TECHNICAL OVERVIEW

S8708A 5G Advanced Performance Test Toolset

Introduction

5G is moving fast. Globally accelerating 5G deployments are having a ripple effect throughout the mobile ecosystem. 5G also represents an exponential increase in technical complexity. The key challenge comes from the millimeter-wave (mmWave) frequencies introduced in 5G new radio (NR) and requiring over-the-air (OTA) test methods. Millimeter wave propagation in the medium is different compared to traditional radio signal frequencies. Millimeter waves propagate like visible light where obstacles are blocking and scattering the signal instead of letting an attenuated signal travel through the medium.

To meet the end users' expectations, device and chipset manufacturers must validate their products against realistic test conditions. To accelerate the launch of new high-quality products, reliable 5G device performance test tools are vital. To overcome the design and schedule challenges, advanced performance test tools must be integrated as part of the device workflow.

3GPP Performance Study Item aka MIMO OTA in TR38.827 has been finalized and it specifies the test methods for FR1 and FR2 MIMO OTA Device Performance Test. This is a very important milestone to guarantee the quality of 5G devices in real world conditions. It is essential to know, how the device behaves in real fading conditions and when the link is blocked with an obstacle. With mmWave mobile devices this is likely to happen in a rapid and unpredictable manner.

The S8708A Advanced Performance Test Toolset is part of Keysight's 5G Network Emulation Solution portfolio that addresses the entire device development workflow from early design to acceptance and manufacturing. The S8708A Advanced Performance Test Toolset will allow you to accelerate the market launch of 5G chipset and devices by exposing them to accurate & realistic conditions in a controlled lab test environment.

KEYSIGHT TECHNOLOGIES

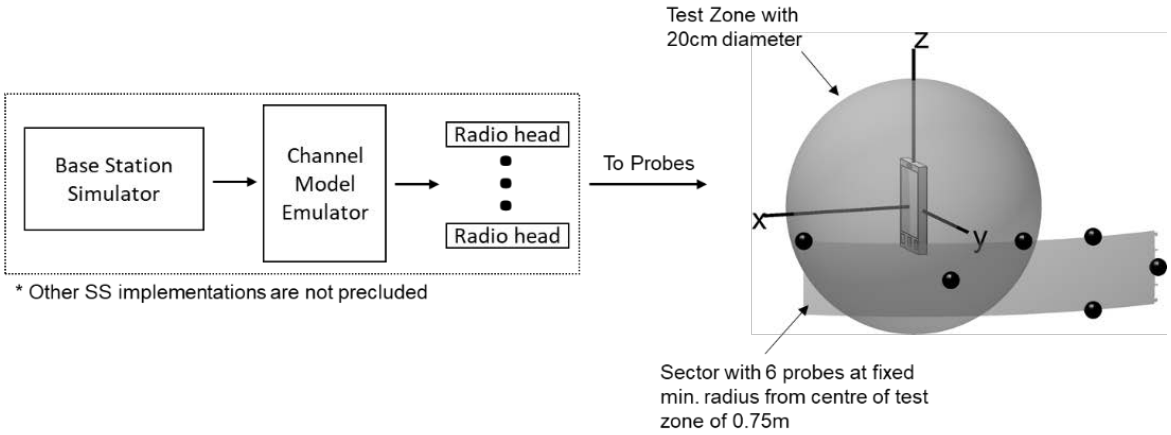

Figure 1. Test method is defined by 3GPP for 5G NR Device performance assessment.

What is the S8708A Advanced Performance Test Toolset?

Keysight's S8708A Advanced Performance Test Toolset is an end-to-end wireless device test solution that enables chipset and device makers together with mobile operators and test laboratories to evaluate and optimize the performance of 5G devices in a lab environment. It integrates the high capacity PROPSIM 5G channel emulator and UXM 5G network emulator together with an multiprobe OTA chamber and mmWave access components.

The solution offers a verified test set developed prior to the release of 3GPP FR2 MIMO OTA and allows R&D teams to test dynamic beam management in 3D spatial fading channel at mmWave frequencies.

Moreover, the solution offers the possibility to create custom tests. It enables 3D spatial channel modelling including an antenna library and an antenna array tool for modeling arrays and beams, as well as emulating NR FR1/FR2 and LTE cells with advanced fading models (GSCM).

Gain insight into 5G device performance in real world channel conditions with the S8708A Advanced Performance Test Toolset.

- Expose early prototypes to accurate & realistic conditions with multiple beams arriving at the DUT from different directions in an 3D OTA test environment
- Stress-test devices and optimize protocol to achieve maximum performance under 3D fading and mobility conditions
- Validate phased antenna arrays with 3D MIMO OTA test at FR2
- Evaluate KPIs under advanced & accurate channel conditions on every software and product release
- Accelerate market launch with Keysight's automated lab test solution.

This document describes the components and functionality of the S8708A Advanced Performance Test Toolset.

Who benefits from using the S8708A Advanced Performance Test Toolset?

- Chipset manufacturers to verify that beam management works in blocking scenarios
- Device manufacturers to ensure that their devices perform in real world radio channel conditions
- Mobile network operators (MNOs) that mandate 3GPP test plans for their ecosystem
- Test houses and test labs that verify that devices are compliant with the FR2 MIMO OTA test specifications and MNO performance requirements

S8708A Advanced Performance Test Toolset Features

The solution offers:

- Turnkey solution with ready-to-run test cases
- Verified test set developed prior to the release of 3GPP FR2 MIMO OTA
- Verified channel models for FR2 MIMO OTA according to the 3GPP TR38.901
- FR1 MIMO/Massive MIMO advanced R&D tests
- Predefined and customizable beam management performance test cases
- Complete end-to-end test solution tailored for each use case and allowing parametrizing of test cases
- State-of-the art logging, visualization and debugging tools to resolve issues more quickly

What makes the S8708A 5G Advanced Performance Test Toolset different:

- Integrated 5G NR network and channel emulation test solution for device FR2 and FR1 performance testing
- Fading capacity with high capacity RF channel emulator
- Multiple RF output ports that enable OTA Spatial fading with several active probes
- Geometric spatial channel models with full customization of parameters in PROPSIM GCM 5G Tool.
- Multi-cell, Multi-rat coherent RF fading

Software and Hardware Components

The S8708A 5G Advanced Performance Test Toolset is an integrated solution comprising of UXM 5G Network Emulation, PROPSIM 5G Channel Emulation, MXA Signal Analyzer, Remote Radio Heads, Test System PC and 3D Multi Probe Anechoic Chamber as illustrated in the figure 2. Keysight's S8708A Advanced Performance Toolset offers a single interface for test case execution, analysis and reporting.

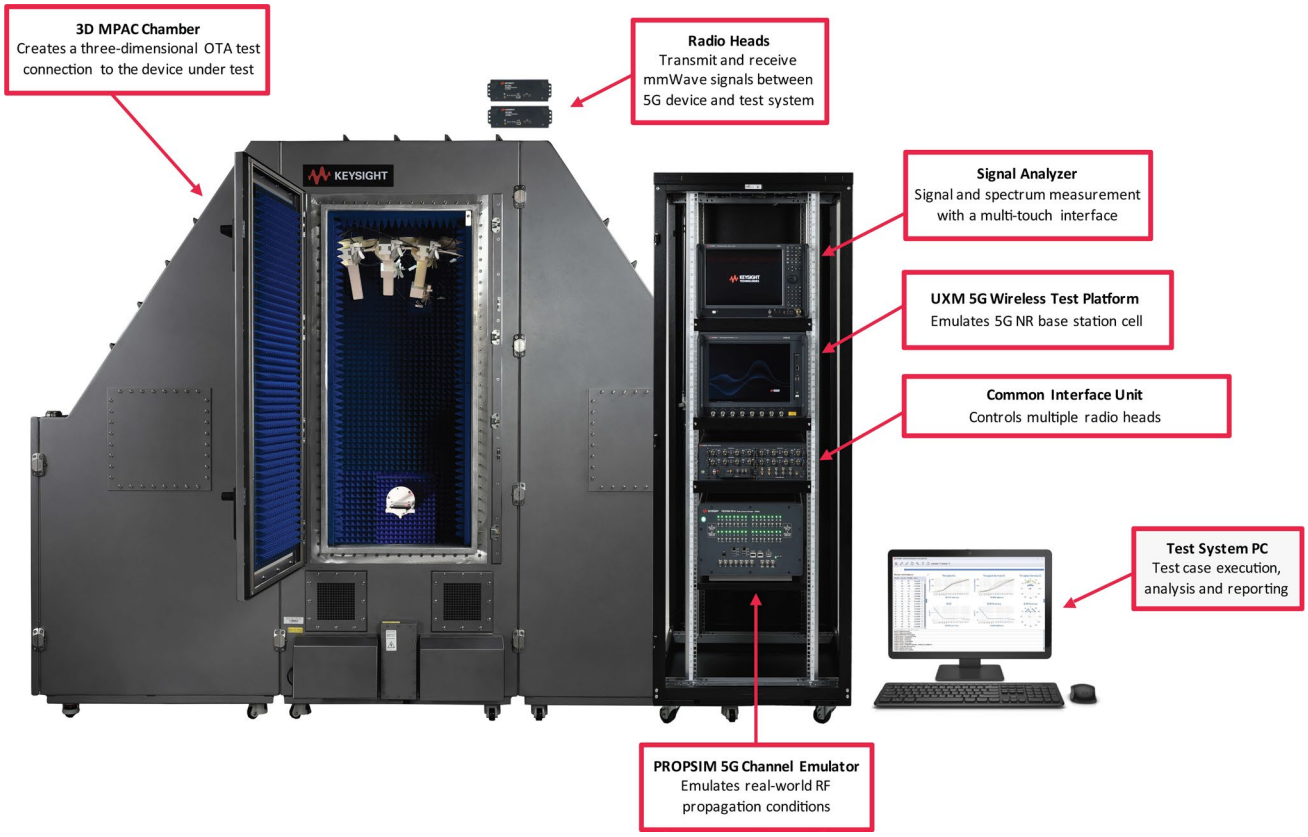

Figure 2. The S8708A Advanced Performance Test Toolset integrates channel and network emulation capabilities with a 3D OTA test environment

The S8708A Advanced Performance Test Toolset simplifies complex mmWave performance testing by integrating instrumentation and the test environment under a single solution. Users gain access to geometric channel models with high-capacity fading options as well as test cases in a single user interface with reports and a live test execution views to monitor the progress of the test run. This enables device R&D teams to benchmark the performance of different builds and support acceptance testing with purpose-built reports. Moreover, the S8708A Advanced Performance Testing Toolset is highly customizable to fit different use cases and needs. Developers of prototypes can use the toolset to verify how well a device performs by stressing the design in a 3D OTA test environment that uses multi-beam and angle of arrival (AoA) to create accurate and realistic conditions. Chipset vendors can utilize the UXM 5G Wireless Test Platform capabilities to customize the test conditions to support their device performance development.

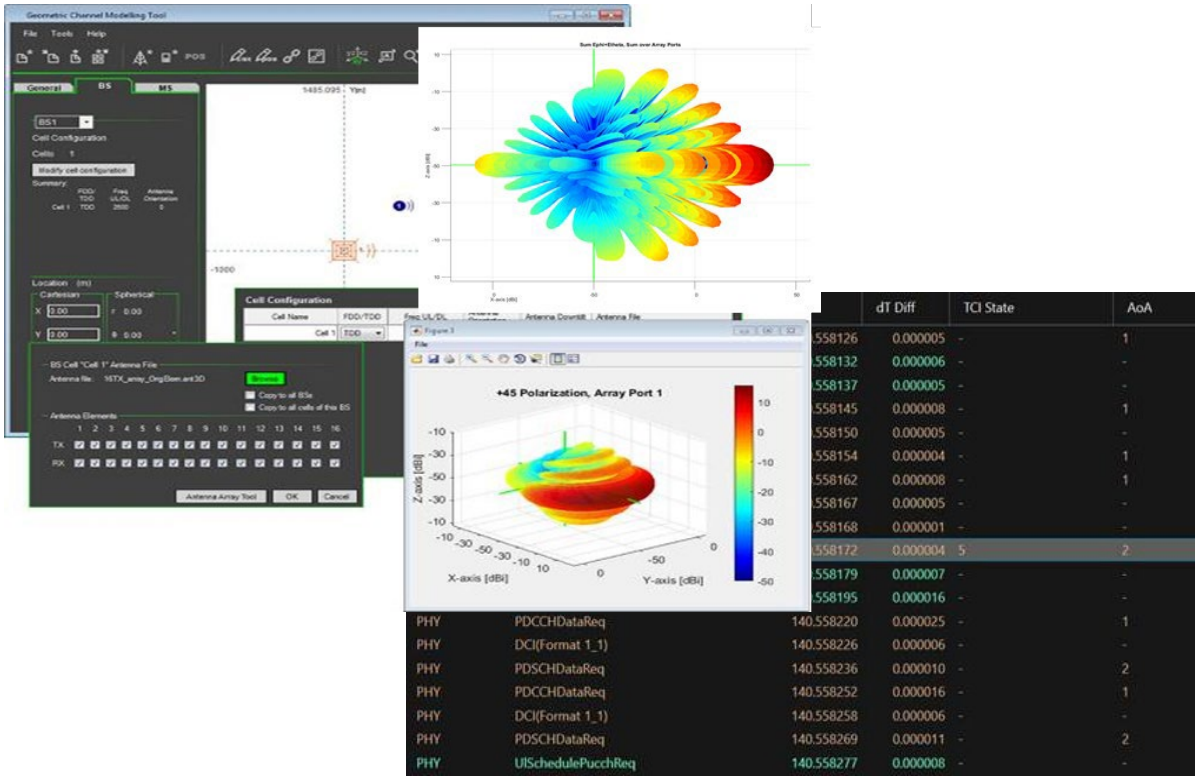

Figure 3. The S8708A Advanced Performance Test Toolset integrates Keysight's network emulation expertise on 5G Protocol and PROPSIM 3D OTA Channel Emulation for complete test solution

Main Use Cases

The S8708A Advanced Performance Test Toolset is an end-to-end solution that simplifies complex mmWave testing with powerful and verified performance test cases. Advanced users can further customize their testing with protocol scripting and geometrical channel modelling tools available for UXM and PROPSIM platforms. The flexible and user-friendly UI allows users with different levels of experience to have an easy and smooth access to the powerful benchmarking capabilities speeding up the time-to-revenue of new 5G NR devices.

mmWave MIMO OTA

With the S8708A Advanced Performance Test Toolset, you can validate mobile device MIMO antenna performance in a final form factor. The toolset comes with verified mmWave MIMO OTA test cases based on 3GPP MIMO OTA TR38.872 – these will be updated according to evolvement on 3GPP MIMO OTA test procedures when available and applicable. Test cases will use different channel models (CDL-C Urban Micro and CDL-A Indoor Office) and the main criteria to define these channel models is Downlink Physical Layer Throughput (BER/BLER). The toolset generates multi-format reports.

Figure 4. Test execution view from the S8708A Advanced Performance Test software in mmWave MIMO OTA view.

mmWave Beam management

With the S8708A Advanced Performance Test Toolset you can verify mobile device beam management under fading and blocking conditions. The solution simplifies complex mmWave beam management testing with verified mmWave Multi-Beam OTA test cases. Keysight Network Emulation Solutions have common tools across the device workflow making the transition from other solutions easy for experienced users. The common protocol scripting and geometric channel modelling tools can be used to build custom test cases.

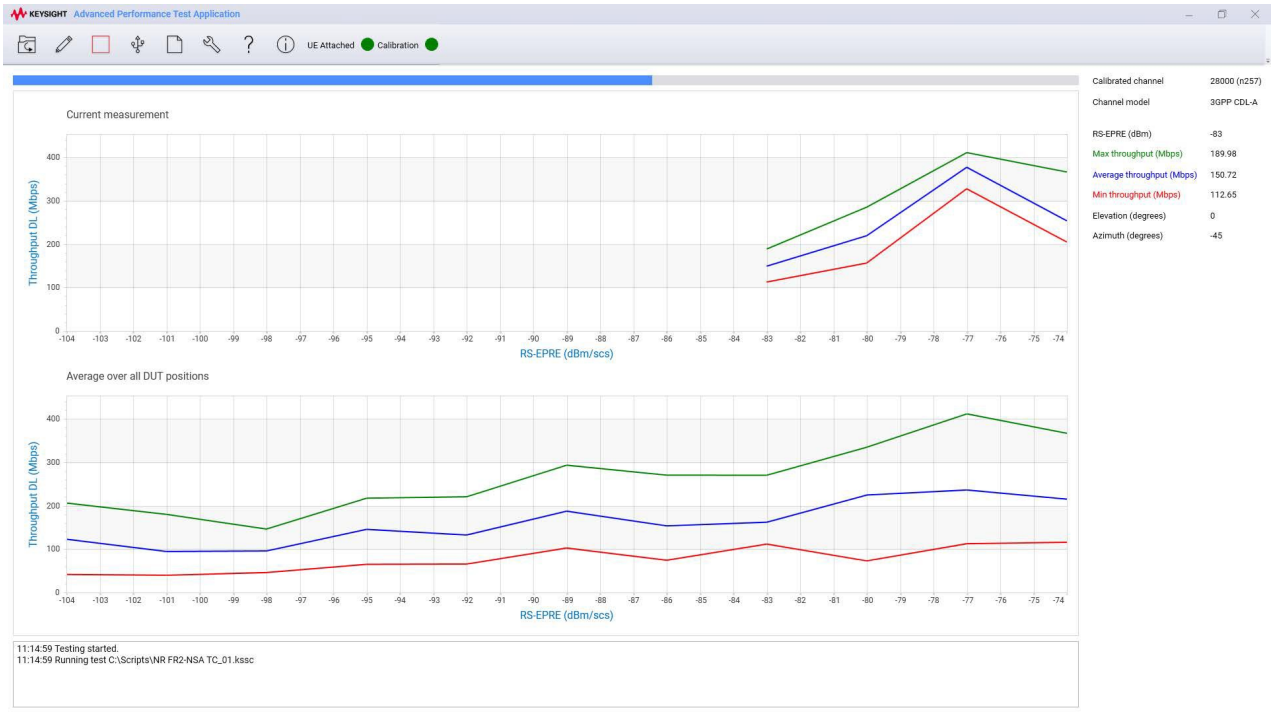

Figure 5. Beam management test software view.

Test cases

The 3GPP Performance Study for MIMO OTA in TR38.827 has recently been finalized. It specifies the test methods for FR1 and FR2 MIMO OTA Device Performance Test. This is an important milestone to guarantee the quality of 5G devices in real world conditions. MIMO OTA FR2 pre-testing will help you to be ready for upcoming 3GPP and CTIA test plans. The S8708A Advanced Performance Test Toolset provides verified test cases for you to verify mobile device performance under 3D spatial fading conditions.

3GPP FR2 MIMO OTA test cases

- CDL-C Urban Micro and CDL-A Indoor Office channel models
- Validate Mobile Device MIMO antenna performance
- Key Performance Indicator is Downlink Physical Layer Throughput (BER / BLER)
- Based on 3GPP MIMO OTA TR38.872 – per the next version when available

FR2 Multi-Beam OTA advanced R&D tests

- 38.901 CDL-A, B, C and D channel models
- Verify Mobile Device beam management under fading and blocking conditions
- Key Performance Indicators are throughput and device beam management measurements
- Multi-beam OTA test cases

FR1 MIMO/Massive MIMO advanced R&D tests

- 38.901 CDL-x channel models
- Verify Mobile Device MIMO/Massive MIMO performance under static and mobile conditions
- Key Performance Indicators are throughput and device mobility measurements

Custom tests

With the S8708A Advanced Performance Test Toolset, you can verify mobile device data performance under static and mobile test conditions, as well as validate device maximum data throughput performance under CDL-x channel models defined in the 3GPP 38.901 standard. The toolset comes with a predefined set of Device Maximum Data Throughput test cases supporting NR FR1 and FR2 together with LTE for NR standalone and non-standalone testing in mmWave and Sub-6 GHz frequency ranges. Device performance can be verified across different Massive MIMO configurations up to NR 8CC + 5CC LTE in spatial fading at Sub-6GHz.

Keysight GCM 5G tool enables custom scenarios on top of the verified performance test cases. With the GCM tool users are able to create different massive MIMO antenna arrays and device antenna beam patterns.

Keysight 5G Solutions

Keysight's 5G end-to-end design and test solutions enable the mobile industry to accelerate 5G product design development from the physical layer to the application layer and across the entire workflow from simulation, design, and verification to manufacturing, deployment, and optimization.

Keysight offers common software and hardware platforms compliant to the latest 3GPP standards, enabling the ecosystem to quickly and accurately validate 5G. You can test chipsets, devices, base stations, and networks, as well as emulate subscriber behavior scenarios. Additional information about Keysight's 5G solutions is available at www.keysight.com/find/5G.

- For more information about Keysight's PROPSIM FS16, visit https://www.keysight.com/en/pd-3036434/propsim-fs16-rf-channel-emulator
- For more information on the M1740A mmWave transceiver, visit www.keysight.com/find/m1740a
- For more information on the E7770A Common Interface Unit, visit www.keysight.com/find/e7770a

Keysight's 5G Network Emulation Solutions leverage the Keysight E7515B UXM 5G Wireless Test Platform. To learn more, please visit www.keysight.com/find/e7515b.

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