공간변화에 따른 Wireless LAN의 통신 활용 범위에 관한 연구

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A Study on Application Boundary of Wireless LAN's Communication for Space Variation

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요 약

본 논문은 Wireless LAN을 이용함에 있어서 사용공간에 따른 이용 범위를 측정하고, 이를 참고하여 실사용 환경에서 Wireless LAN 환경을 구축하기 위한 참고, 자료로서 활용가능토록 측정되었다. 구성환경은 Wireless LAN의 미국 표준인 IEEE 802.11b 시스템을 기반으로 한 Wireless LAN을 대상으로 구성했으며, 캠퍼스 환경에의 적용이라는 전제를 가지고 실제 측정을 통하여 작성했다.

측정은 실사용 환경인 Office Environment와 Open Space 환경에서 이용 가능거리의 측정과 각 거리에 따른 신호의 S/N 비를 측정하여 학내 Wireless LAN 망 환경구현에 기초가 되는 데이터로서 측정했다. 단, 실내 환경에서의 측정은 기본 차폐물로서 벽이 2개 이상 존재할 경우를 대상으로 하였으며, 실외 환경에서의 측정은 차폐물이 없을 경우, 1차적인 차폐물이 존재할 경우, 그리고 2차적인 추가 차폐물이 존재할 경우를 나누어서 수행했다.

ABSTRACT

The objective of this thesis is to measure the limit of the real space where wireless Local Area Network (LAN) is used, and to apply this result as reference to set up a real Wireless LAN environment. The organized circumference was composed of Wireless LAN based on IEEE 802.11b of the American standard, and the examination is carried out on the campus.

On the real condition of office environment and open space, the ratio of available distance to a signal at each distance was measured and this result was studied as data to embody wireless LAN on the campus. The measurement under an indoor environment was executed under circumstance having two walls and open space, however, was executed respectively under three circumstances : Where no obstacle, where one wall exists, and where two or more walls exist.

키워드

AP, Wireless LAN, CSMA/CA, S/N rate

Ⅰ. Introduction

An information-oriented basis in today's society has been changing fast. In this today's society, to investigate the best efficiency of use of information, many studies to deal with mass storage of information, as well as the backbone network as a basic one, have been carried out. Wireless LAN, one of them, has been developed for the objective of alternation of Wired LAN, having the problem of Client movement at indoor environment and additional setup, but it has not caught attention broadly.

However, recently with the population of mobile devices such as PDA and laptop by coming mobile age, Wireless LAN becomes much highlighted. In

here, not only development of the backbone network but also high speed of Wireless LAN become the facilitation to make this population remarkable, and both expansion of the boundary based on this development and related studied are actively being progressed. In addition, another convenience in using Wireless LAN at outdoor environment becomes increased, and the study for this is also being progressed.

Accordingly, to overcome the limitation of embodying Wireless LAN network in given environment, real measurement on campus of Kyoung-sang University, Tong-young, is carried out; moreover, for the objective of establishing the basic data to use into outdoor application, the available distance at each environment is directly measured.

In this project, to conform the availability of Wireless LAN, a test is carried out under the condition of Office Environment and Open Space, and there are three kinds of Open Space: Where no obstacle, where one obstacle such as a street tree or street lamp exists, and where two or more walls exist. According to the condition and environment under testing, the analysis of real measured data, and the identification of available distance range, the followings are described: Tested results and analysis of these data, connection ability of technical development of currently studied Wimax and Wap of MS, etc.

II. Theoretical Basis

1. The outlines of Wireless LAN

Wireless LAN is being substituted for Wired LAN, or extended for Wired LAN by data communication system, and Wireless LAN is using RF technology. A transmission method of Wireless LAN for range, performance, data security prevails spread spectrum mode of Wireless LAN making use of ISM(Industrial, Scientific, Medical) Band.

Wireless LAN is using 2.4GHz and over band among ISM band : 902 - 928Mhz (26Mhz Band width), 2.4 - 2.4835Ghz (83.5Mhz Bandwidth), 5.725 - 5.85Ghz (125Mhz Bandwidth).

A transfer and control mode of Wireless LAN is using Spread Spectrum, DSSS, FHSS and OFDM, and a access mode of Wireless LAN is using a CSMA/CA(Carrier Sense Multiple Access / Collision Avoidance) mode.

2. Component and Component Elements of Wireless LAN

① Component Elements of Wireless LAN

• NIC(Network Interface Card) : NIC classify PCI, mini-PCI, PCMCIA, CF, USB, etc for interface, make use of a terminal and back up communication among networks.

• AP(Access Point): AP is specially configured nodes on wireless local area networks. AP acts as a central transmitter and receiver of WLAN radio signals.

AP used in home or small business networks are generally small, dedicated hardware devices featuring a built-in network adapter, antenna, and radio transmitter. AP supports Wi-Fi wireless communication standards.

Although very small WLANs can function without access points in so-called "ad hoc" or peer-to-peer mode, access points support "infrastructure" mode. This mode bridges WLANs with a wired Ethernet LAN and also scales the network to support more clients. Older and base model access points allowed a maximum of only 10 or 20 clients; many newer access points support up to 255 clients.

• Internal/External Antenna : Increase the separation between the equipment and receiver and connect the equipment to a circuit outlet other than the receiver's with AP.

• Feeder : Feeder is connect cable using each AP, NIC and Antenna

• Bridge : This connects wired Network to wireless Network or each AP

② Component of Wireless LAN

Wireless LAN can be embodied by the following methods:

• Ad hoc mode(Peer-to-peer)

- Make up only NIC
- Communication between Wireless Clients with Wireless Adapter Card
- Each Clients can be accessed other client

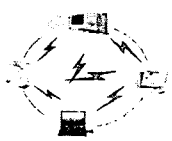

Fig.1 P-to-P mode

• Infrastructure networking(Client/Server)

- Make up AP and NIC
- Possibility Communication between Wireless Clients and the existing wired Network
- Single access points support average of only 20 or 30 clients

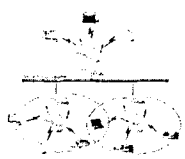

Fig. 2 Client/Server mode

• Expansion Point

When it is impossible to directly communicate by an obstacle, Wireless Bridge can be set up and used

as Expansion Point. That is, it functions as repeater. Expansion Point, which consists of two Bridge modules and two antennas, can be set up at proper distance detouring a obstacle.

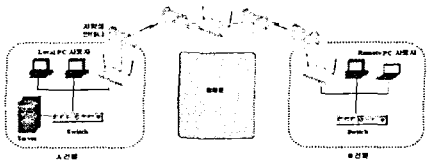

Fig. 3 Expansion point mode having fence

In addition, this organization can be utilized when network is set up at a broad area like the campus.

Fig. 4 Expansion point mode of broad space

Besides, this can be set up as wireless POS system at a big market place, as well as a network of service in a hospital, bank, hotel, etc.

III. Measurement Environment

1. Measuring Tool

Measuring Tools have being used that AP set is SWL 4000 AP(DA) of Magic LAN and Software is NetStumbler v0.4.0.

① Reason of choice

- Using without regulation for rental radio
- International IEEE802.11b Standard
- High Performance 11Mbps DSSS

② Features

- AP
- Radio : 2.400~2.4835GHz ISM Band
- Roaming : IEEE 802.11b
- Cell Coverage : Open Space 150m(11Mbps)
  Office Environment 30m(11Mbps)
- Transmission Mode : DSSS
- Modulation Mode : CCK, DBPSK, DQPSK
- Receiver Sensitivity : -84dBm (Typical), at 11Mbps
- NIC
- SWL-2100E
- PCMCIA Type Wireless LAN Card
- Radio : 2.4 - 2.48GHz
- Transmission Speed : 1, 2, 5.5, 11Mbps
- IEEE802.11b Standard
- Access Protocol : CSMA/CA
- SWL-2100P
- PCI Type Wireless LAN Card
- Radio : 2.4 - 2.48GHz
- Transmission Speed : 1, 2, 5.5, 11Mbps
- IEEE802.11b Standard
- Access Protocol : CSMA/CA
- External Omni- Directional Antenna

Using in NIC and AP of Wireless LAN environment secure settled transmitting and receiving data both AP and node.

- 360° Wireless Link Support
- Gain : 11dBi, 15dBi
- Max transmission distance : 1.5Km
- Software

Windows that allows you to detect Wireless Local Area Networks (WLANs) using 802.11b, 802.11a and 802.11g. It has many uses:

- Verify that your network is set up the way you intended.
- Find locations with poor coverage in your WLAN.
- Detect other networks that may be causing interference on your network.
- Detect unauthorized "rogue" access points in your workplace.
- Help aim directional antennas for long-haul WLAN links.

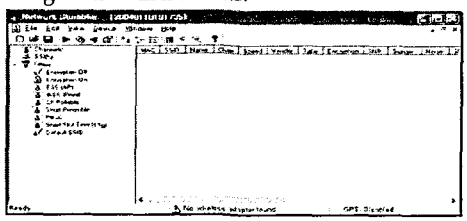

Fig. 5 Network stumbler V.4.0

2. Measurement Environment and analysis

① Measurement Environment

- Measurement Period and Climate

Measurement was made fourth, and was ruled out an indefinite data. Measurement can be embodied by the measure environment

Table.1 The measure environment

Measurement Period		Cloud Cover	Humidity	Wind Velocity	Min/max Temperature
Number of Measurement	Day				
Primary	2004.11.10	8.0	84.6	4.7	16.0/21.5
	~	~	~	~	~
	11.20	0.1	57.0	2.2	7.9/16.8
Secondary	2005. 1.29	3.5	56.4	2.9	-0.4/7.8
	~	~	~	~	~
	2. 3	0.0	54.4	1.8	-4.9/4.4
Tertiary	2.14	6.8	60.3	3.3	-2.4/9.0
	~	~	~	~	~
	2.25	0.9	34.8	3.4	-1.6/6.5
Fourth	3.20	4.0	43.5	2.5	6.1/13.2
	~	~	~	~	~
	3.28	3.0	60.6	3.2	8.1/18.9

• Measurement Range

Measurement make experiment on Office Environment and Open Space, and Transmission Speed is 11Mbps. Measurement in office environment make experiment on 10m,15m, 20m, 25m, 30m, 35m, 40m and 45m , and measurement in open space make experiment on 90m, 100m, 110m, 120m, 130m, 135m, 140m, 150m, 155m, 160m, 165m, 170m and 175m.

The qualification on measurement have an obstruction which exist two wall in office environment and nonexistent obstruction, one obstruction, two obstruction on open space.

Measurement make an experiment on office environment with comparatively regular obstacle and open space with comparatively irregular obstacle.

IV. Measurement and Analysis

1. Office Environment

The range in common use on manual is maximum 30m at 11Mbps. Measurement in office environment make experiment on 10m, 15m, 20m, 25m, 30m, 35m, 40m and 45m at 11Mbps transmission Speed.

The test at 45m can not receive a signal and measure S/N rate form AP. Indoor test using Magic LAN can be obtainable the results of an examination that could keep in touch to range of 45m.

Measurement in an experiment was verified that basic data for the result obtained make Wireless NAN network in office environment and lecture room.

The figure below shows the analysis of data for each measured distance. The following figure shows an example of analysis of data for each measured distance.

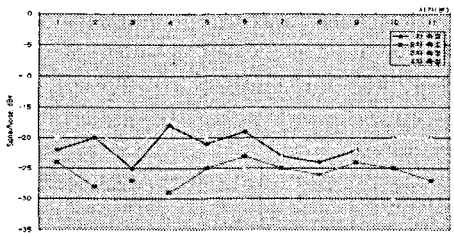

Fig. 6 S/N rate of 10 meters distance in office environment

The data obtained from a test of an office environment can be arranged as the following. The following figure shows the measured values based on both graphs and averages.

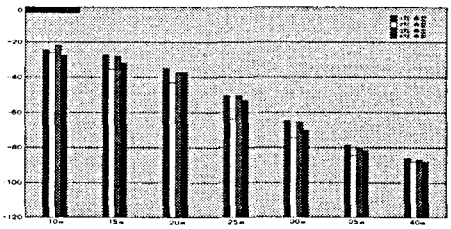

Fig. 7 S/N rate to distance in office environment

In addition, both reflected waves and factors on interfering electric waves, which affect speed of network connection, should be considered.

2. Open Space

The range in common use on manual is maximum 150m at 11Mbps . The outdoor test was divided into three cases and individually measured: Where no obstacle, where the one obstacle exits, and where additional obstacles exist.

The range of measurement make experiment from 90m to 175m at intervals of five meter or ten meter at nonexistent obstruction, from 100m to 165m at intervals of five meter or ten meter at one obstruction and from 90m to 135m at intervals of five meter at second obstruction.

① Open space without a hedge

In case of outdoor test without obstacle, high speed Wireless LAN with 11 Mbps was stably embodied within 150 meters; however, from the new testing, it was verified that the result obtained about no obstacle was 170 meters.

The data obtained from a test of open space can be arranged as the following. The following figure shows the measured values based on both graphs and averages.

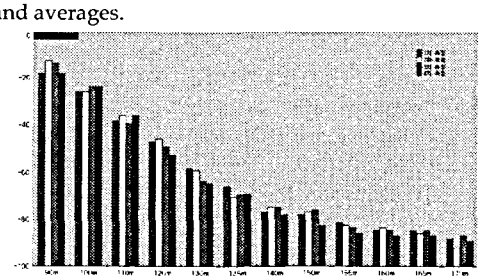

Fig. 8. S/N rate to distance in open space without a hedge

② Open space with primary hedge

Where primary obstacle existed, it was verified that the result was 165 meters for high speed Wireless LAN with 11 Mbps, and intensity of signal

was obviously decreased on open space with trees, streetlight, benches etc.

The data obtained from a test of open space with primary hedge can be arranged as the following. The following figure shows the measured values based on both graphs and average

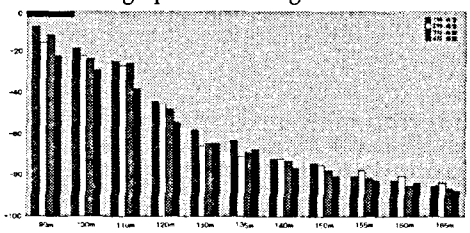

Fig. 9. S/N rate to distance in open space with primary hedge

③ Open space with secondary hedge

Where second obstacle existed, it was verified that the result was 130 meters, and intensity of signal was obviously decreased.

The data obtained from a test of open space with secondary hedge can be arranged as the following. The following figure shows the measured values based on both graphs and averages.

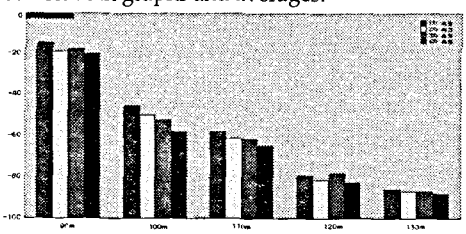

Fig. 10. S/N rate to distance in open space with secondary hedge

V. Conclusion

In this project, according to Wireless LAN based on IEEE 802.11b, the test able to be used as fundamental data, which are necessary to embodying Wireless LAN network on campus, was measured and analyzed by using signal level and distance measured under real used environment.

The indoor test was carried out for more than two walls as basic obstacle; however, the outdoor test was divided into three cases and individually measured: Where no obstacle, where the one obstacle exits, and where additional obstacles exist.

The result obtained from indoor test showed that to construct high speed, stable Wireless LAN of 11 Mbps from AP, a distance of 30 meters was proper. However, causing error of real distance range, other factors were excluded for reliable test. From the real measurement, the maximum distance available for Wireless LAN network was 40 meters.

In case of out door test without obstacle, high speed Wireless LAN with 11 Mbps was stably embodied within 150 meters; however, from the new testing, it was verified that the result obtained about no obstacle was 170 meters, and the result obtained about one obstacle was 165 meters.

On the contrary, where second obstacle existed, it was verified that the result was 130 meters, and intensity of signal was obviously decreased. To embody Wireless LAN network, these results should be considered. Moreover, since there is much interference such as jamming elements or a reflected wave, the effect caused by these factors should be also studied. This complementary study can be used as basic data for more exact result.

The efficiency of Wireless LAN showed that with potential of expanding the Wireless LAN network range, it could be embodied as backbone network wherever no obstacle existed. The technical development of Wimax and Wap of MS helped verify the possibility of Wireless LAN in real environment.

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