Anritsu Advancing beyond

IEEE 802.11ax Test Challenge

Wireless Connectivity Test Set MT8862A

As IoT devices become more widespread, WLAN functionality is being added not only to mobile terminals, including smartphones, but also to household electrical goods, such as printers, TVs, etc., automobiles, industrial machines, and sensors. However, various issues, such as a shortage of frequency resources for WLAN connections, difficulties making stable connections and problems of slower communications speeds, are occurring in this environment with a dense population of diverse WLAN products.

To solve these issues, the IEEE 802.11ax (Wi-Fi 6) standard is being extended to support multiple simultaneous WLAN connections to one access point (AP) for better communications efficiency with limited frequency resources. Additionally, the Wi-Fi Alliance has announced its Wi-Fi 6E standard to leverage the 6 GHz band for unlicensed Wi-Fi operation. Until now, Wi-Fi 6 has used the 2.4 and 5-GHz frequency bands, but Wi-Fi 6E not only supports both these bands used by the IEEE 802.11ax standard, but also enables use of the new unlicensed 6-GHz band. In the 2.4 and 5-GHz bands, a total of up to two 160-MHz channels can be used. In comparison, FCC*1 and ETSI*2 have defined 7 and 3 channels. As a result, the new Wi-Fi 6E achieves both higher speeds by using wideband channels, and stable connections by reducing interference with other signals.

*1: US Federal Communications Commission
*2: ETSI European Telecommunications Standards Institute

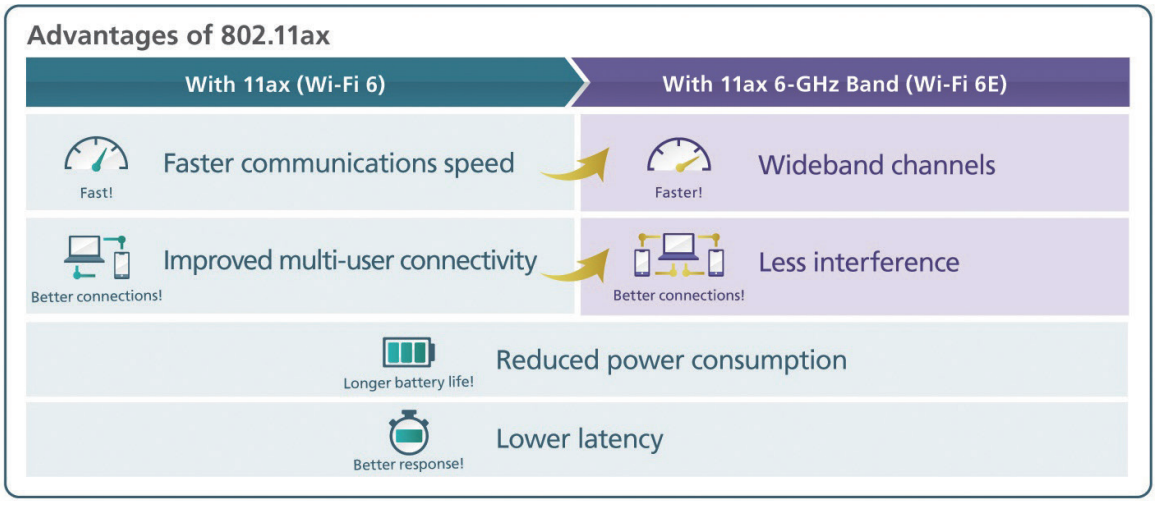


Fig. 1 Advantages of IEEE 802.11ax

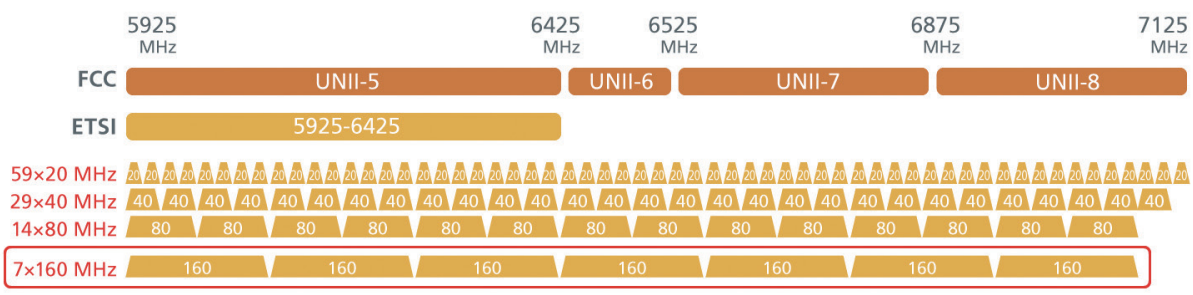


Fig. 2 6-GHz Band (Unlicensed)

Standards Trends

IEEE 802.11ax was officially released in May 2021. However, due to its highly acclaimed performance, it has been increasingly adopted in the smartphone and PC markets since its draft version stage. IEEE 802.11ax is expected to become a major WLAN standard in the future. The 6 GHz band was opened to unlicensed use in April 2020 in the U.S., and many countries and regions around the world are following the U.S. framework in considering and adoption. With the final approval in the EU in June 2021, the use of WLAN in the 6 GHz band is on track to accelerate.
Additionally, the 6 GHz band is almost mandatory in IEEE 802.11be, which is the successor to IEEE 802.11ax, making 6 GHz support a key step in standards trends.

Fig. 3 Future Main WLAN Standards

On the other hand, Draft 0.1 of the IEEE 802.11be standard was released in the end of 2020. The final 11be specifications should be clarified by 2022 to 2023, followed by release in 2024. Consequently, 6 GHz band usage will be widespread as basic spectrum for IEEE 802.11ax and is expected to remain in use for a long time even after release of the IEEE 802.11be standard.

Essential WLAN Signal Evaluation Tests

New test items and complex measurement methods are being added to the IEEE 802.11ax standard to offer new functions. Moreover, the antenna is a key evaluation item for supporting the 6-GHz band, because antenna performance requirements change with the frequency.

- TRx Test Specified by IEEE 802.11ax
- OTA (Over the Air) Antenna Performance Test

TRx Test Specified by IEEE 802.11ax

The IEEE 802.11 standard specifies the following Tx and Rx tests. The HE TB PPDU format Tx test using the OFDMA method adopted from IEEE 802.11ax and evaluation of 1024QAM modulation, plus the newly added Transmit power and RSSI measurement accuracy, carrier frequency offset error, etc., tests are extremely important test items.

Table 1 Tx Test Items

Category	Chapter	Title	Detail	Availability	DUT
27.3.15 Transmit requirements f 11ax Test Items	27.3.15.3	Pre-correction accuracy requirements	Transmit power and RSSI measurement accuracy	✓	STA
			Carrier frequency offset error	✓	STA
			Symbol clock error	✓	STA
			The arrival time of the HE TB PPDU at the AP	✓	STA
27.3.19 Transmit specification	27.3.19.1	Transmit spectral mask	—	✓	AP/STA
	27.3.19.2	Spectral flatness	—	✓	AP/STA
	27.3.19.3	Transmit center frequency and symbol clock frequency tolerance	—	✓	AP/STA
	27.3.19.4.2	Transmit center frequency leakage	—	✓	AP/STA
	27.3.19.4.3	Transmitter constellation error	—	✓	AP/STA
	27.3.19.4.4	Transmitter modulation accuracy (EVM) test	—	✓	AP/STA

Receiver test is also required because performance varies with conditions, such as frequency and modulation method including 1024QAM.

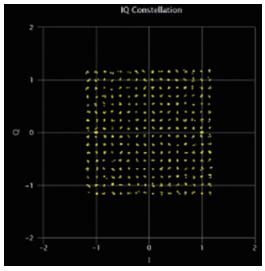
Table 2 Rx Test Items

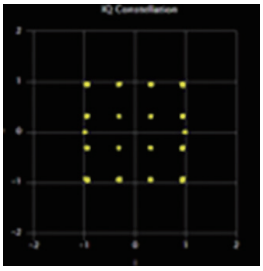
Category	Chapter	Title	Detail	Availability	DUT
27.3.20 Receiver specification	27.3.20.2	Receiver minimum input sensitivity	—	✓	AP/STA
	27.3.20.3	Adjacent channel rejection	—	✓	AP/STA
	27.3.20.4	Non-adjacent channel rejection	—	✓	AP/STA
	27.3.20.5	Receiver maximum input level	—	✓	AP/STA

Examples of the key IEEE 802.11ax standard test items are shown below.

• Modulation Accuracy

Performance changes as the modulation method changes at each data rate. Consequently, checking each modulation accuracy helps reduce problems following the product launch. The MT8862A can control data rates on both multi user (HE TB PPDU) and single use (HE SU PPDU) modes using the patented technology.

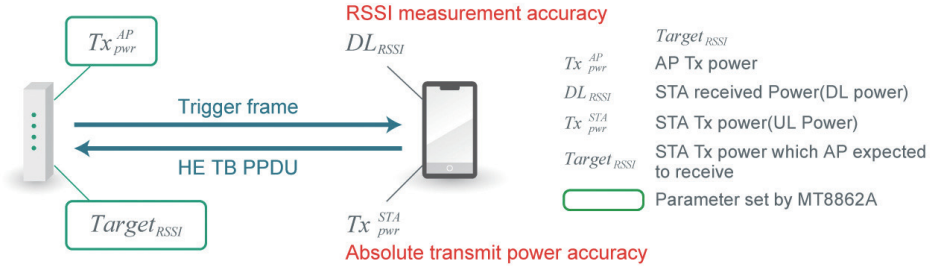




	Average	Maximum	Minimum
RMS EVM [dB]	-32.58	-32.58	-32.58
RMS EVM [%]	2.35	2.35	2.35
Peak EVM [dB]	-23.98	-23.98	-23.98
Peak EVM [%]	6.33	6.33	6.33
Average RMS EVM Pass/Fail	FAIL		

• Pre-correction (Power Adjustment)

Total values of the RSSI measurement accuracy and Absolute transmit power measurement accuracy are measured by displaying the difference (Gate 1 Average Power Difference) between the $Target_{RSSI}$ set by the user and the actual DUT signal received by the MT8862A.



HE TB Power Pre-Correction

	Average	Maximum	Minimum
Gate1 Average Power Difference [dBm]	3.49	3.61	3.28
	Average Value	Worst Value	
Gate1 Average Power Difference Pass/Fail	FAIL	FAIL	

Fig. 4 Power Pre-Correction Scheme

OTA (Over the Air) Antenna Performance Test

Antennas have frequency characteristics and use of a new frequency band requires adequate performance evaluation for antennas; support for the 6-GHz band in the IEEE 802.11ax standard requires antenna performance evaluation using Over The Air (OTA) tests.

Most OTA tests commonly evaluated based on the CTIA/WFA CWG Test Plan.

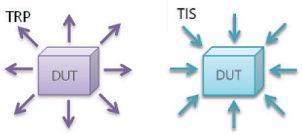
The OTA-environment test items specified by CTIA/WFA CWG Test Plan Version 2.1 are as follows:

- Wi-Fi Total Radiated Measurements

  TRP (Total Radiated Power)
  Measures power radiated from DUT in all directions

  TIS (Total Isotropic Sensitivity)
  Measures the power of radio waves received by the DUT in all directions

  These TRP/TIS measurements require setting multiple data rates for each frequency band (sub-band).



- Wi-Fi Desense Measurements with Cellular Transmitter On
  Confirms whether there is any deterioration in the Wi-Fi reception ability while DUT performing cellular communications

- Cellular Desense Measurements with Wi-Fi Transmitter On
  Confirms whether there is any deterioration in the Wi-Fi reception ability while DUT performing Wi-Fi communications

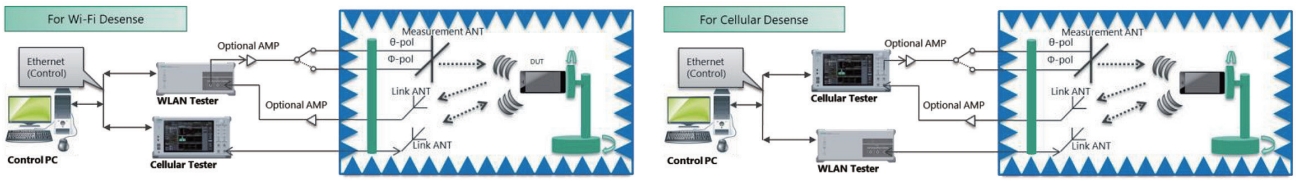


Fig. 5 OTA-environment Test Scheme

More Efficient 802.11ax WLAN Signal Quality Measurement

The Wireless Connectivity Test Set MT8862A measures the TRx RF characteristics of stations (STA) and access points (AP) built into WLAN devices. Since it uses standard WLAN protocol messaging (WLAN signaling), it supports network mode (signaling mode) using the same processes as an actual DUT. Test results are output as graphs and numerical values by simple GUI operations for Pass/Fail evaluation.
Moreover, support the vendor-specific Direct mode facilitates a wide application range. In addition to IEEE 802.11ax test compliance, the wide dynamic range assures stable OTA test connectivity.

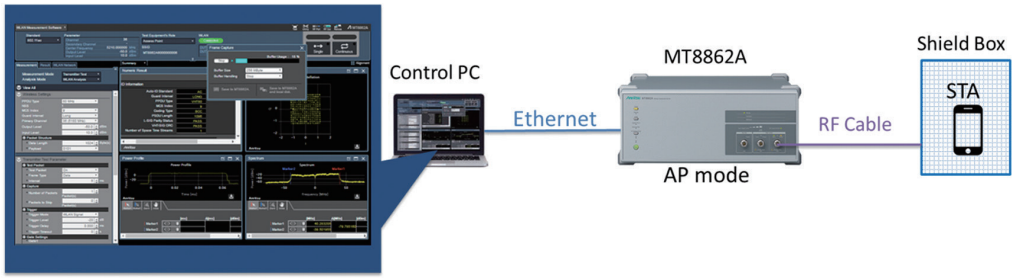


Fig. 06 MT8862A Setup

Typical MT8862A Product Configuration

The recommended MT8862A configuration for connecting with WLAN products and evaluating TRx performance for IEEE 802.11ax is listed below.
Contact our sales representative separately for details about the minimum configuration.

Model	Name	Remarks
MT8862A	Wireless Connectivity Test Set	Main Unit
MT8862A-001	RF Frequency 2.4 GHz, 5 GHz	Requires Options
MT8862A-002	RF Frequency 6 GHz	Option for 6 GHz Band support
MT8862A-010	Extended RF Hardware	Option for 6 GHz Band support
MX886200A	WLAN Measurement Software	Optional software, for IEEE 802.11b/g/a/n TRx evaluation
MX886200A-001	WLAN 802.11ac Option	Optional software, for IEEE 802.11ac TRx evaluation
MX886200A-002	WLAN 802.11ax Option	Optional software, for IEEE 802.11ax TRx evaluation
MX886200A-020	WLAN Security Function	Supports WEP, WPA/WPA2/WPA3-Personal encryption
MX886200A-030	160 MHz Bandwidth	Supports 160 MHz Bandwidth

* Functional details of each optional product and dependencies between optional products are described in the product brochure.