# Wireless LAN Tester Conformable to IEEE802.11ac

**Abstract**

This article describes the development and introduction of a wireless LAN (local area network) tester conformable to the IEEE802.11ac standard. This is the thirty-second article in a bimonthly series on practical field information on telecommunication technologies. This month's contribution is from the EMC Engineering Group, Technical Assistance and Support Center, Maintenance and Service Operations Department, Network Business Headquarters, NTT EAST.

*Keywords: wireless LAN tester, IEEE802.11ac, access point*

## 1. Introduction

The proliferation of mobile terminals equipped with wireless local area network (LAN) functions has led to the installation of wireless LAN access points (APs) both indoors and outdoors and to the creation of Internet connection environments in diverse places.

In addition, the new IEEE*802.11ac wireless networking standard was approved in January 2014 with a maximum theoretical bit rate of 6.9 Gbit/s. In line with these trends, NTT EAST has been increasing the provision of telecommunication services using wireless LAN. For example, it has made its fifth-generation home gateway conformable to IEEE802.11ac and begun providing FLET'S HIKARI optical broadband services capable of gigabit-level communications.

However, installing Internet connection environments using wireless LAN can lead to communication problems due to radio wave interference and other factors. In fact, communications by wireless LAN can be lost in homes and retail establishments due to the effects of radio waves emitted from a variety of wireless devices. It is desirable that such problems be solved at an early stage, and for this reason, we developed a wireless LAN tester that can visualize signal and communication conditions in the radio interval and expanded its on-site use [1].

In this article, we introduce our development of a wireless LAN tester conformable to the new IEEE802.11ac standard.

## 2. Wireless LAN tester functions

The main inspection requests and failure causes in relation to on-site use of wireless LAN are shown in **Fig. 1** together with corresponding functions deemed necessary for the wireless LAN tester. Here, the main causes of communication failures are interference from extraneous noise and inter-channel wireless LAN interference. In addition to finding solutions for communication problems, there is also a need to inspect AP placement and the electromagnetic environment prior to AP installation. To meet these needs, we have equipped the wireless LAN tester with the following functions.

Function 1: AP detection

- Detect APs conformable to IEEE802.11a/b/g/n/ac and display a list of APs.
- Select any AP and display channel number, transmission method, and other details of that AP.

Function 2: Received signal strength (RSS) measurement

- Continuously measure the RSS of all detected APs.
- Display temporal fluctuation of RSS for any AP.

* IEEE: Institute of Electrical and Electronics Engineers

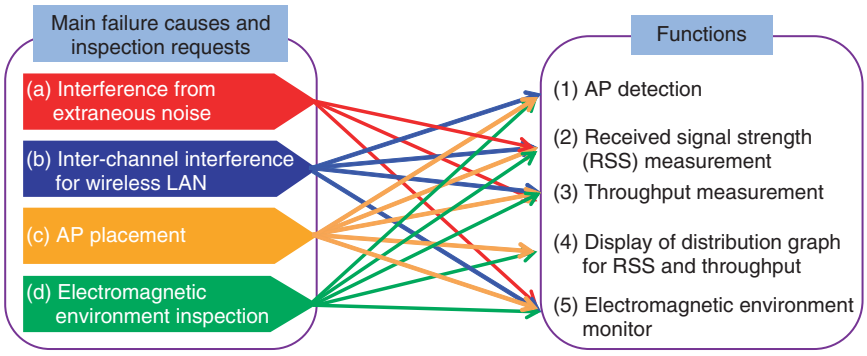



Fig. 1. Main inspection requests in relation to wireless LAN and functions.

Function 3: Throughput measurement
- Connect to any AP and continuously measure its throughput in the radio interval.
- Display temporal fluctuation of measured throughput.

Function 4: Display of distribution graph
- Display a distribution graph of RSS and throughput for any AP.

Function 5: Electromagnetic environment monitor
- Display RSS of all detected APs by channel.
- Display noise affecting wireless LAN communications by channel.

Function 6: Interference analysis
- Quantify possibility of throughput degradation due to inter-channel interference by channel.
- Display channels having low possibility of inter-channel interference as recommended channels.

Function 7: Pass/fail judgment
- Set targets (RSS and throughput) and automatically make a pass/fail judgment on measured values.

Function 8: Report preparation
- Output reports on measurements and judgment results.

Our wireless LAN tester equipped with the above functions consists of a personal computer (PC), dedicated wireless LAN adapter, and dedicated software. In addition, a USB (universal serial bus)-type spectrum analyzer can be used to measure noise affecting wireless LAN communications.

## 3. Conformity with IEEE802.11ac

### 3.1 AP detection

A wireless LAN AP periodically transmits a beacon signal to notify the surrounding area of its existence. This signal includes information that is needed for a terminal to connect to the wireless LAN network such as the channel number and security information. The AP detection function can detect and analyze this beacon signal and display detailed information on that AP. The function can also display a list of all detected APs classified by channel or service set identifier (SSID) and can be used to check for available channels and the interference with other APs.

A screenshot of the AP detection function is shown in **Fig. 2**. Detailed information on an AP selected from the left of the screen is displayed on the upper right of the screen. It can be confirmed that the target AP conforms to IEEE802.11ac.

The IEEE802.11ac standard achieves high-speed communications through a channel-bonding function that binds multiple channels. The AP details in Fig. 2 indicate that communication that binds four channels (for a total bandwidth of 80 MHz) is possible enabling a maximum bit rate of 1.3 Gbit/s.

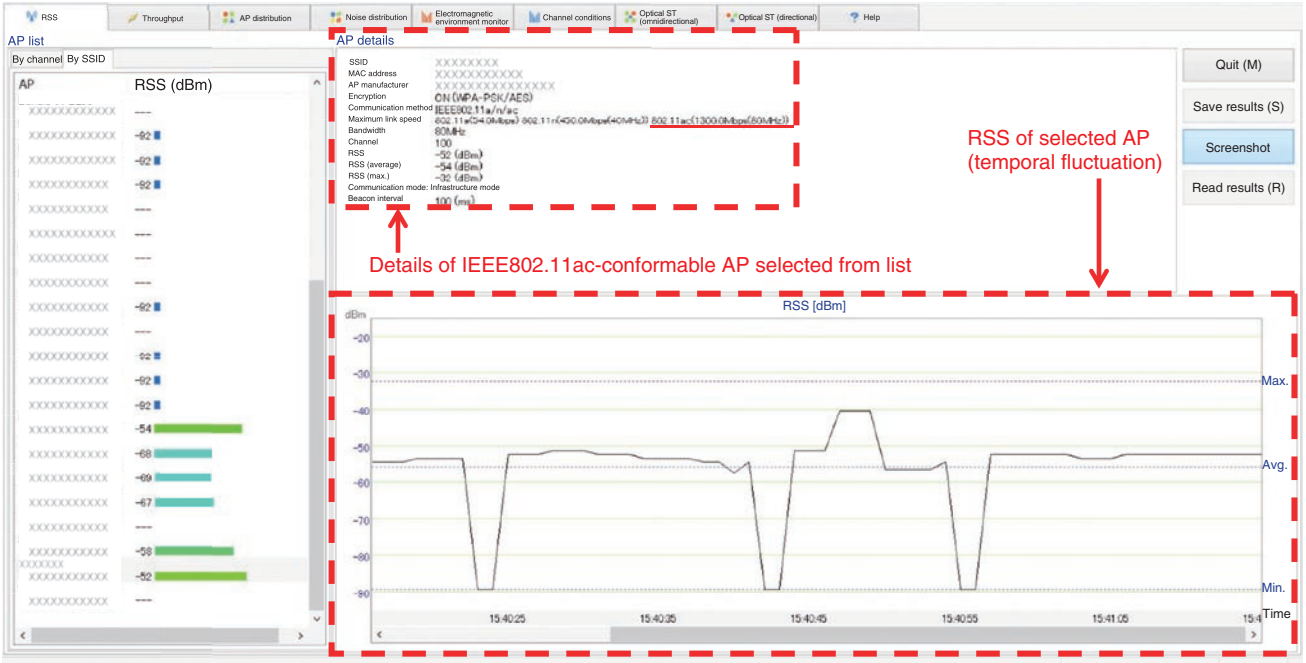
### 3.2 RSS measurement

The function can display the signal strength of APs in real time. A screen shot of this function is shown in the lower part of Fig. 2. The function can be used to examine the temporal fluctuation of RSS and to check the RSS of wireless LAN signals at any position.

### 3.3 Throughput measurement

This function continuously transmits User Datagram Protocol packets generated by dedicated software on the wireless LAN tester to the wireless LAN adapter and measures throughput on the radio interval between the AP and the tester. This requires a connection with the AP targeted for measurement and a password to make that connection.

A screenshot of throughput measurement for an IEEE802.11ac-conformable AP is shown in **Fig. 3**.




MAC: media access control
ST: station

Fig. 2. Screenshot of AP detection function.

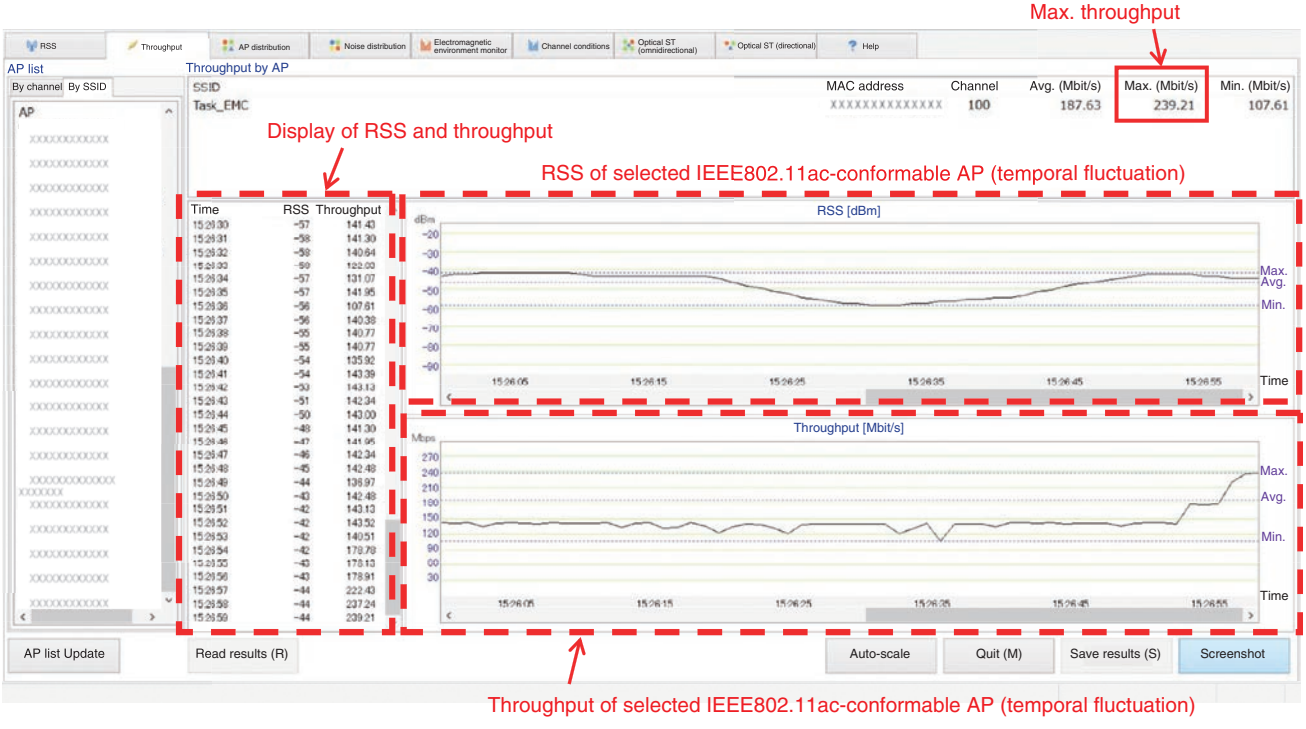



Fig. 3. Screenshot of throughput measurement function.

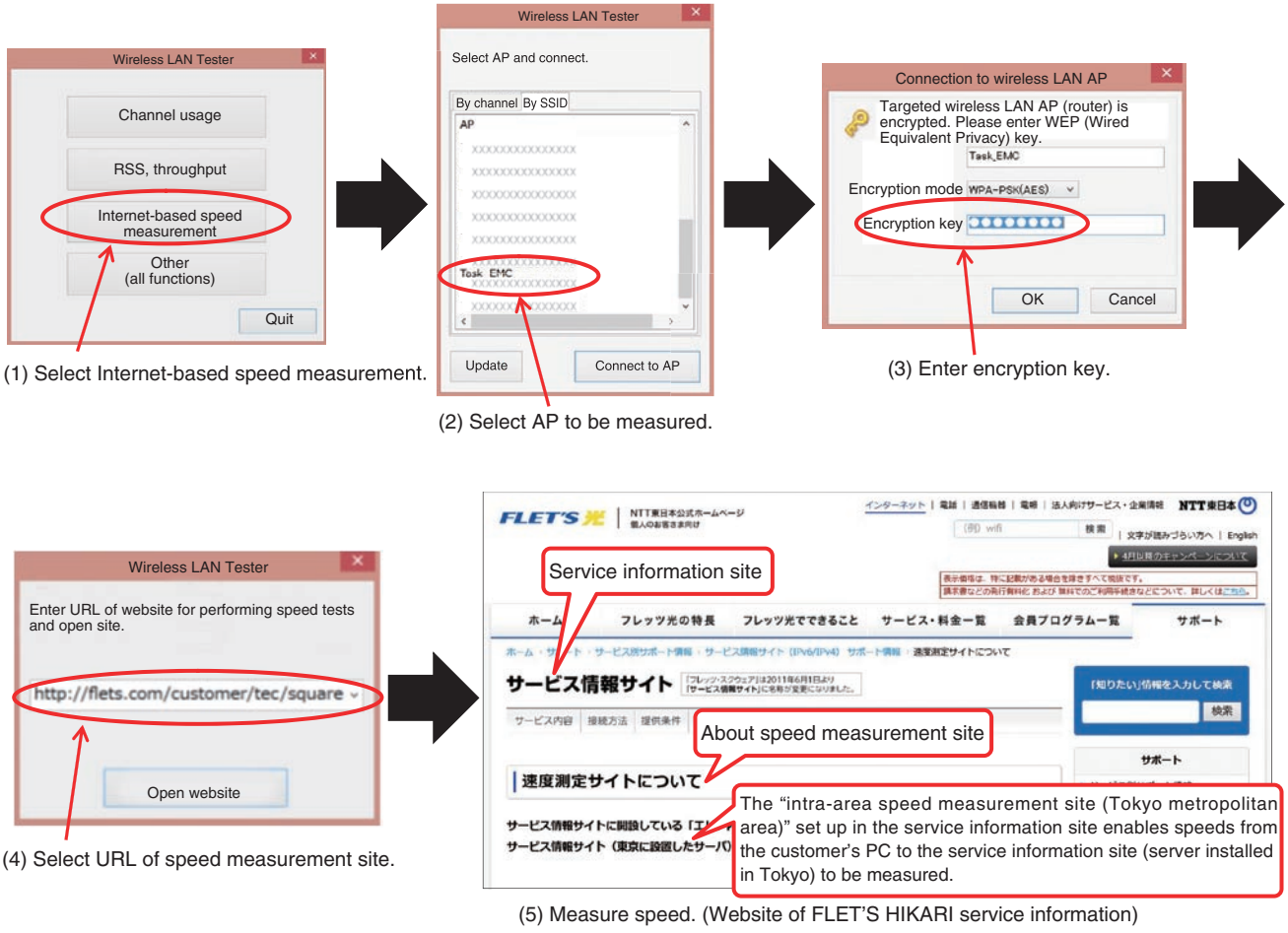



Fig. 4. Screenshots of Internet-based speed measurement.

These results show that a maximum throughput of 239 Mbit/s was measured. Displaying the measurement results for RSS and throughput on one screen in this way enables the user to examine the correspondence between these two characteristics. Furthermore, in an environment enabling an Internet connection, throughput can be measured by connecting to a website for measuring speed as shown in **Fig. 4**.

### 3.4 Electromagnetic environment monitor

This function can be used to examine the level of noise affecting wireless LAN communications on each channel. It can also be used to confirm the channels set for a wireless LAN AP and associated bandwidth and RSS. A screenshot of the electromagnetic environment monitor is shown in **Fig. 5**. It can be confirmed that a noise level is extremely high in channels 4–6 in the 2.4-GHz band, while it is extremely low in the 5-GHz band. In addition, while the channel set for this AP in the 5-GHz band is channel 100, communications using four channels becomes possible through the channel bonding function.

## 4. Application

We describe here AP placement as an application of the wireless LAN tester. We tested the signals transmitted from an AP installed outside an apartment room for achieving shared use of wireless LAN in that apartment. We used the distribution graph function of the wireless LAN tester. The results are shown in **Fig. 6**. The AP was set to channel 100 in the 5-GHz band. These results show that the RSS and throughput were greater than –67 dBm and 53 Mbit/s, respectively, which indicates that wireless LAN communications were possible in all rooms within the apartment. Thus, the wireless LAN tester was effective for

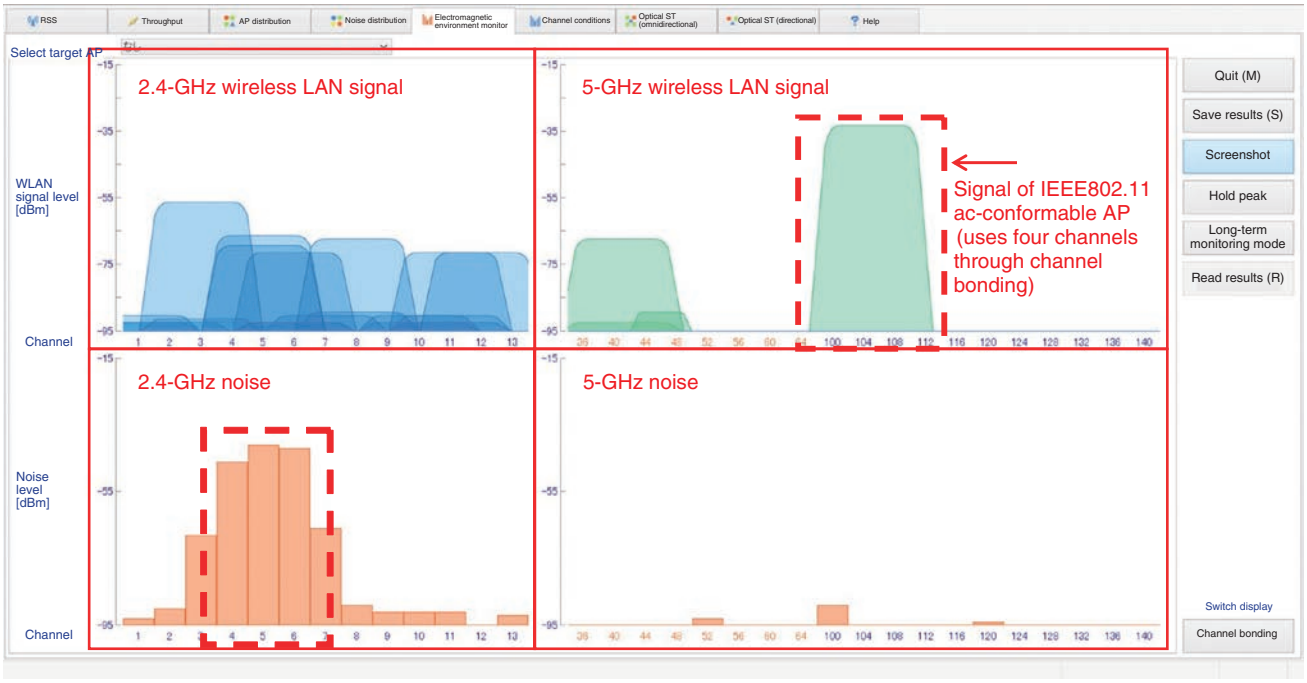
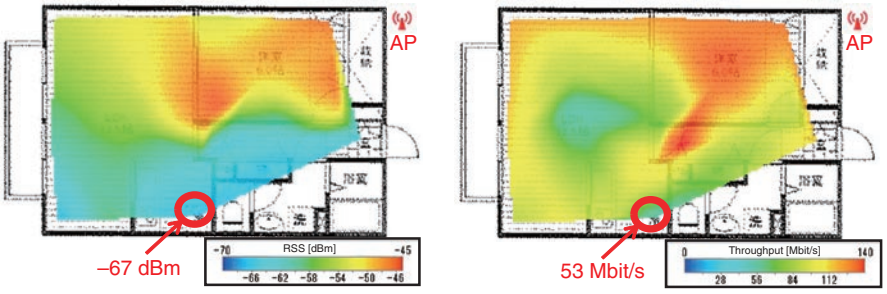



Fig. 5. Screenshot of electromagnetic environment monitor.




(a) RSS (b) Throughput

Fig. 6. RSS and throughput measurement results.

visually confirming the signals transmitted from an AP.

## 5. Conclusion

In this article, we introduced the functions of an IEEE802.11ac-conformable wireless LAN tester and described an application including a distribution graph for RSS and throughput.

We made this wireless LAN tester conformable to IEEE802.11ac with respect to the functions of AP detection, RSS measurement, throughput measurement, and electromagnetic environment monitoring. We also devised a display format that shows the measurement results of RSS and throughput on one screen to speed up troubleshooting of the causes of failures. We plan to improve and expand the functions of this tester and to make it conformable to any new wireless LAN standards.

The EMC Engineering Group of the Technical Assistance and Support Center is committed to achieving prompt resolution of failures related to wireless LAN and to contribute to the smooth provision of communication services. To this end, it is

actively engaged in technology dissemination activities through technical support, development, and technical seminars.

## Reference

[1] K. Okamoto et al., "Introduction of Wireless LAN Tester toward Smooth Provision of Wi-Fi Services," IEICE Communications Society Magazine (B-plus), Vol. 7, No. 25, pp. 38–43, 2013 (in Japanese).