8100 Mobile Device Test System Location Technology Solution

Introduction

With the 8100 Mobile Device Test System (MDTS) Location Technology Solution (LTS), users benefit from the unique advantage of being able to test multiple A-GNSS location technologies and air interfaces in one system, which scales to address evolving 5G, LTE, Wi-Fi, Cat M1, Bluetooth (BLE), and sensor multi-mode device testing needs. Keysight solutions also include the industry's first system to test devices in parallel, cutting overall test time and increasing team productivity.

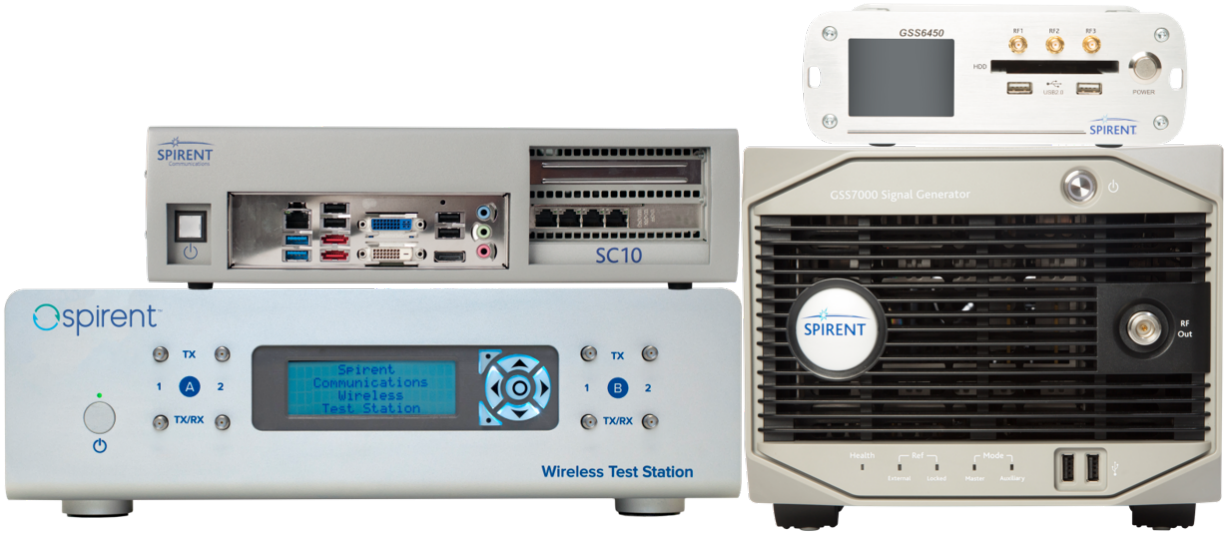

Figure 1. Q750 configuration with optional record and playback unit

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Overview

Keysight's 8100 MDTS Location Technology Solution (LTS) provides comprehensive performance and conformance testing for A-GNSS, Observed Time Difference of Arrival (OTDOA), Enhanced Cell ID (ECID) and Wi-Fi measurement for positioning. Keysight LTS supports critical features such as GPS L5 band positioning, end-to-end VoLTE E911, LTE-to-Wi-Fi handover and offload, LTE-to-3G circuit-switched fallback (CSFB), and emergency IMS procedures. In addition, it was also the first solution to support A-BeiDou, A-Galileo, A-GPS L5, and multiple satellite constellations running simultaneously.

The advent of 5G is bringing many new challenges to location positioning, one of the foremost being the possibility of interference from the different orders of intermodulation and harmonics between 4G and 5G signals. This interference is proven to degrade location performance as compared to the already-proven accuracy of 4G location technologies. Keysight's 8100 LTS supports both 4G and 5G simultaneously to help identify and evaluate any interference between the two.

Emergency (E911), navigation, and location-aware applications are becoming ever more prevalent on wireless devices. Ensure that your devices meet the needs of next-generation location applications running on 5G, LTE, and Wi-Fi networks with Keysight's Location Technology Solutions.

Applications

Device and chipset manufacturers:

- Type approval and certification testing (CTIA/GCF/PTCRB)
  - A-GNSS, OTDOA, and ECID protocol and minimum performance
  - OMA SUPL test specifications
- Design verification and validation
- R&D performance and functional testing
- Operator-acceptance testing and validation

Network operators:

- Acceptance testing
- Device characterization and comparison

Test labs:

- Type approval and certification testing (CTIA/GCF/PTCRB)
  - A-GNSS, OTDOA & ECID protocol and minimum performance
- Operator-acceptance testing and validation

Another challenge introduced in 5G is regarding the impact of high data traffic on location performance. With 5G, large amounts of data are sent/received with the device. This could impact the performance of the GNSS chipset and the prioritization of location traffic, e.g., SUPL, vs other data, which may cause location accuracy failures.

There are many new location technologies introduced in 5G specified by 3GPP Rel 15, such as updated LPP protocol running in NSA and SA mode. This is followed by Emergency Fallback location call flow and location with true Voice over New Radio (VoNR). In 3GPP Rel 16, even more improvements are coming: downlink/uplink OTDOA, downlink/uplink angle of arrival (AoA), multi-round trip time (RTT), 5G ECID, and precise point positioning (PPP)/ real time kinematic (RTK).

To help leverage our customers' investments and fulfill upcoming advanced 5G location requirements, existing 8100 LTS systems can be easily upgraded to support new 5G technologies through our integration with National Instruments' flexible software-defined radio (SDR) platform as a core component of the solution. This SDR platform has been deployed globally for several years and is proven to be very stable, scalable, and reliable.

Benefits

- **A single solution for the entire product lifecycle.** Control both conducted mode and radiated over-the-air (OTA) testing using a single user interface.
- **Committed to address your location test needs.** Keysight's 8100 Location Test Solution is your trusted partner to address location technology testing challenges.
- **Addresses the requirements of leading network operators.** Keysight test cases ensure that you'll quickly meet operator acceptance test requirements, shaving weeks off your product's time to market.
- **Results you can trust.** Industry leaders the world over trust Keysight's 8100 MDTS Location Technology Solution to provide accurate and reliable results to meet their quality goals and commitments.

Key Features

- Easy-to-use graphical user interface provides simple test execution and results analysis.
- Test case configurability enables testing beyond 3GPP conformance.
- Troubleshooting capabilities analyze device failures quickly and efficiently.
- Industry-leading GNSS simulation capabilities guarantee accurate, reliable, and repeatable test results.
- For E911 calls, barometric pressure performance testing satisfies all FCC and carrier requirements for z-axis device testing for 5G NR NSA, 5G NR SA, 4G LTE, WCDMA, GSM, and CDMA.

Conformance and Operator Acceptance

Network operators are actively rolling out a rich array of protocols to enable location technologies on multi-mode devices. Keysight works directly with 3GPP working groups, GCF, PTCRB, CTIA, OMA, operators, and technology leaders to ensure complete test coverage of user plane and control plane implementations are available when needed by early adopters.

This includes the new GPS L5 bands, Galileo, Wi-Fi positioning, barometric pressure (Z-axis), LTE positioning methods such as OTDOA, positioning protocols such as LTE Positioning Protocol (LPP), legacy protocols such as Radio Resource Location Protocol (RRLP), andIS-801-1, as well as user plane protocols, including SUPL 2.0.

Keysight's offerings include critical LTE features such as VoLTE E911 functional tests, advanced field-to-lab performance tests, multi-access point Wi-Fi performance tests, and OTDOA test cases for both conformance and carrier requirements.

Coverage Across Multiple Satellite Constellations and Bands

Having supported Assisted GPS (North American) and GLONASS (Russian) satellite positioning for many years, Keysight's 8100 LTS has added capabilities for the BeiDou Chinese satellite and Galileo European satellite systems.

Initially developed for the military, A-BeiDou positioning is now a requirement for any device or chipset vendor supporting the Chinese market. 8100 LTS supports key test cases established by the China Communication Standards Association (CCSA) as well as 3GPP and CTIA.

In 2018, Galileo was approved by the FCC for use in US markets, thereby increasing the accuracy that can be achieved for E911 needs.

GPS L5 is a new and critical GNSS constellation for the industry because repeated simulation and field testing has shown marked improvements in location accuracy, as much as 100 times in certain complicated environments (from an order of meters to centimeters). The Keysight LTS system has supported GPS L5 testing since 2018 and was the first solution to be validated both in GCF and PTCRB as well as in carrier acceptance test plans.

GNSS Record and Playback

Testing A-GNSS performance in real-world conditions is important to ensure a wireless device's positioning performance, but live testing is expensive and difficult to consistently reproduce. Keysight's A-GNSS record and playback capability brings the field-testing environment into the lab with a controlled and repeatable methodology to identify any device's positioning performance issues.

Figure 2. 8100 5G location test system

Conducted and Over-the-Air (OTA) Radiated Testing

The 8100 MDTS Location Technology Solution is not limited to conducted-mode testing. For OTA testing, Keysight offers seamless integration with leading anechoic test chambers. Keysight always keeps its testing capabilities at the forefront of location technology, ensuring that its customers can focus on their testing, no matter how the industry's OTA test requirements evolve in the future. Keysight is ready right now with the test cases you need for operator acceptance across several major global carriers. The Keysight LTS is completely compliant with current LTE OTA CTIA test requirements.

Figure 3. SR5750 Wi-Fi multi-AP system

Hybrid Positioning Technologies for Greater Accuracy Indoors

Accurate positioning in consumer devices leverages GNSS global satellites with assistance from the cell network, called A-GNSS. Yet obtaining a position fix indoors is difficult due to multi-path reflections and multiple sources of interference. In dense urban areas with closely-situated multi-story buildings, just a few feet can make a huge difference in helping to locate persons in need. This is especially important as the public is increasingly using wireless devices as the primary means for contacting emergency services. With GNSS impractical indoors, alternate hybrid positioning technologies are used to either augment or replace satellite positioning.

Keysight's 8100 LTS supports ECID and OTDOA to augment A-GNSS for device-based positioning techniques as well as indoor positioning methods such as Wi-Fi via the SR5750 multi-access point (AP) instrument for Wi-Fi protocol and performance tests. The SR5750 incorporates Wi-Fi chipsets for more accurate representation of up to 32 "real" APs and supports active scanning of devices for more realistic emulation of the live dynamic environment.

Parallel Device Testing

The 8100 LTS is available in a configuration tailored for A-GNSS LTE parallel device testing. Increase productivity and reduce overall test time by parallel execution of test cases in one of three scenarios:

- Same test case executed on two devices
- Same GPS conditions with different A-GPS parameters
- Simultaneously perform R&P tests on one device and GPS parameter tests on another

Location Positioning Test Coverage

Keysight currently offers coverage for the following test specifications:

Technical Specifications	GCF	PTCRB	Operator-Specific
3GPP TS37.571-1 5G Section 13 A-GNSS minimum performance	Yes	Yes	Yes
3GPP TS37.571-1 Section 7 LPP A-GNSS (GPS, GPS L5, GLONASS, BeiDou, Galileo) minimum performance	Yes	Yes	Yes
3GPP TS37.571-1 Section 8 LPP eCID minimum performance	Yes	Yes	Yes
3GPP TS37.571-1 Section 9 &10 LPP OTDOA minimum performance	Yes	Yes	Yes
3GPP TS37.571-1 Section 12 LPP Wi-Fi performance	Yes	Yes	Yes
3GPP TS37.571-1 5G Section 13 A-GNSS minimum performance	Yes	Yes	Yes
3GPP TS37.571-2 Section 7 LPP protocol conformance	Yes	Yes	Yes
CTIA A-GNSS and standalone GNSS OTA Test Plan	N/A	Yes	Yes
CCSA A-BeiDou and standalone BeiDou minimum performance and OTA performance	CCSA	N/A	N/A
OMA LPPe ETS protocol conformance	Yes	Yes	Yes
LPPe indoor positioning protocol tests with Wi-Fi, BT, Barometric pressure	N/A	N/A	Yes
LPPe indoor positioning Wi-Fi performance	N/A	N/A	Yes
A-GNSS record and playback	N/A	N/A	Yes
OTDOA position accuracy performance	N/A	N/A	Yes
E911 Hybrid A-GNSS+OTDOA	N/A	N/A	Yes
VoLTE E911 functional test	N/A	N/A	Yes
E911 calling over Wi-Fi	N/A	N/A	N/A
E911 barometric pressure performance test	N/A	N/A	Yes

Keysight evolves its test solutions to meet the latest requirements as the plans of key technology providers and network operators evolve.

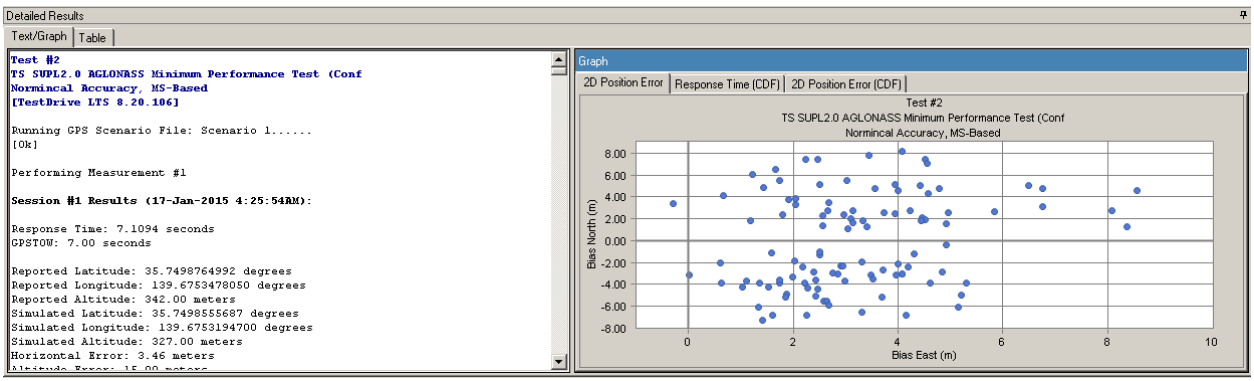

Figure 4. Sample results from SUPL 2.0 A-GLONASS minimum performance testing

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.

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