



Delivering First 5G NR Device Technology for Volume Shipments

Operators and device vendors have started conducting field trials around the world, and the race is on to commercialize 5G. One of the first 5G products introduced was a customer premises equipment (CPE) unit for a fixed wireless access service, offering multi-gigabit data throughput in select US cities. Mobile hotspots and mobile smart phones in multiple worldwide locations will follow shortly after.

5G deployments will use the latest technologies in sub-6 GHz and millimeter-wave (mmWave) frequencies to achieve multi-gigabit throughput rates. To achieve higher multi-gigabit throughput rates, 5G designs need to implement multi-element antenna arrays with wider transmission bandwidths and adaptive beamforming.

5G New Radio (NR) testing has taken place in design labs and deployed in multiple trials around the world. However, translating the 5G NR specification into commercial products produced in volume is essential to successful 5G deployments at scale.



Company:

- Customer premises equipment (CPE) manufacturer

Key Issues:

- Time to volume shipments
- Volume testing 5G NR multi-antenna mmWave devices using over-the-air (OTA) test methods

Solution:

- Keysight network emulation solutions

Results:

- Accelerated time to market
- Reduced test times by 20%

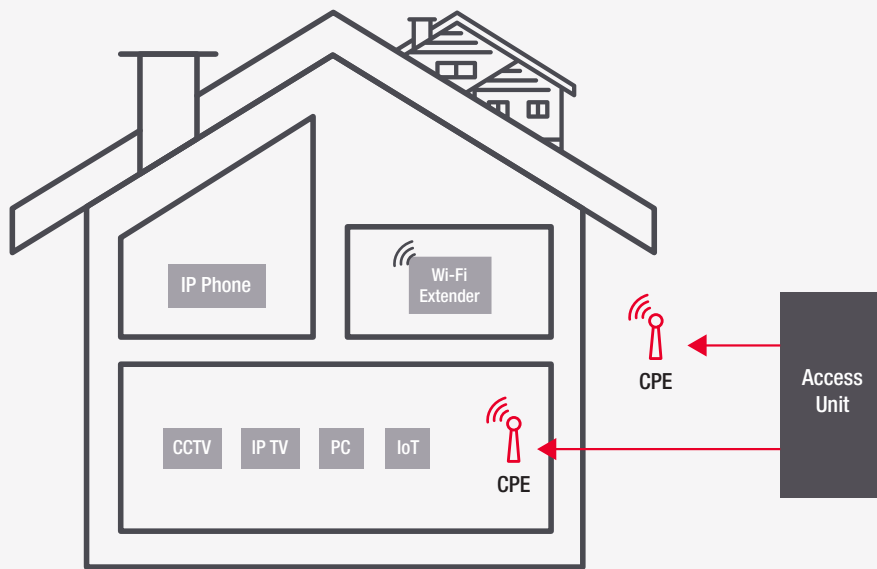


Figure 1: 5G Fixed Wireless Access CPE

5G devices must provide reliable performance under many different user scenarios. With the use of mmWave antennas, the first to market CPE manufacturer needed to rethink their approach to manufacturing test. One of the biggest issues they faced was validating the performance of the many antenna elements in new mmWave operating bands that required new OTA testing methods.

Key Issue

Volume testing 5G NR multi-antenna mmWave devices using OTA test methods

Implementing designs that operate in sub-6 GHz and mmWave bands introduces many new challenges for this manufacturer and the rest of the mobile industry. A CPE device uses dual polarized antenna arrays to support multi-user MIMO (MU-MIMO) with beamforming. This results in hundreds of beam indexes that need OTA testing, which is vastly different from the approach used in 4G testing. While the manufacturer adapted its R&D test processes to this new methodology, the OTA aspect presented new challenges for volume manufacturing test.

To introduce a first 5G CPE device in volume, the manufacturer re-evaluated their manufacturing test strategy. They needed new automated OTA test methods that could validate sub-6 GHz and mmWave antenna performance in volume.

Validation of the 5G CPE device across multiple frequency bands (i.e., 6 GHz, 28 GHz, and 39 GHz) using the 5G TF (technical forum) signal with eight 100 MHz wide carriers was needed for a total aggregated bandwidth of 800 MHz with a 28 GHz carrier frequency. Equally important, the use of mmWave beamforming with dual polarized antennas to transmit two streams of data required testing of hundreds of beam indexes. These requirements were much more demanding than the most advanced devices they had produced to date, significantly increasing test complexity and test times.



The new test solution needed to measure RF performance as well as throughput rates, scale to higher frequencies and wider bandwidths, and support new emerging features as the 5G NR standards evolve.

In addition to the immense technical challenges, the CPE device manufacturer had very tight deadlines to meet the committed market introduction date in late 2018.

Solution

Keysight's 5G Network Emulation Solution portfolio with mmWave OTA test

The manufacturer asked Keysight to provide a test solution that simulated a 5G base station with network protocols to support beamforming and measure the RF performance and throughput rates of their 5G devices.

Keysight's 5G **Network Emulation Solutions** with OTA test capabilities were selected to perform the tests. The Keysight UXM 5G Wireless Testset, which enables both protocol and RF testing, is the basis of this solution. The UXM 5G wireless testset simulates the 5G network protocols that support beamforming and beam tracking, and the 5G RF DVT toolkit provides the RF test cases used to measure the RF performance of the 5G device.

The automated test procedures are based on Keysight's test automation platform (TAP). The TAP software orchestrated test steps, including device attach and cell configuration. The CPE device manufacturer validated RF performance, including tests of total radiated power (TRP), adjacent channel leakage ratio (ACLR), frequency error, spectrum emissions mask (SEM), and channel power measurements using the 5G RF DVT Toolset. The CPE device manufacturer also engaged Keysight's services team to develop automated test procedures. Using Keysight services, the CPE manufacturer reached volume testing in manufacturing several months faster and accelerated test times by 20%.

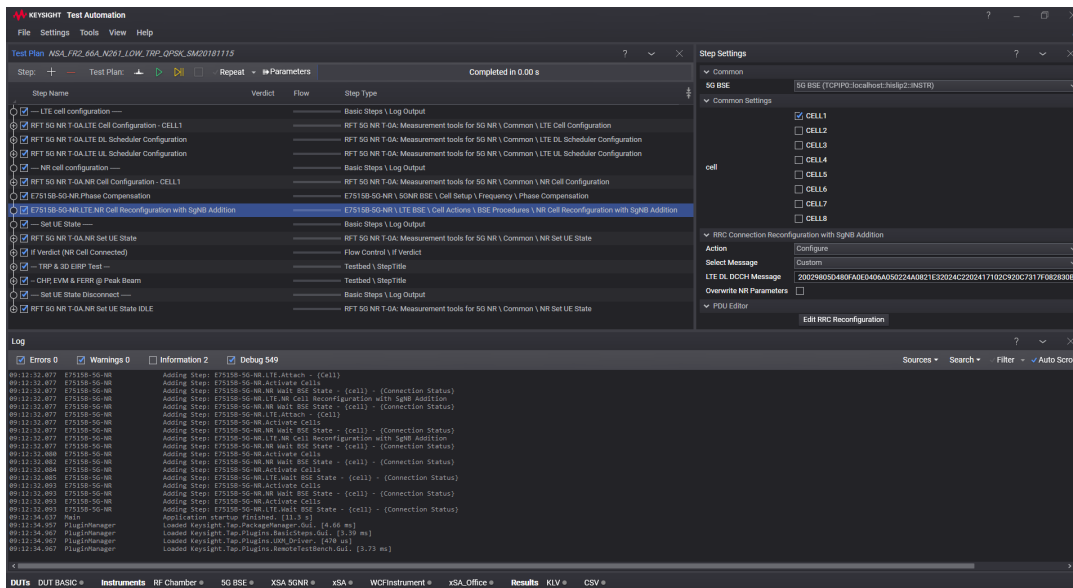


Figure 2: Keysight's Test Automation Platform (TAP) automates test cases

The RF DVT Toolkit automated test cases across different frequencies and bandwidths with various beam configurations. The automated tests were performed in a 3GPP (third generation partnership project) approved compact antenna test range (CATR) that delivered position control and plotting software for testing 3D radiated beam size and direction. The CATR solution provides a chamber that is about half the size of the traditional direct far-field test methods.

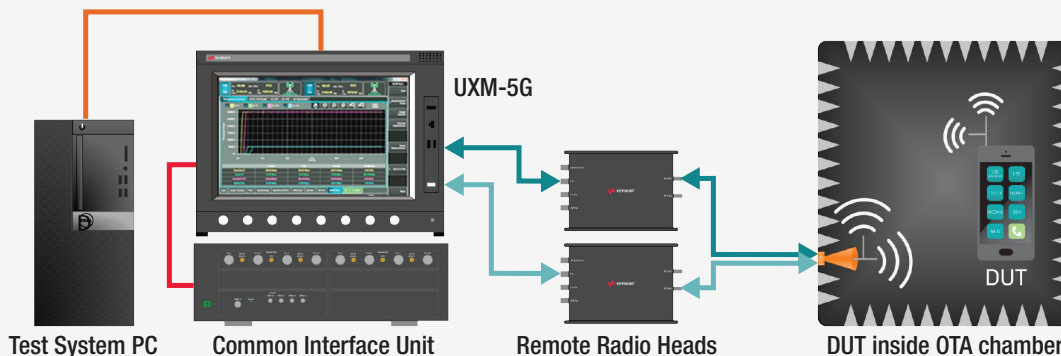


Figure 3: OTA test solution based on Keysight's 5G UXM wireless testset and CATR chamber

The 5G CPE device was based on the first-to-market Qualcomm Snapdragon X50 5G modem chipset. Since the test solution selected was the same test solution used by the chipset manufacturer, the CPE device manufacturer leveraged the initial 5G test cases jointly created by Qualcomm and Keysight, and had traceability back to Qualcomm's test results for troubleshooting.

Results

First-to-volume 5G NR mmWave device

The company achieved manufacturing volume testing on their first 5G CPE device using OTA test methods implemented with Keysight's 5G Network Emulation Solutions. Keysight is the only vendor who offers a complete automated protocol and RF OTA solution. The Network Emulator Solutions provide the protocols and RF measurement capabilities with a CATR chamber, enabling the company to validate hundreds of beams that span sub-6 GHz, 28 GHz, and 39 GHz frequency ranges in a manufacturing environment.

By leveraging work done by Qualcomm and Keysight, the device manufacturer is confident their 5G CPE devices will meet the performance expected on a 5G network. They leveraged the many test cases already developed, accelerated their time to market by several months, and reduced test times by 20% in volume manufacturing.

Related Information

- [5G New Radio Solutions for Chipset and Device Designers](#)
- [Top Considerations for 5G New Radio Device Designers ebook](#)

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