Testing Multi-GNSS in an Integration and Validation Environment

From GPS to Multi-GNSS

SPIRENT®

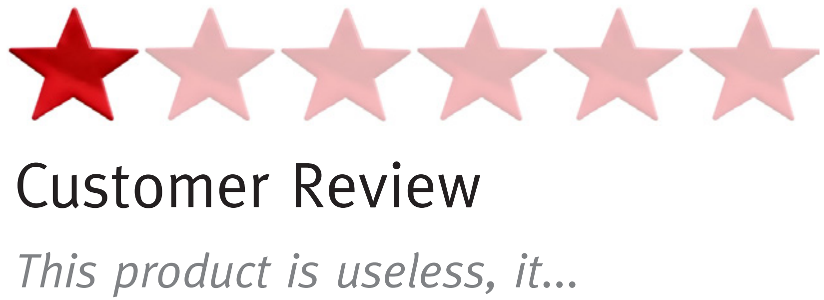
The next generation

The shift from individual satellite navigation systems using GPS to next-generation receivers capable of exploiting multiple global navigational satellite systems (Multi-GNSS) offers a host of benefits in terms of improved coverage and accuracy and in new services.

However, this switch to *Multi-GNSS* dictates that manufacturers take a different approach to testing their products to ensure that they will function as desired, regardless of which satellite signals can be acquired at any given time. And that new approach has to run throughout the lifecycle of the product from the *research and development* lab right through *integration* and *validation* of the design to the end of the *production* line.

Quality is king

One thing is certain: there is no way any manufacturer can get away with releasing faulty or poor-performing products to market. Today's tech-savvy consumers will be quick to spot any failing product, and easy access to social media allows any disgruntled user to spread the word far and wide. Hard-won brand reputations can be destroyed in a matter of weeks.



However, with time to market a key factor in the success of any high-technology device, the pressure is on to get any new design into production as soon as possible and to begin pre-launch marketing, focusing on the unique features of the new equipment.

So before any design of GNSS receiver or location-enabled device featuring such a subsystem emerges from the laboratory and enters *production* it is essential that the design and its functionality are fully validated.

The validation procedure

While it may be the case that validation testing will have been performed at various stages during the design, the final acceptance test regime must always be the most arduous. It is essential that the GNSS receiver be tested for all reasonable operating parameters, and under all reasonable operating conditions.

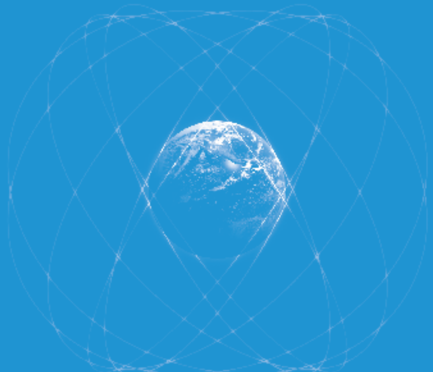
This will mean running the full set of tests typical for any GNSS receiver:*

- Cold-start time to first fix
- Warm-start time to first fix
- Hot-start time to first fix
- Acquisition sensitivity
- Tracking sensitivity
- Reacquisition time
- Static navigation accuracy
- Dynamic navigation accuracy
- Radio frequency interference
- Plus application-specific tests for the overall equipment

* For more information on GNSS Receiver testing, please download the ebook ‘Simulation versus Real-World Testing’

The multi-GNSS difference

Clearly, the *Multi-GNSS* receiver differs from previous-generation GPS-only devices in its ability to work with multiple satellite navigation systems. This might be GPS and GLONASS, GPS and Galileo, GPS and Compass, or any combination of the existing and soon-to-be-expanded services.



Indeed, one of the most appealing aspects of Multi-GNSS receivers is their truly global application, enabling manufacturers to produce a single device for use anywhere in the world and for sale in all markets.

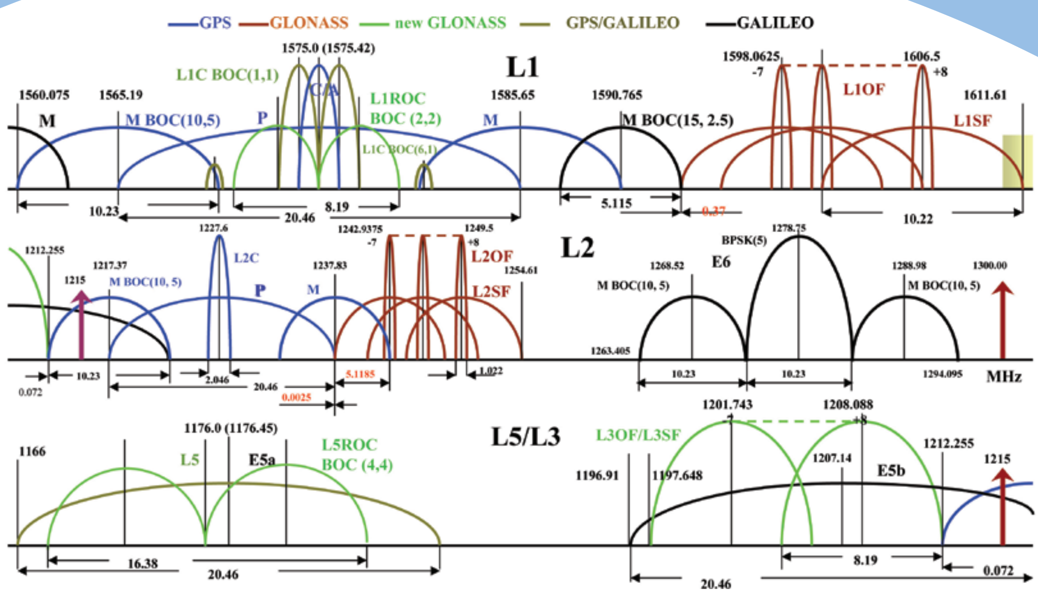
The Multi-GNSS problem

However, this does mean that all the tests typically used for qualifying a single-system receiver will need to be repeated for each system used by the receiver. And there will also be a requirement to test the unit in the presence of “composite” signals made up of partial navigation signals from two or more satellite constellations.

This “composite” testing will determine factors such as

- *When to use GPS only or Multi-GNSS*
- *Which order a receiver uses available signals*
- *Performance implications of choices made*
- *Interoperability issues such as system time and reference frames of different GNSS systems*

This is made all the more difficult because the signals from the various GNSSs have different frequencies and bandwidths. And while the design may feature a good deal of common circuitry between the different receivers, various programmable elements such as clocks and filters will operate differently in the presence of different systems.



So many tests, so little time

Even assuming that the final validation would only comprise the nine basic tests listed earlier but repeated for each of the satellite systems covered, the test programme will require considerable time and resources to complete because each test has to be done multiple times and under different conditions to get a statistical distribution of results.

And, just to complicate matters, many of the satellite signals concerned are not yet fully available. For example, Russia's GLONASS system is only now approaching global coverage, the EU's Galileo constellation is not yet in position, and the Chinese Compass system is still in its local configuration of Beidou.
So real-world "live-sky" testing is simply not an option. And that can actually be viewed as a benefit.

Experience in testing GPS receivers has shown that manufacturers always underestimate the time and resources required for real world environment testing. So imagine the problems of repeating road tests for each of three or four satellite systems.

Requirements for repeatability

Indeed, the need for repeatability is an important criterion that effectively rules out road testing as a means for validating any GNSS receiver design – or a piece of location-aware equipment featuring such a receiver.

Even the simplest test of *static location* accuracy can never be precisely repeated using "live-sky" testing with real signals from real satellites. For, while the location of the test may not vary, the exact positions of the satellites within the GNSS constellation are continually changing. So it is not possible for exactly the same conditions to be presented twice.

There is however a case where capturing the richness of the sky signals to playback later in the lab compliments simulation as a source of GNSS signals for test. More information on this can be found by downloading the eBook 'Everything you need to know about Record and Playback'.

The simulation solution

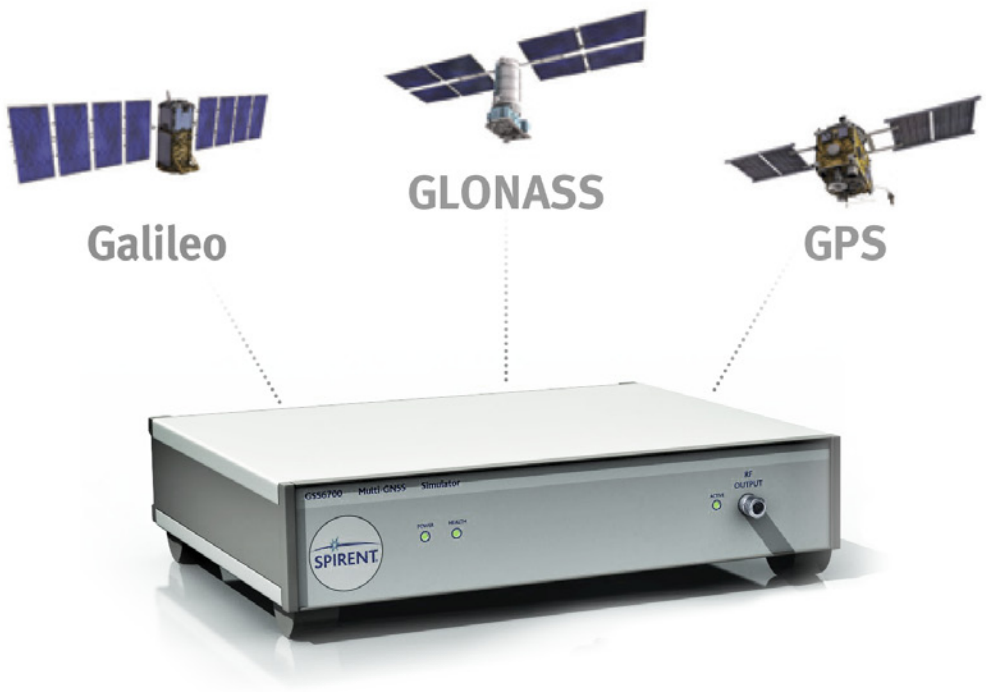
Remarkably, all the tests required for validation of a Multi-GNSS receiver design can be performed in the laboratory, and the key to this setup is a single item of test equipment – a multichannel GNSS simulator. Under software control and with a library of ready-written test scenarios, today's multichannel Multi-GNSS simulators can form the basis of a complete test laboratory for location aware products.

Every test is entirely repeatable using signals which are precisely known and controlled, and complex test sequences can be programmed to run overnight, with all results available the following morning for detailed analysis. And the simulator can be integrated into a multi-part test setup using USB or GPIB, allowing engineers to evaluate the performance of a receiver embedded within any piece of location-aware equipment.

Today’s tests and tomorrow’s tests

One huge advantage of the multichannel GNSS simulator is that it can be used to generate signals from satellite systems that do not yet exist. So, not only will a suitable instrument be capable of simulating today’s GPS and GLONASS signals, the same hardware will be capable of generating the signals that have been defined for Galileo and Compass systems – plus the additional signals that will be available in the next wave of GPS modernisation.

In this way, the GNSS simulator can be viewed as in investment in future test capabilities as well as a solution to today's test requirements.



The science of compliance

The holy grail of producing a single piece of location-aware equipment for sale in multiple global markets, potentially using several different global navigation satellite systems offers manufacturers massive economies of scale and the ability to expand their global brands.

However, different markets still have different local certifications, and so the globalisation of a single product could come with a number of certification headaches.

However, by using a globally certified multi-channel GNSS simulator to validate the design and maintaining full test records of the validation process, manufacturers can be shown to be performing due diligence in their test procedures. And this can translate into a simplified compliance procedure, particularly in markets that allow self-certification (such as the EU R&TTE Directive).

The Spirent GNSS and Wi-Fi Solutions

Spirent is the industry leader for GNSS simulator products. Spirent offers several different models of GNSS simulators that support a variety of different applications and cover the full spectrum of civilian and military GNSS testing needs. Spirent products range from basic single-channel simulators, suitable for simple production testing, through multi-channel, multi-constellation simulators, suitable for the most demanding research and engineering applications.

Spirent GSS8000

Multi-GNSS Constellation Simulator

Spirent GSS6700

Multi-GNSS Constellation system

Spirent GSS6300

Multi-GNSS Signal generator

Spirent GSS6400

Record & Playback System

Spirent GSS5700

Wi-Fi Access Point simulator

Why not find out more about Testing Multi-GNSS in an R&D environment? Download the E-Book "Testing Multi-GNSS in an R&D Environment".

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gnss-solutions@spirent.com

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Spirent
+44 1803 546325
globalsales@spirent.com
www.spirent.com/positioning

Spirent Federal Systems
+1 714 692 6565
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