

5G Device Test Solutions

Keysight's comprehensive and industry-leading portfolio of 5G device test solutions span the entire device development lifecycle, from early chipset development, device integration and optimization through to conformance, regulatory and carrier acceptance testing, along with manufacturing and post-deployment repair and optimization.

These comprehensive solutions cover a range of test domains (protocol, RF, functional and performance, non-signaling calibration and verification), and are used by device development and verification engineers from chipset vendors, device manufacturers, test laboratories and mobile network operators.

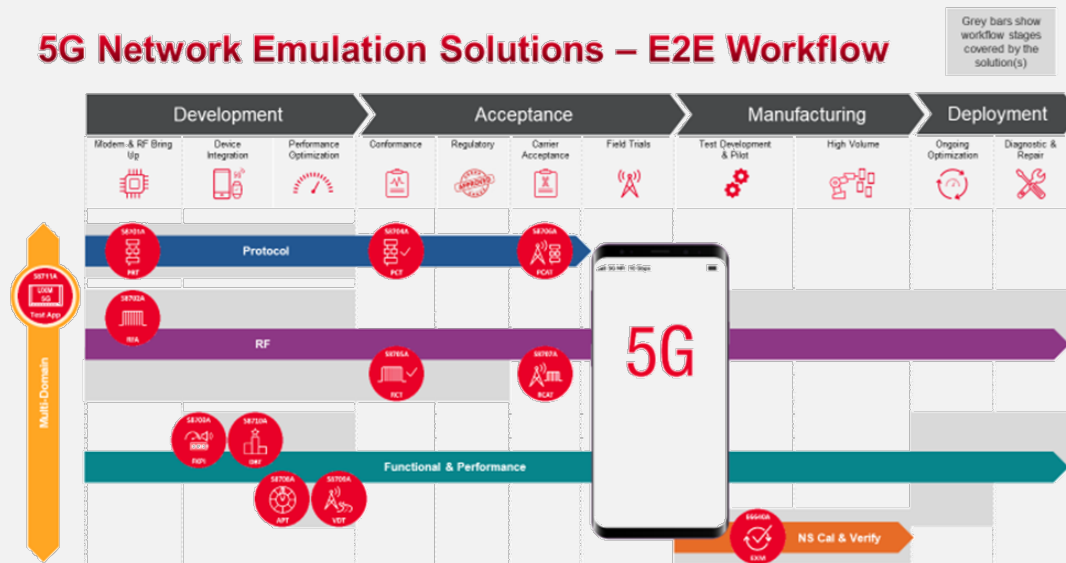


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5G Network Emulation Solutions – E2E Workflow



Test Solutions

S8711A UXM 5G Test Application

The UXM 5G Test Application is a comprehensive testing tool that allows you to fully control the network environment and validate customized testing campaigns through RF Performance & Functional KPI. It is a transversal and scalable tool from development to acceptance. It represents the baseline for growth and evolving technology. Therefore, it can be used alone running on the UXM 5G unit or as a component of certain 5G NES toolsets, it easily scales up with all software solutions on a common hardware and software platform.



The UXM 5G is an interactive real-time testing tool that covers the full chipset and device development workflow from early prototype testing through integration and verification. A comprehensive suite of tools for network emulation, RF and functional testing, allows for a high level of autonomy in configuration and parametrization.

The Test Application Framework has an easy-to-use interface through which you can handle all operations related to emulation and testing across all scenarios: powerful GUI, log viewer and remote control through SCPI interface.

Future proof:

Supporting UXM 5G on array to achieve the widest range of real network 5G NR NSA and SA, TDD, FDD, LTE and C-V2x

- The strongest processing capacity on the market, dynamic port mapping, up to 800MHz per port
- Most Complete Coverage for Functional & RF Measurements Testing

- 100% COVERAGE 3GPP compliance and beyond
- Quick configuration tools to facilitate operation, ease-of-use interface
- RF testing: MIMO, Carrier Aggregation, FR1, FR2, FDD, TDD. UE's receiver reports in real-time for each RAT and CC: BLER / HARQ, Flexible scheduler, AWGN, Fading
- Functional testing: E2E Data Throughput, Voice / Video with integrated IMS, Battery Drain



SA8700A C-V2X Test Solution

Autonomous vehicles (AVs) depend on technologies that enable greater situational awareness: observing, predicting, and automatically taking action. Cellular vehicle-to-everything (C-V2X) has emerged as the wireless link that can help developers achieve higher levels of autonomous operation. However, because C-V2X is built on the evolving 5G standard, its test requirements are a moving target.

Keysight offers a solution that is tracking along with the evolving C-V2X requirements. The SA8700A Test Solution supports RF, protocol and application-layer testing, and the underlying platform will support future releases of 5G NR C-V2X. This protects your initial investment and will accelerate deployment of the technologies that enable advanced AV capabilities.

The foundation is the proven Keysight UXM 5G wireless test set coupled with the C-V2X test application (C8732114A), a suite of Keysight X-Apps C-V2X RF measurements (C87320R1A), C-V2X waveform generation (C87320R2A), an intelligent transportation system (ITS) stack, and application-layer testing. If you're already using another Keysight solution for 4G LTE or 5G testing, the C-V2X solution leverages the same X-Apps and the same measurement algorithms used in our signal analyzers and wireless test sets.

Meet stringent goals for quality, performance and safety

- Simplify C-V2X protocol and RF measurements with an intuitive user interface
- Emulate GNSS signals with an RF vector signal generator (Keysight N5182B MXG X-Series)
- Utilize an advanced 5G measurement platform (Keysight UXM 5G wireless test set)
- Measure Rel14 C-V2X now and be future-ready for 5G NR V2X
- Be ready for C-V2X conformance testing
- Utilize a comprehensive and holistic approach to testing
- Cover RF, protocol and application-layer testing with a single platform
- Address protocol and functional testing of the Uu and PC5 interfaces
- Characterize transmitter performance: power, error-vector magnitude (EVM), frequency accuracy, in-band emissions, adjacent channel leakage ratio (ACLR)
- Perform detailed receiver testing: sensitivity, maximum input level, adjacent-channel selectivity



S8701A Protocol R&D Toolset

The S8701A Protocol R&D Toolset is part of Keysight's 5G Network Emulation Solution portfolio. It is a comprehensive solution that addresses diverse global spectrum requirements and efficiently prototype advanced 5G protocol features.

The S8701A toolset easily scales with Keysight's S8704A Protocol Conformance Toolset and S8706A Protocol Carrier Acceptance Toolset solutions to facilitate mobile device verification across the protocol workflow; from early modem development through to device certification and carrier acceptance.

The toolset is designed to provide an easy-to-use environment to develop and execute tests that verify the 5G NR and LTE signaling protocols of the latest 5G chipsets and devices. The toolset flexibly

addresses a wide range of test scenarios in sub-6GHz (FR1) and mmWave (FR2) frequencies, for both non-standalone (NSA) and standalone (SA) mode.

The toolset offers:

- Support of multiple phases of wireless device development, from pre-silicon protocol prototyping to systems integration and verification;
- Feature breadth and depth to go beyond mandatory industry requirements, allowing tests to be carried out to your specific needs and unique specifications
- Earliest availability of advanced 5G features to test your implementations in complex and simulated real network scenarios
- Accelerate test case creation and analysis, with the highest level of flexibility and control, to achieve first-to-market functionality with impeccable quality
- Flexible licensing infrastructure that allows optimal asset utilization
- Advanced logging features that enable rapid debugging of test case failures

S8702A RF Automation Toolset

When developing new 5G devices, RF design engineers require access to tools that enable them to rapidly inspect and verify the transmitter and receiver performance of their devices. This allows them to identify and focus on areas where performance is sub-optimal and quickly retest when the issue has been rectified.

Keysight's RF Automation Toolset addresses this need by providing a suite of RF transmitter and receiver tests based on the relevant 3GPP test specifications. These tests are optimized for speed and designed to run on a benchtop platform, allowing each engineer to have a dedicated test system on their own desk. Combined with Keysight's sophisticated logging and debugging tools, the toolset enables design verification engineers to accelerate the transformation of new 5G devices from prototypes to commercial products.

The S8702A RF Automation Toolset is a comprehensive benchtop solution that enables 5G device development engineers to quickly inspect and verify the RF transmitter and receiver performance of new 5G NR devices in accordance with the 3GPP TS 38.521 and 3GPP TS 36.521 specifications; supporting FR1 and FR2 deployments for both 5G NR NSA and SA modes devices.

The S8702A RF Automation Toolset extends the capabilities of the 5G test application by providing:

- An intuitive and easy-to-use graphical user interface for creating, configuring and running test campaigns
- A suite of fully-automated RF transmitter and receiver tests, based on the 3GPP TS 38.521 test specifications for 5G New Radio (NR), and on 3GPP TS 36.521 for LTE Advanced
- Optimized test execution times, enabling rapid inspection of the RF performance of 5G NR devices
- A report generator to summarize the results of test campaigns
- Support for both NSA and SA 5G modes in the same network emulator, providing a small footprint benchtop solution
- State-of-the art logging, visualization and debugging tools

- Flexible licensing options and tools

The toolset is based on:

- Keysight E7515B UXM 5G Wireless Test Platform: emulates the 5G network
- Keysight's Test Application Framework Software: provides control of the UXM 5G network emulator
- Keysight's X-Series Measurement Software: provides ready-to-use measurements for signal analysis
- Keysight's E7770A Common Interface Unit, M1740A mmWave Transceiver and mmWave OTA chambers: extend testing range to mmWave frequencies (FR2)

S8703A Functional KPI Toolset

The S8703A Functional KPI Toolset is part of Keysight's 5G Network Emulation Solutions portfolio. It provides an efficient and cost-effective platform designed for development and validation engineers within chipset manufacturers, mobile device manufacturers, operators and repair houses to validate user experience scenarios.

When developing new 5G devices, design engineers require access to tools that enable them to rapidly inspect and verify the functional aspect of their devices, allowing them to identify and focus on areas where performance is sub-optimal and quickly retest when the issue has been rectified. Keysight's-Functional KPI Toolset extends the functionality of the UXM 5G Test Application by providing an automated suite of test scenarios around data throughput, audio, power consumption, mobility and emergency services, which have been optimized for speed and designed to run on a benchtop platform, allowing each engineer to have a dedicated test system on their own desk. Combined with Keysight's sophisticated logging and debugging tools, the solution enables design verification engineers to accelerate the transformation of new 5G and 4G devices from prototypes to commercial products.

The S8703A toolset provides a comprehensive and easy-to-use solution for development engineers working on integration and functional testing to validate the performance of their devices. The toolset flexibly addresses test needs around data throughput, power consumption (battery life), audio, mobility and emergency application services.

The toolset offers:

- An intuitive and easy-to-use graphical user interface for creating, configuring and running test campaigns
- Supports two modes: Runtime mode - enables pre-canned test scenarios, and Developer mode - provides advanced users with the ability to create test scenarios with a higher level of complexity and flexibility
- Optimized test execution times, enabling rapid inspection of the functional performance of 5G NR and 4G devices
- A report generator to summarize the results of test campaigns
- State-of-the-art logging, visualization and debugging tools
- Flexible licensing options to scale with the technology

S8704A Protocol Conformance Toolset

The S8704A Protocol Conformance Toolset is part of Keysight's 5G Network Emulation Solution portfolio. A compact solution that supports the entire protocol testing needs of the GCF and PTCRB certification bodies, the S8704A Protocol Conformance Toolset easily scales with the Keysight S8705A 5G RF/RRM DVT & Conformance Toolset to facilitate mobile device verification and certification across radio frequency (RF), radio resource management (RRM) and protocol.

The S8704A shares key components with other Keysight 5G solutions, such as the S8701A Protocol R&D Toolset and S8706A Protocol Carrier Acceptance Toolset.

The toolset provides up-to-date and comprehensive access to 5G including USIM/USAT, IMS, LTE and C-V2X protocol conformance test cases as defined in 3GPP test specifications to ensure mobile devices perform as expected on a live mobile network.

The 3GPP test specifications supported are:

- 3GPP TS 38.523-1 (5GS)
- 3GPP TS 31.121 (USIM)
- 3GPP TS 31.124 (USAT)
- 3GPP TS 36.523-1 (LTE and C-V2X)
- 3GPP TS 34.229-1/5 (IMS)
- 3GPP TS 37.901 (LTE Data Throughput)

The test cases are based on the latest TTCN-3 test specification from 3GPP RAN5 required for device certification and support all GCF and PTCRB mandated frequency bands in both sub-6GHz (FR1) and mmWave (FR2) frequencies.

The toolset offers:

- Comprehensive access to GCF and PTCRB protocol test cases
- Modular and scalable software and hardware platform
- Flexible licensing infrastructure that allows optimal asset utilization
- Comprehensive campaign management
- Advanced logging features that enable rapid debugging of test case failures
- Unattended test campaign execution with device automation
- Unique solution for automatically programming required SIM card profiles

S8705A RF/RRM DVT & Conformance Toolset

The S8705A RF/RRM DVT and Conformance Toolset is part of Keysight's 5G Network Emulation Solution portfolio. A compact solution that supports the entire RF testing needs of the GCF and PTCRB certification bodies. The S8705A easily scales with the Keysight S8707A 5G RF/RR Carrier Acceptance Toolset which delivers complementary coverage for supplementary test plans defined by Mobile Network Operators.

The S8705A provides up-to-date and comprehensive access to 5G NR and C-V2X RF and RRM conformance test cases as defined in 3GPP TS 38.521-1-4 (5G NR RF), 3GPP TS 38.533 (5G NR RRM) and 3GPP TS 36.521 (C-V2X based on LTE) to ensure mobile devices perform as expected on a live mobile network.

The toolset is an approved test platform for device certification at GCF and PTCRB that supports both TDD and FDD and all relevant bands in both sub-6GHz (FR1) and mmWave (FR2) frequencies.

The toolset offers:

- Comprehensive access to GCF and PTCRB RF test cases in conformance mode
- Tools to customize test cases by adding new test points, modifying channel bandwidth, test frequencies, and other parameters, to go beyond industry requirements defined by 3GPP in the DVT mode
- Modular and scalable software and hardware platform
- Access to approximately 80% of total validated test cases in the benchtop configuration, both FR1 and FR2
- Flexible licensing infrastructure that allows optimal asset utilization
- Comprehensive campaign management
- Advanced logging features that enable rapid debugging of test case failures
- Unattended test campaign execution with device automation

S8706A Protocol Carrier Acceptance Toolset

The S8706A Protocol Carrier Acceptance Toolset is part of Keysight's 5G Network Emulation Solution portfolio. It provides an efficient platform for mobile device evaluation based on the test requirements of major mobile operators, who validate the test supported by the S8706A 5G Protocol Carrier Acceptance Toolset solution as part of their device acceptance programs.

The S8706A easily scales with Keysight's S8701A Protocol R&D Toolset and S8704A Protocol Conformance Toolset solutions to facilitate mobile device verification across the protocol workflow, from early modem development through to device certification and carrier acceptance.

The toolset provides comprehensive access to protocol carrier acceptance test plans mandated by the world's major 5G mobile operators. The toolset flexibly addresses a wide range of test scenarios in sub-6GHz (FR1) and mmWave (FR2) frequencies, for both non-standalone (NSA) and standalone (SA) mode: signaling, performance and application testing.

The toolset offers:

- Comprehensive coverage of 5G protocol carrier acceptance test plans
- Modular and scalable software and hardware platform
- Flexible licensing infrastructure that allows optimal asset utilization
- Comprehensive campaign management
- Advanced logging features that enable rapid debugging of test case failures
- Unattended test campaign execution with device automation

S8707A RF/RRM Carrier Acceptance Toolset

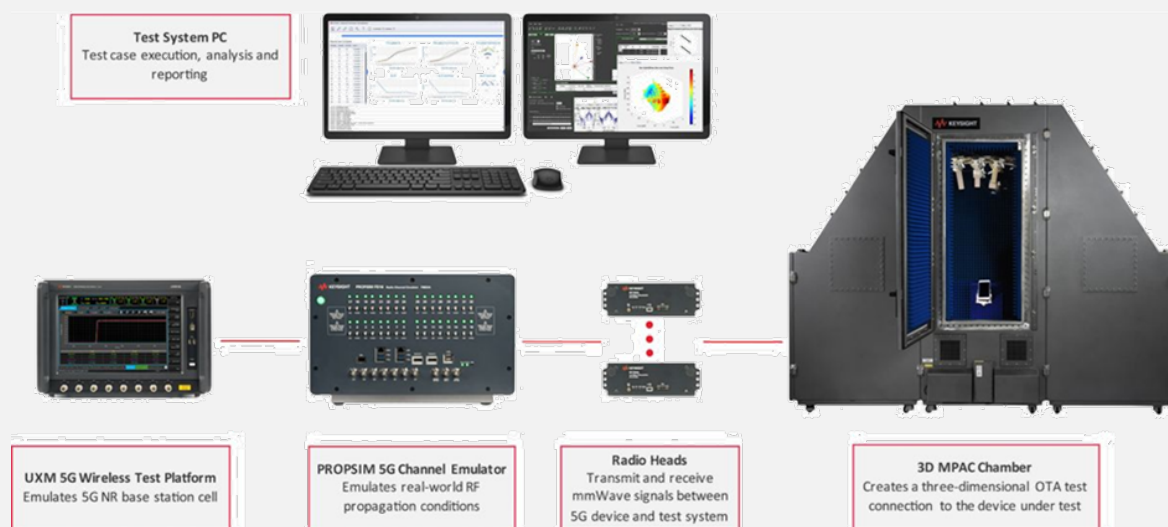
The S8707A RF/RRM Carrier Acceptance Toolset is part of Keysight's 5G Network Emulation Solutions portfolio. It provides an efficient platform for mobile device acceptance based on the test requirements of major mobile operators, who validate the test cases supported by the solution as part of their device acceptance programs.

The S8707A easily scales with Keysight's S8705A RF/RRM DVT and Conformance Toolset solution to facilitate mobile device verification across the RF workflow, from early modem development through to device certification and carrier acceptance, on a common hardware and software platform.

The toolset provides comprehensive access to RF/RRM carrier acceptance test plans mandated by the world's major 5G mobile network operators. The toolset flexibly addresses a wide range of test scenarios in sub-6GHz (FR1) and mmWave (FR2) frequencies, for both non-standalone (NSA) and standalone (SA) mode.

The toolset offers:

- Comprehensive coverage of RF/RRM carrier acceptance test plans
- Modular and scalable software and hardware platform
- Flexible licensing infrastructure allowing optimal asset utilization
- Comprehensive campaign management capabilities
- Advanced logging features that enable rapid debugging of test case failures
- Unattended test campaign execution with device automation



S8708A 5G Advanced Performance Test Toolset

Keysight's S8708A 5G Advanced Performance Test Toolset is an end-to-end wireless device test solution that enables chipset and device makers together with mobile operators to evaluate and optimize the performance of 5G devices in a lab environment. The S8708A is a part of Keysight's 5G Network Emulation Solution portfolio that addresses the entire device development workflow from early design to acceptance and manufacturing.

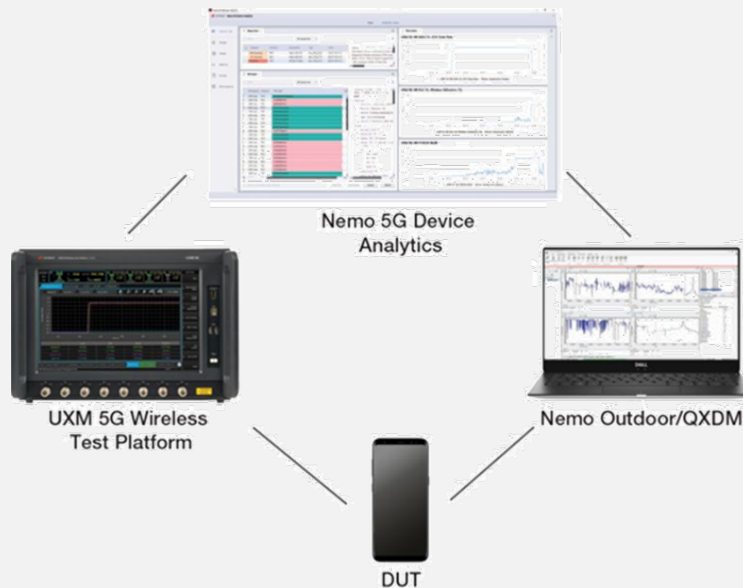
The solution offers a verified test set developed prior to the release of 3GPP FR2 MIMO OTA and allows R&D teams to test beam management in a 3D spatial fading channel at mmWave frequencies. It covers advanced performance testing above standard requirements for beam management testing with pre-defined test cases and customizable test scripts that are available to meet specific customer requirements.

With the S8708A you will gain insight into 5G device performance in real world channel conditions. The toolset enables reliable performance testing of mobile devices in a lab and allows you to reach a first-to-market status with high-quality devices.

This toolset is the most complete solution for device performance testing. It integrates a high capacity PROPSIM channel emulator and an UXM 5G network emulator together with FR2 OTA chambers and mmWave access components. The solution covers mmWave MIMO OTA tests according to the pre-3GPP test specification and allows R&D teams to validate beam management in real world radio channel conditions. It delivers an integrated lab-based test solution that enables users to validate real world performance in a controlled lab environment for enhanced product quality. The S8708A supports stress-testing of devices as well as optimization to achieve maximum performance. Expose early prototypes to realistic field conditions and accelerate market launch with Keysight's automated lab test solution.

The toolset offers:

- Verified test set developed prior to the release of 3GPP FR2 MIMO OTA
- Validated channel models for FR2 MIMO OTA according to the TR38.901 test specification
- Predefined and customizable beam management performance test cases
- Verified device data throughput performance under CDL channel models in FR1 and FR2
- State-of-the art logging, visualization and debugging tools to resolve issues more quickly



S8710A Device Benchmarking Toolset

With S8710A Device Benchmarking Toolset, you will gain objective insight into comparable 5G device features and selected KPIs. The toolset comes with advanced test automation capabilities that enable high-volume testing and repeatability – directly improving product quality and minimizing the risk of human error.

With the S8710A, you can objectively benchmark and compare the performance of devices and software and hardware builds with one single tool. The toolset may be used to ensure the high quality of 5G devices and increase customer satisfaction, or to evaluate, compare and select the best devices on the market. The toolset automatically creates a benchmark report for each device under test, along with an overall score and rank for each tested device. Advanced test automation capabilities enable you to optimize the performance of your new 5G devices and accelerate their time-to-market.

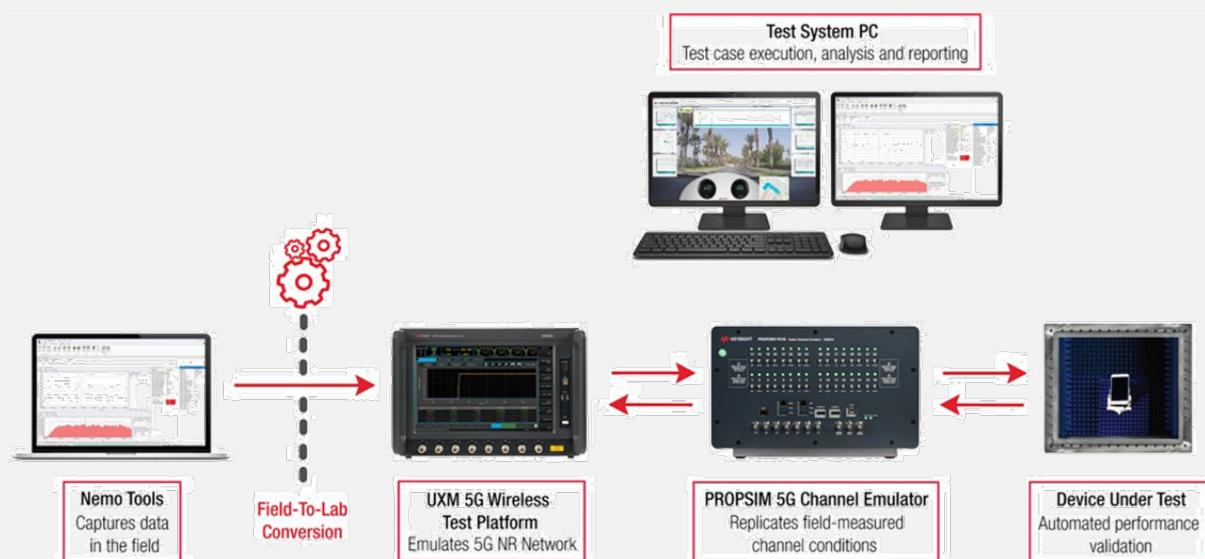
The toolset combines Keysight's UXM 5G Wireless Test Platform and Nemo Outdoor with the new Nemo 5G Device Analytics software. This software may also be used to enable device troubleshooting, via the correlation of logs from the device under test with logs from the network emulator, providing an end-to-end view of the communication exchanges to enable in-depth analysis and pinpointing of device issues.

The S8710A enables device makers and mobile operators to automate testing and reporting across different device builds and models.

This automated solution offers standardized scoring of key performance indicators (KPIs), allowing normalized comparison of the overall performance of different software and hardware builds, or the evaluation of your device's performance compared to competitor devices.

The toolset offers:

- Fully automated end-to-end test environment for benchmarking devices produced by any manufacturer or devices built using modems from any chipset maker
- Automated benchmark report generation for the device under test
- User-definable ranking of individual KPIs to determine the device's overall score
- Comparison reports showing the rank, scores and KPIs from a range of devices
- Pre-defined test cases to obtain KPI measurements
- High-volume testing and repeatability



S8709A 5G Virtual Drive Test Toolset

The S8709A Virtual Drive Test Toolset is the only solution bringing real world logs to the testing workflow. It makes repeatable real-world performance testing accessible to R&D teams by integrating instrumentation and the test environment under a single lab solution. You gain access to field measured geometrical channel models with high-capacity fading options as well as signaling scripts replicating operator-specific network capabilities.

By seamlessly integrating Keysight's 5G channel emulation and network emulation solutions with Keysight's Nemo Outdoor and 5G Device Analytics tools, you can quickly and easily verify the end-user experience based on real-life mobility scenarios, such as challenging high-speed train conditions. The

data captured in the field is imported into the toolset test scenario, resulting in reliable and repeatable replay of signaling events and radio channel environment in a controlled laboratory environment.

The S8709A toolset is a real-world lab test environment for validating 5G devices under a wide range of network signaling and radio channel conditions. It offers a fully controlled test scenario enabling quick and systematic performance validation. Moreover, it enables you to efficiently analyze the performance of 5G new radio (NR) devices deployed in non-standalone (NSA) or standalone (SA) networks and under various mobility scenarios.

The toolset is a part of Keysight's comprehensive portfolio of 5G NR design and test solutions that spans the entire workflow from simulation, development, and design verification, to conformance and acceptance testing, and finally manufacturing and deployment. It creates a representation of real-world conditions without a need for comprehensive analysis and simulation of the environment. Lab-based testing enables mobile operators and wireless device manufacturers to quickly and efficiently benchmark different mobile devices. The toolset therefore accelerates the validation of wireless devices, supporting new design development from prototypes to fully functioning 5G devices.

The toolset offers:

- Test campaign management with detailed status information and KPIs
- Result analysis with clear reports for decision making
- Ready-to-run test cases based on real-world drive test routes from major operator networks representing signaling and RF environments in various parts of the world
- Complete end-to-end test solution allowing parameterizing of test cases
- State-of-the art logging, visualization and debugging tools to resolve issues more quickly
- Mobility performance testing, covering:
 - Handover and cell re-selection success rates
 - Call drop rates and service interrupts
 - Data performance
 - Voice call quality

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Test equipment rentals help you meet your deadlines at fraction of the purchase price!

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