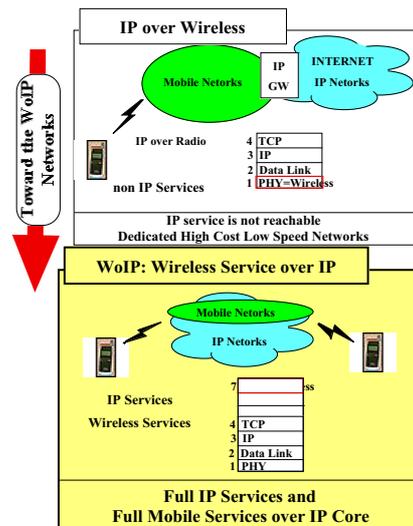


Figure 9. IP over radio to Wireless over IP

CONCLUSION

This paper summarizes the broadband access methods and services in Japan, and also some technology trends are introduced. In the final part, Radio Agents and wireless over IP (WoIP) are proposed to establish more flexible and efficient use of radio spectrum.

REFERENCES

- [1] Shozo Komaki, "Flexible and Open Spectrum Utilization for the Future Wireless Access Systems," Techno-Stream of NTT-AT, vol.25, No.1, pp2-7, Jan. 2002
- [2] Mitsuaki Hanaoka, et. al., "Special Issue on i-Mode Service Network System," Technical Journal of NTTDoCoMo, vol.1, No.1, pp14-24, Oct 1999
- [3] Eiji Okamoto, et. al., "Development of Millimetre-Wave Broadband Wireless Access System," 2002 National Conference of IEICE Japan, B-5-324 thru 331, March, 2002
- [4] Shozo Komaki, et. al., "Considerations on Open Frequency Intelligent Networks: OFINe," National Conference of IEICE Japan, SC-3-1, Sep. 1996
- [5] Shozo Komaki, "Software Radio Networks using Virtual Radio Free Space," MTT-S IMS Workshop, WMB III-5, June 1998
- [6] Ryoichi Shinkuma, et. al., "Adaptive Transmission Scheme for Web Prefetching in Wireless Environment," Trans. on electronics of IEICE Japan, Vol. E85-C, No.3, pp.485-491, March, 2002