

Profound Contents to Be Enabled by Wireless Connectivity of AR/VR

* The following presents an interview with Zhejiang Sunnyverse Technology Co., Ltd. (hereinafter referred to as "Sunnyverse") and Anritsu, originally published in Chinese in EE Times China, translated and partially edited by Anritsu Corporation (hereinafter referred to as "Anritsu").
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Launches of XR products, including AR/VR, are expected to further stimulate the market. This article delves into the challenges of wireless connectivity technologies required for excellent XR experiences and the testing requirements for validating the wireless connectivity performance of XR products.

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— Zhejiang Sunnyverse Technology Co., Ltd.

With the launch of the Apple Vision Pro, Extended Reality/Cross Reality (XR) devices including Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) devices are expected to give rise to a new market frenzy. XR devices have a center of public attention over the past several years as an important gateway to the metaverse. At technology events including the Consumer Electronics Show (CES), XR glasses/headsets have debuted, offering new features and new experiences as integrated carriers of innovative technologies, drawing the attention of industry and the public.

"Apple Vision Pro will have a strong pulling effect on the XR industry. Vision Pro will drive manufacturers in the upstream of the industry chain to continuously upgrade and iterate related technical solutions and production processes, improve production efficiency, and reduce the costs of technology and parts manufacturing." said the Product Manager of Sunnyverse, which was established in China in 2021. "Sunnyverse is a carrier for technology extension and product upgrades within the Sunny Group in the fields of optics and optoelectronics, possesses strong integrated development and production capabilities for XR optical modules and XR glasses systems, and strives to become a leading global XR glasses system solution provider," said the Sunnyverse product manager.

Note that XR products present a considerable number of technical challenges. Compared to smartphones and common IoT products, users put more stringent demands on XR products' performance including portability, power consumption, performance, and wireless connectivity. From the perspective of wireless connectivity alone, "the biggest difference in performance requirements between XR products and common IoT products is latency in communications. XR products have higher requirements." said the Sunnyverse product manager.

"XR devices need to respond to user actions and inputs in real time, so the latency requirements are more demanding. XR devices also have greater data throughput. XR products not only present text and images but also conduct 3D spatial processing of many different types of video and graphic content, which leads to an exponential increase in data volume. Moreover, in the bandwidth of many products on the market, the physical layer throughput may not reach 90% of the chip throughput, but our goal is to achieve this rate on XR devices." said a Sunnyverse test engineer.

"Focusing on interconnection, XR products often need to be connected to multiple devices as well as a single device, such as controllers with *Bluetooth*[®] technology, Bluetooth headsets, and some peripheral wearable sensors. All these differ from common IoT products."

As a system solution provider in the XR field, Sunnyverse also focuses on wireless connectivity technologies.



To satisfy the higher RF connection requirements of XR products, Sunnyverse needs reliable and convenient test and measurement solutions. So, we, EE Times China, also conducted a special interview with Anritsu, the provider of wireless testing solutions to Sunnyverse. Anritsu announced its cooperation with Sunnyverse in September 2023. Subsequently, Sunnyverse began using the Wireless Connectivity Test Set (WLAN Tester) MT8862A and Bluetooth Test Set MT8852B, provided by Anritsu, to verify the wireless communication performance of its XR products.

Thanks to this opportunity, we can clearly understand the testing requirements and performance differences in the wireless connectivity requirements of contemporary XR products.

Sunnyverse: Key Indices for Wireless Connectivity of XR Products

The "wireless connectivity" referred to in this article includes wireless LAN (WLAN) and Bluetooth technologies, even though there is more to IoT wireless connectivity. For WLAN connectivity, the Sunnyverse product manager mentioned four key testing items:

1. WLAN signal coverage
2. Signal strength and quality
3. Data throughput
4. Stability.

"In addition, we check for the occurrence of abnormal conditions such as network disconnection or packet loss when the network is unstable or experiencing heavy congestion," said the Sunnyverse product manager.

For Bluetooth connectivity, "In addition to the coverage, quality, transmission rate, and stability, more emphasis is placed on latency. Bluetooth connections place higher requirements on real-time performance, as well as low energy consumption. All these are of great concern to us." said the Sunnyverse product manager.

A Sunnyverse test engineer explained to us that full-process testing of a WLAN connection is executed in accordance with the IEEE 802.11 protocol and the certification requirements in different countries. "There are also some routine test items, such as power, spectrum, minimum receiving sensitivity, EVM, and so on. Bluetooth tests are based on the regulations laid down by the Bluetooth SIG and the certification requirements imposed by different countries. The specific testing indices are similar.

Note that XR products with WLAN and Bluetooth capabilities have higher requirements than common products in terms of receiving sensitivity, throughput, and latency." Refer to the data about latency and throughput mentioned at the beginning of the article.

CCSA TC625 released its White Paper for Extended Reality Terminal Equipment Testing (2023 Edition), which stipulated some indices related to the connection of XR devices. For example, the White Paper mentioned antenna performance including the routine determination of XR terminal equipment testing indices and the short-distance tests in dynamic testing. The following table lists the indices for the short-distance tests.

Table Indices for Short-distance Tests

Standard	Test Type	Name of Index	Requirements for Reference
Wi-Fi®	Performance	Throughput	Reference for information prompts and viewing scenes: TX: 129 Mbit/sec, RX: 240 Mbit/sec
		Connecting time	≤1.5 s
		Latency	≤20 ms
	Success rate	Connection success rate	≥99.5%
	Compatibility	Connection success rate	IEEE 802.11n/802.11ac/802.11ax modes
		Compatibility with chip manufacturers	Qualcomm, Broadcom, MediaTek, HiSilicon, etc.
Bluetooth	Performance	Classic Bluetooth active pairing latency	≤2 s
		Classic Bluetooth passive pairing latency	≤2 s
		Classic Bluetooth automatic reconnection latency	≤2 s
		BLE throughput (10 kB)	≥50 kb/s
		BLE latency (500 B)	< 100 ms
	Success rate	Bluetooth connection success rate	≥99.5%
		Bluetooth automatic reconnection success rate	≥99.5%

Source: China Communications Standards Association (CCSA) Extended Reality (XR) Industry and Standardization Promotion Committee (TC625).

This includes the throughput and latency of the WLAN and Bluetooth connections mentioned by Sunnyverse. It also specifies the relevant components including the connection success rate and compatibility. In other words, the White Paper specifically mentions the overview of the key XR technologies related to the throughput and latency requirements.

For example, for the throughput, the real-time data volume of AR maps and AR store search applications is more than 10 times greater than that of traditional navigation maps, and the peak rate during the preloading process can reach 100 MB/s. For the latency, besides the real-time experience interaction mentioned by Sunnyverse, it is of equal importance to "reduce the dizziness caused by motion latency".

Selecting Anritsu for Wireless Connectivity Performance Tests of XR Devices

Given the wireless communication requirements for XR devices mentioned above, the testing of the wireless connectivity performance is crucial. Sunnyverse notes that the following factors are to be considered when selecting testing solutions:

1. The testing objectives and requirements
2. The continuous availability of testing solutions in the future
3. The cost and budget of the enterprise
4. The availability and reliability of the testing equipment and solutions
5. The matching capabilities of the solutions, e.g. maintenance and update of the tested products.

These are explained in the following discussion.

"Many of Anritsu's testing instruments are superior to those of their competitors in many aspects, particularly in terms of portability and operability, which we value highly," said the Sunnyverse product manager. A Sunnyverse test engineer also stated, "Anritsu has a higher level of automation and integration, a friendly man-machine interface, and a simple and clear method of setting test parameters, which is ideal for R&D and secondary development in production. In particular, the modular design of the test scripts is very convenient for testing."



Anritsu is an innovative communications solutions provider with over 120 years of history. The company's test and measurement solutions cover a wide range of fields such as wireless communications, optical communications, microwave/radio frequencies, and high-speed signals.

The WLAN Tester MT8862A and Bluetooth Test Set MT8852B, developed and offered by Anritsu, were specifically designed for short-distance communications testing. They were developed using dedicated hardware platforms combined with corresponding software. As a global leader in its field, Anritsu provides flexible customized measurement solutions for the growing IoT market.

Differences between WLAN and Bluetooth Tests

The WLAN Tester MT8862A was specifically designed for testing the TRx RF characteristics of IEEE 802.11a/b/g/n/ac/ax/be (2.4, 5, and 6 GHz bands) devices. This includes RF performance measurement under practical operating conditions (network mode), easy measurement environment configuration, 2x2 MIMO Rx sensitivity, and Tx power measurement functions, the measurement of devices with security settings such as Wired Equivalent Privacy (WEP) and WLAN Protected Access (WPA), transmission measurements at specified data rates, and so forth.

The Anritsu marketing manager specifically mentioned that the MT8862A supports both network and direct modes, which are also called signaling and non-signaling modes. During non-signaling testing, test engineers set the WLAN chips of devices under test (DUTs) to factory test mode to allow them to directly control the DUT's specified transmission power/frequency or the chip's receiving of specified data packets. Subsequently, the MT8862A directly measures the physical layer RF indices of the tested object. Anritsu told us that this measurement method requires cooperation with the WLAN chip vendors. In contrast, signaling mode can be used to test the wireless performance indices by directly simulating the practical network connection and completing the wireless connection between the DUTs and the MT8862A acting as an access point (AP) or station (STA).

The Anritsu marketing manager said, "Signaling mode testing is a distinctive feature of the MT8862A. The MT8862A is widely used in the testing and verification stages of the hardware development of some WLAN devices. The MT8862A is also used in many wireless communication certification laboratories, while the certification tests of some WLAN products rely on the MT8862A."

A Sunnyverse test engineer added, "The signaling mode fully simulates the process of registration calls and data interaction between XR products and APs."

"Anritsu provides WLAN signaling mode testing solutions from the previous generation of the MT8862A. This feature has been widely supported by the industry." Signaling mode is ideal for the testing and verification of various types of WLAN products. "For those companies in the IoT field that are not familiar with WLAN chips and WLAN standards, especially, the MT8862A will be extremely useful."

In addition, Anritsu also emphasizes the MT8862A's full support of multiple WLAN protocols, including the latest WLAN 7 (IEEE 802.11be) standard. "Moreover, it has a wide range of applications from mobile phones, tablets, and laptops to various types of IoT devices. For example, sweeping robots also need to be connected to WLAN, and we have some successful application cases in this field."



On the other hand, for the Bluetooth test, Sunnyverse uses Anritsu's Bluetooth Test Set MT8852B. As mentioned earlier, "The Bluetooth test items are based mainly on the Bluetooth SIG protocols and certification requirements, including power, modulation characteristics, carrier frequency error, and minimum sensitivity." The Sunnyverse test engineer said, "In addition to objective indices, we also measure test items including the transmission distance from the perspective of human-factor engineering."

The product document for the MT8852B explicitly mentions that tests are carried out according to the RF testing specifications for Bluetooth devices, including the Bluetooth Low Energy (BLE), 2-Mbps Low Energy PHY (2LE), and Bluetooth Long Range (BLR) tests, the adaptive FM monitoring function test, the arrival/departure angle test, and so on. The Anritsu marketing manager explained that Anritsu is one of the earliest senior members of the Bluetooth SIG. "We also participated in the development of the Bluetooth testing specifications. Therefore, all the Bluetooth test cases supported by the MT8852B follow the latest RF testing specifications for Bluetooth devices."

Like the WLAN testing product, the MT8852B also supports comprehensive versions of the Bluetooth protocols. "From the earliest Bluetooth basic data rate, through enhanced data rate testing specifications, the Bluetooth Low Energy (BLE) test specifications, to the latest RF testing specifications such as Bluetooth 4.2, 5.0, 5.1, 5.2, and 5.3. It is easy to operate, as everything is based on the testing specifications."

"Since our company was one of the earliest participants in the development of the Bluetooth testing specifications, most Bluetooth chip vendors have adopted our MT8852B," said the Anritsu marketing manager. "So, the MT8852B has a wide distribution and a large presence throughout the industry chain including Bluetooth modules, devices, and laboratories with Bluetooth functions. The test results are highly respected both upstream and downstream in the industry. Vendors of mobile phones, tablets, Bluetooth keyboards and mice, Bluetooth audio devices, gamepads, and in-vehicle infotainment systems all choose the MT8852B for their Bluetooth device testing."

Beyond WLAN and Bluetooth Test Sets

"Our cooperation is not just about equipment rental or sales," said the Sunnyverse product manager when introducing the company's cooperation with Anritsu. "This also involves deep cooperation in equipment testing protocols and testing solutions. Anritsu provides us with invaluable support and assistance, including on-site technical training, test script editing, and testing architectures for production line automation solutions."

"If new features are added to existing products, Anritsu will promptly provide software and hardware update options to satisfy the latest technical standards. We will provide them to customers including Sunnyverse," said the Anritsu marketing manager.

"Previously, Sunnyverse had relatively high requirements for product testing, and we cooperated to provide a prototype capable of verifying the capabilities of the latest features. All these require communication and cooperation between both sides."

Meanwhile, Anritsu provides prototype evaluation and trial use, as well as guidance for customers. "After product delivery, we dispatch technicians to provide on-site technical training for our customers." Anritsu has also established offices in multiple cities in China, with most being equipped with open laboratories that provide wireless testing systems. "If customers want to try the equipment, they can apply it, short-term, to their product verification and testing."

Despite being a new entrant to this market, Sunnyverse, a total solution provider of XR optical modules and optical engines, is very optimistic about the future of XR. Anritsu also has high expectations for this market, without being limited to the WLAN and Bluetooth testing on which this interview focuses.



Sunnyverse also specifically mentioned the potential value of 5G cellular networks for XR products. "Latency in the communication between XR products and edge cloud servers must be calculated in milliseconds, which means that network transmission needs to support both low latency and high bandwidths. XR products still need data support from cellular communications. Particularly, as computing power and content move towards cloud platforms, 5G will be indispensable for XR products in the future. The reason why 4G and 5G support is currently rarely seen for XR products is that there are limits on their power consumption and size. We believe that these problems will be solved and XR products will soon support 4G and 5G with the ongoing development of the technology. 4G may seem a bit outdated for XR now, but 5G's low latency and wide bandwidth can perfectly satisfy the rigid demands of XR and the specific capabilities of XR products."

Attempts are already being made to apply 5G network slicing and edge computing technology to different XR scenarios. The former is used in enhanced Mobile Broadband (eMBB) scenarios, providing wide bandwidth. In contrast, Ultra-Reliable Low-Latency Communication (URLLC) will fulfill the XR interaction requirements, such as that required by cloud games. In the future, XR terminals may adopt massive Machine Type Communication (mMTC) as 5G network slicing. When XR goes outdoors and becomes an integral part of our daily lives in the future, the support of cellular networks will indeed become indispensable. This will bring huge opportunities for both Sunnyverse and Anritsu.

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