Wireless LAN Radio Monitoring Scheme

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Abstract

Wireless local area network (LAN) systems have become familiar wireless access solutions in homes, offices, and public spaces and this trend is being strengthened by the advent of wireless IP-phones (IP: Internet protocol). This article describes a wireless LAN radio monitoring scheme that makes it easy to acquire key radio parameters and a wireless LAN access point monitoring tool that simplifies the installation of access points.

1. Introduction

More and more people are starting to use optical fiber communications in homes and offices. Most people would like to have wireless LAN (local area network) systems for their home networks. In the office, users are constructing all-IP (Internet protocol) networks and want to install wireless IP-phone systems. Even personal wireless IP-phones are starting to appear in Japan. However, wireless LAN systems may not achieve the expected performance due to the influence of other access points.

We have developed a wireless LAN radio monitoring scheme that measures the key parameters associated with system performance. We have also developed a wireless LAN access point monitoring tool that makes good use of the scheme. This article gives an overview of the monitoring scheme and presents the main specifications of the monitoring tool and shows some examples of the tool's uses.

2. Conventional radio monitoring scheme

The main system parameters are throughput and delay. To measure these parameters, the conventional approach is to establish a mini network, as shown in **Fig. 1**, because if "echo request" and "echo reply", commands of ICMP (Internet control message protocol), were used as a delay measurement scheme, it would not be possible to achieve sufficient precision. To measure the throughput, a server must be connected to an access point through the network and a special device must be installed to measure the delay. To construct networks, we must set IP configurations such as the IP address and subnet mask and set up wireless LAN configurations such as a service set identifier (SSID) and a wired equivalent privacy (WEP) key. Thus, the conventional scheme requires the user to have knowledge about IP networks and wireless LAN systems.

3. Wireless LAN radio monitoring scheme

Our wireless LAN radio monitoring scheme can investigate the throughput and delay easily without an access point being installed in the network. It does not require the user to provide and use networking equipment, so users do not need knowledge about IP networks or wireless LAN systems. It consists of two schemes for measuring the throughput and estimating the IP-phone quality, as shown in **Fig. 2**.

3.1 Throughput measurement scheme

The throughput measurement scheme (Fig. 2(a)) does not have to be associated with an access point. Here, association is the process by which a mobile

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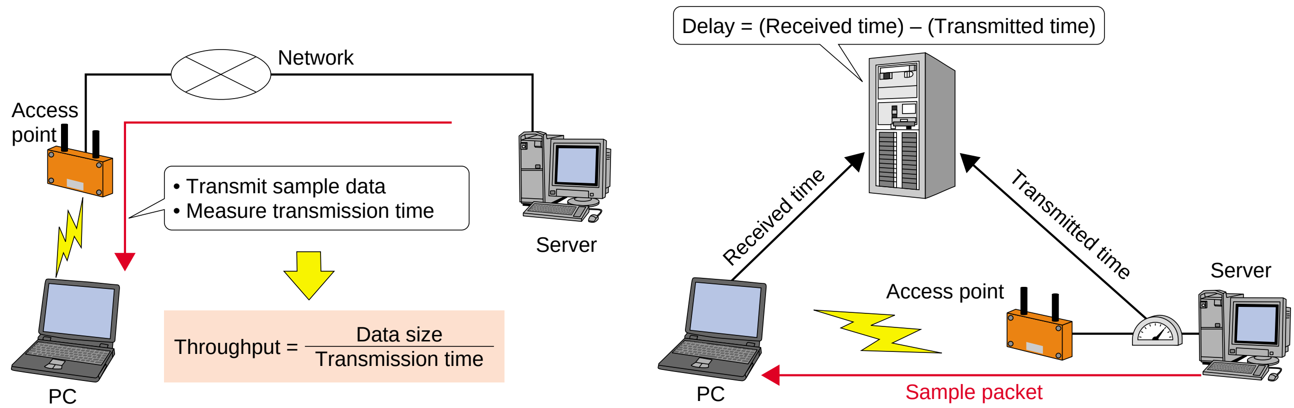


(a) Throughput measurement scheme
(b) Delay measurement scheme

Fig. 1. Conventional scheme.

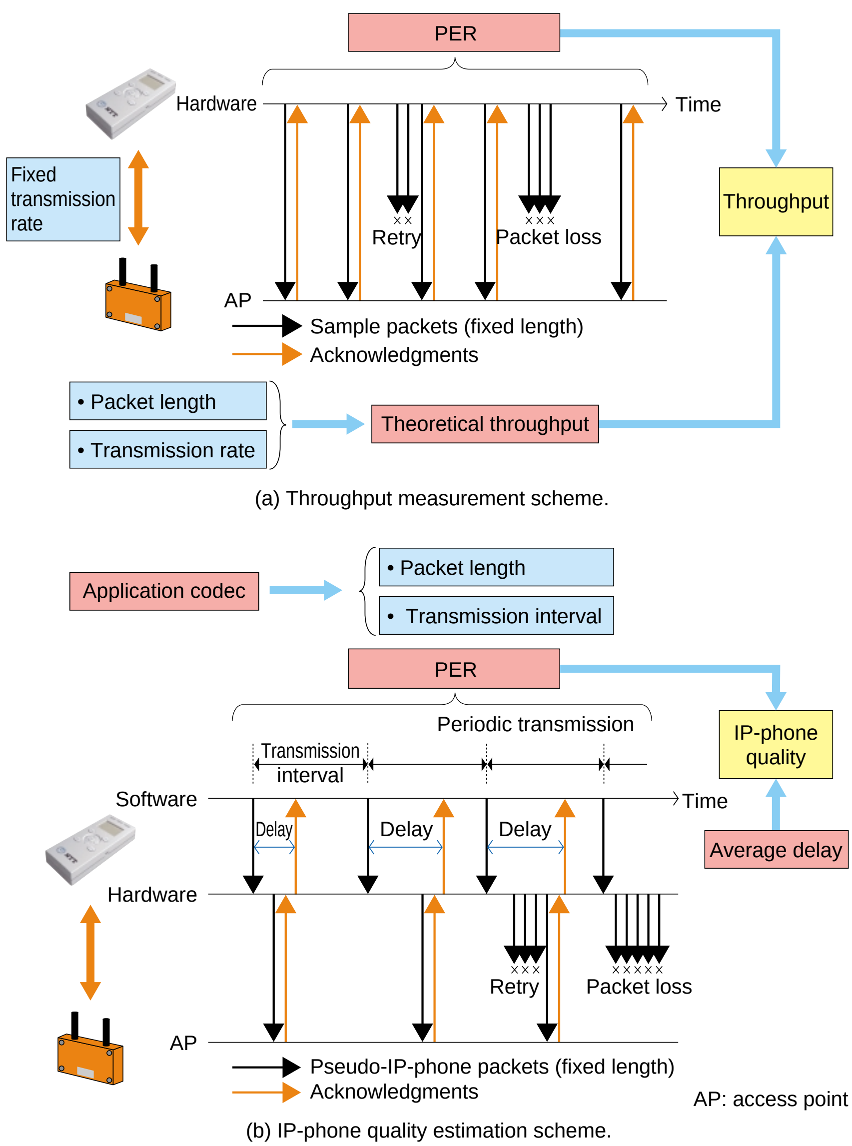


Fig. 2. Wireless LAN radio monitoring scheme.

station joins a wireless LAN network; it is logically equivalent to plugging in a network cable of an Ethernet network. This scheme can get the packet error rate (PER) and calculate the throughput from it. In most wireless LAN systems, the transmission rate is optimized dynamically according to radio conditions. However, our scheme transmits fixed-length sample packets at a fixed transmission rate to an access point. It counts the number of sample packets transmitted and the number of acknowledgments received and then calculates the PER from these values. It then calculates the throughput from the PER and also calculates the theoretical throughput from the transmission rate and the packet length of the sample packets. In actual environments, the transmission rate can vary even at the same measurement point and the packet length can vary even if the same application is used. Therefore, the results of our scheme do not always correspond to reality. However, the ratio of its values to those of the conventional scheme is constant, as verified by experiments.

3.2 IP-phone quality estimation scheme

The main factors degrading the quality of an IP-phone are packet losses and delays. Our IP-phone quality estimation scheme (Fig. 2(b)) focuses on these factors. It transmits pseudo-IP-phone packets to an access point without any association and measures the PER and the average delay. Most IP-phone packets have a fixed short length and a constant transmission interval. The packet length and transmission interval are decided depending on the type of codec used. Therefore, the parameters of the pseudo-IP-phone packets are decided based on these considerations.

Delay is generated when a transmission opportunity is missed as a result of either contention or transmission errors. Our scheme measures the average delay, where the delay is taken as the period from the generation of a pseudo-IP-phone packet to the reception of its acknowledgment. It also calculates the PER from the number of pseudo-IP-phone packets transmitted and the number of acknowledgments received. From the average delay and the PER, it is possible to estimate the IP-phone quality.

4. Wireless LAN access point monitoring tool

The wireless LAN access point monitoring tool is shown in **Fig. 3** and its specifications are given in **Table 1**.

4.1 Miniaturization

To enable it to be used just like a wireless IP-phone, it is compact and weighs about 160 g. For simplicity, it runs on two AA batteries.

4.2 Wireless LAN standards supported

It supports all current wireless LAN standards in Japan: IEEE802.11a, b, and g. It can detect all access points, whichever standard is used.

Fig. 3. The wireless LAN access point monitoring tool.

4.3 Main functions

The main functions of the tool are described below.

(1) Display of peripheral access points

The tool can detect the beacons from peripheral access points and analyze the following characteristics of each one.

- SSID
- Channel number (frequency used)
- Received signal level
- Wireless LAN standard
- MAC (media access control) address
- Security level

This function enables the user to understand the status of peripheral access points, so he or she can select the target access point for monitoring radio performance.

(2) Display of channel numbers in use

The tool can visually show the received signal levels by the channel number. The user can easily check the channel numbers already in use and can thus decide the channel number to be used when setting a new access point.

(3) Display of radio status

The tool can automatically update the following parameters of the selected target access point.

- Received signal level
- Received noise level
- Optimum transmission rate

5. Utilizing the wireless LAN access point monitoring tool

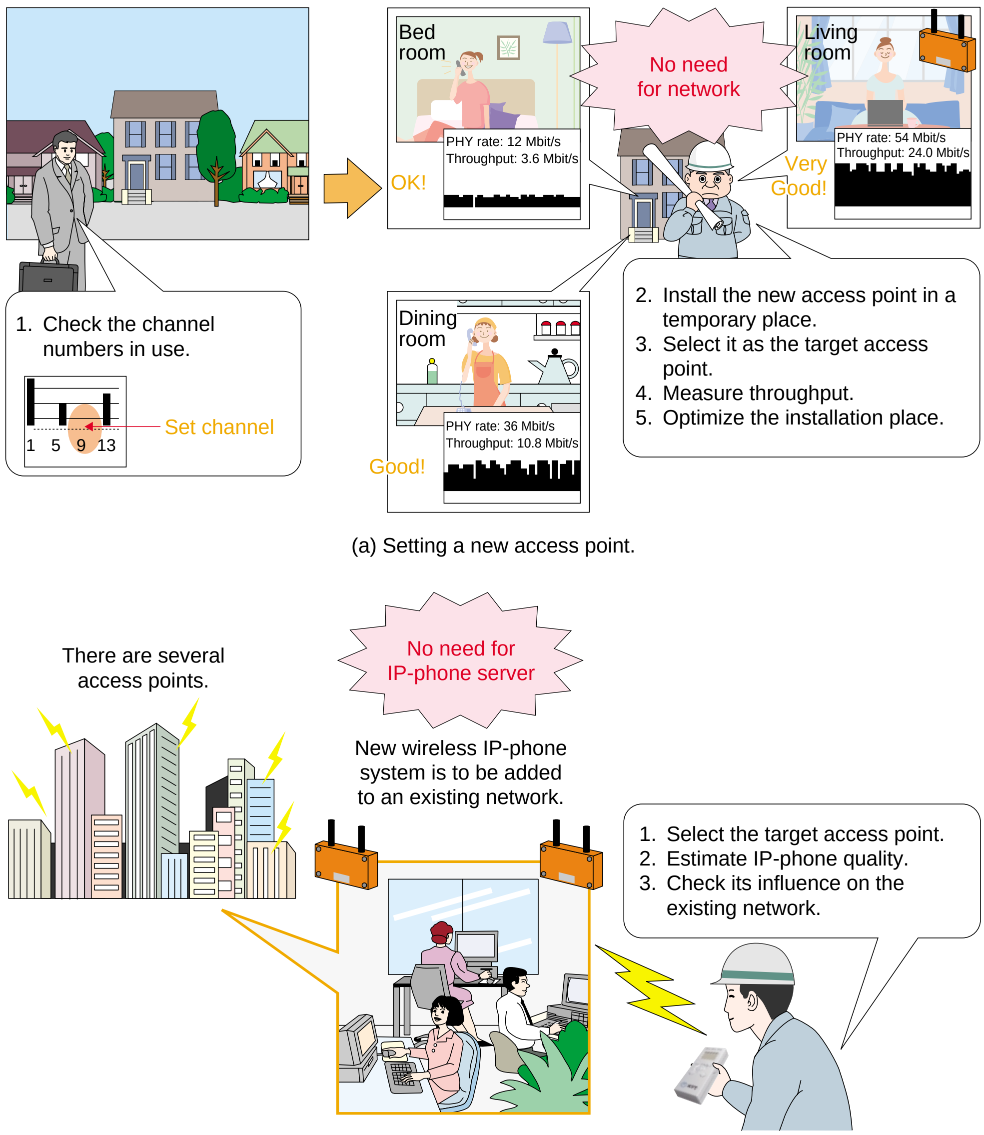
Here, we introduce two examples of utilizing the tool (**Fig. 4**).

5.1 Setting a new access point

In this case, we assume that the user wants to set up a new access point (Fig. 4(a)). First, the user checks the channel numbers already in use by using the "dis-

Table 1. Specifications.

Size	60 mm × 140 mm × 20 mm
Weight	160 g
Power	Two AA batteries
Supported wireless LAN standards	IEEE802.11a, b, and g
Main functions	• Display of peripheral access points • Display of channel numbers in use • Display of radio status • Throughput measurement scheme • IP-phone quality estimation scheme



(b) Checking wireless IP-phone introduction.

Fig. 4. Examples of using the wireless LAN access point monitoring tool.

play of channel numbers in use" function on the wireless LAN access point monitoring tool. Based on the results, he decides the channel number for the new access point. Next, he must determine the optimum placement. He installs the new access point in a temporarily place and selects it as the target access point using the "display of peripheral access points" function at several typical mobile locations. He then confirms whether it can be used by means of the "throughput measurement scheme" function after checking the transmission rate with the "display of radio status" function. The placement of the access point is changed until adequate performance is achieved.

5.2 Checking wireless IP-phone introduction

In this case, we assume that a new wireless IP-phone system is to be added to an existing network that has several access points (Fig. 4(b)). First, the user should select the target access point by means of the "display of peripheral access points" function. Though several access points may have the same SSID, the wireless LAN access point monitoring tool can distinguish them based on their MAC addresses. Next, the user measures the IP-phone quality degradation factors such as the PER and the delay via the "IP-phone quality estimation scheme" after checking the received signal level via the "display of radio status" function. Thus, he judges the feasibility of introducing the wireless IP-phone system into the existing environment or whether an additional access point is necessary. When the wireless IP-phone system is actually installed, its influence on the existing network can be verified because the wireless LAN access point monitoring tool actually sends the pseudo-IP-phone packets to the access point.

6. Conclusions

Our wireless LAN access point monitoring tool, which is based on a wireless LAN radio monitoring scheme, can assess the communication quality of wireless LANs easily even if the user has no knowledge about wireless LANs and does not know the network configuration.

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