How to Guarantee Product Quality in Location Enabled Devices

Navigating Consumer Confidence

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How to guarantee product quality in location-enabled devices

With the steady reduction in the cost of GNSS receiver chipsets and the maturing of the technology, there are ever more classes of consumer products that are being designed with some degree of location awareness. Many manufacturers of such products have limited experience with the technology, and could potentially jeopardise their brand's reputation if their location-aware products underperform.

A non-functioning navigation system makes nonsense of any location-aware product. And there is no hiding place for a poorly performing navigation system: if the user is told they are standing in front of a certain place of interest but the actual landmark can clearly be seen 100 metres distant there is clearly something wrong. And with online forums providing a simple way for consumers to express their feelings to the rest of the market, the damage can be there for all to see. So, how can this be avoided?

Manufacturers of consumer products routinely perform functional testing on all production output, and so it is only logical to add some form of location testing to these production test routines to verify the operation of the GNSS receiver within the end product. But where do you begin?

There will certainly be classes of location-aware products in which the navigation system is critical to the operation of the device and performs an essential safety-related or legally required function. In these cases multiple tests may need to be performed on all products manufactured to ensure not only operation but adequate performance.

However, for the vast majority of location-aware consumer products, if the design has been properly characterised, the performance level can be “taken as read”. In these cases, the functional test is no different from any other circuit: does the product deliver a predictable response to a known stimulus?

The practicalities of testing

The first obstacle that will be encountered in integrating GNSS receiver testing into a production test setup is pretty obvious. As such tests are performed at the end of the production line, they are inevitably performed indoors. And regardless of whether the equipment is designed to work indoors or outdoors, the roof and walls of the building will introduce variables into the test that will negate its effectiveness. So-called "live-sky" testing is therefore impossible without relaying the GNSS signals from outdoors to the production tester.

It is a relatively simple exercise to capture live GNSS signals and re-radiate them within the production test environment. However, this comes with its own set of shortcomings (one of them being the fact that it is illegal in some countries).

First, re-radiating any signal in such an environment might have unforeseen consequences on other tests that are performed on the product; and conversely, other RF signals and noise within the production test area may well impact on the integrity of the GNSS signals.

More importantly, though, the inherently dynamic nature of GNSS signals means that while each unit may well be tested in the same physical location (i.e. in the production tester fixture), the relative positions of the GNSS satellites will be different for every unit tested. Even changes in weather conditions will have significant impact on these "live-sky" signals. And, not surprisingly, this makes direct comparison between results unreliable at best.

The simple truth is that if you don't know the exact stimulus that is being applied, there is no way you can assess whether the product has come up with the correct response.

The tests required

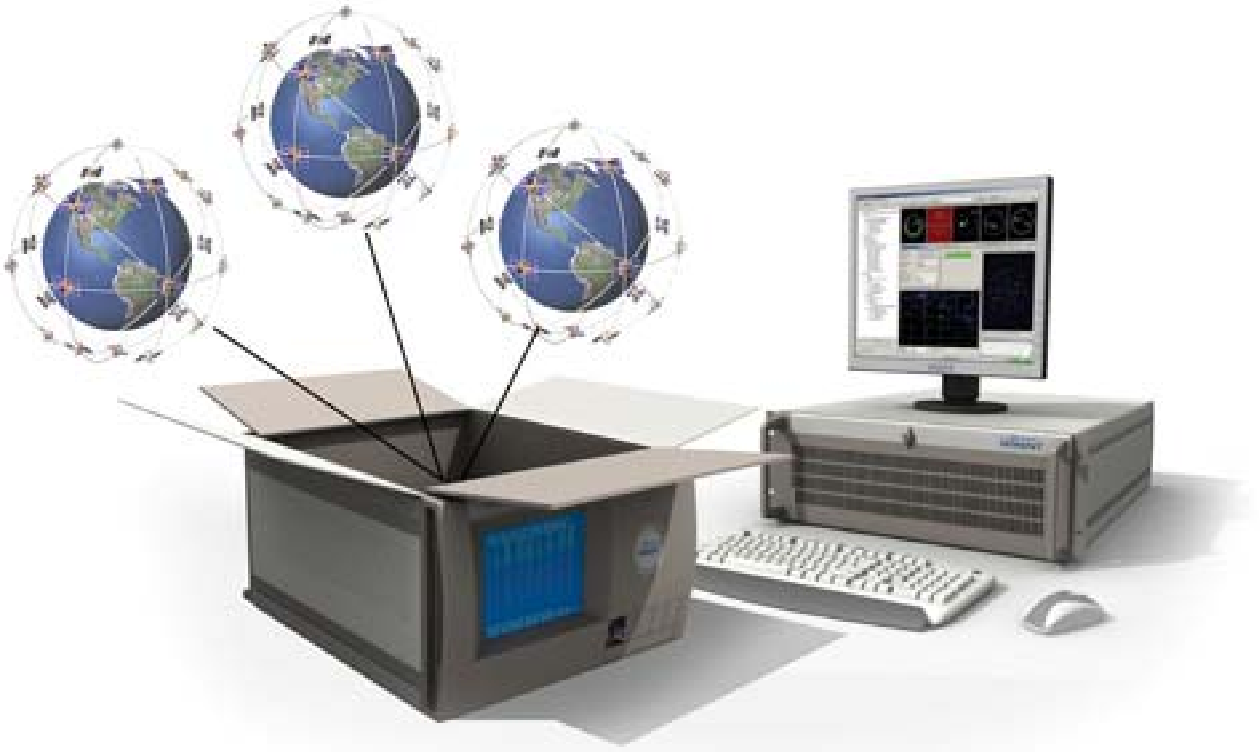
In order to fully assess the performance of a GNSS receiver embedded in any piece of equipment, it is important to work out exactly what response is required. Ultimately, there will be varying degrees of performance required, depending on the end application, but the requirement will be for a combination of navigational accuracy and sensitivity under a wide range of operational conditions. There may also be a requirement for the equipment to work with not just the existing Global Positioning System (GPS), but also with the forthcoming enhanced GPS, GLONASS and Galileo systems at the very least.

Some systems may have no direct output. Or, more to the point, the output may only be in the form of an alarm or trigger that is supposed to be produced with proximity to certain coordinates. This does not however mean that the performance demands on the receiver are any less arduous. It would however, dictate the pass/fail criteria for the production

The case for simulation

While it might be tempting to assume that these measurements can be made effectively in the real world using **live-sky signals** from the current Global Positioning System, as mentioned earlier, such an approach is severely flawed due to the inherently dynamic nature of GPS signals. Not only do the signals change with the movement of the satellite constellation, variations in ambient conditions due to atmospheric pressure, humidity and other outside influences will make any attempt to compare receiver designs extremely difficult.

Even assuming that such variations were acceptable in providing a rough appraisal of each different receiver, such "live" tests can only be performed using today's GPS constellation. This might be fine for the short term, but with the Russian GLONASS system due to come on stream within the next couple of years, scheduled enhancements to GPS and the eventual arrival of the EU's Galileo system, live-sky testing gives no option to test the multi-GNSS capabilities that will form the basis of the next generation of location-enabled equipment.



Given the inherent variability of any type of live-sky testing, it is logical to seek a more precise and repeatable stimulus against which the performance of an embedded GNSS receiver can be assessed. And this can be supplied in the form of a GNSS simulator. Indeed, this does not necessarily have to be the complex multi-channel simulator that was used for characterising the design. A single-channel unit can be used in most cases purely to provide a simple signal which will provoke an easily measured response.

Certainly, during development the tests typically performed on any navigation device are inherently complex, covering the full range of performance criteria from navigational accuracy and sensitivity to acquisition time and immunity to interference. These tests have been designed to ensure the performance of dedicated GNSS receivers, and have been proved over successive generations of personal navigation devices.

However, the end of the production line is no place to be running a full set of performance tests. Once the desired performance of the design has been characterised, the production tests for the end product can be refined into a considerably smaller set of acceptance criteria that can be performed in a matter of seconds.

Such functional (go/no-go) testing can only be performed using a precise stimulus with a known outcome. There is no time to question the integrity of the test stimulus, and that can only mean using a GNSS simulator.

Test systems integration

Spirent has produced a range of GNSS simulators that are designed for easy integration into production line automatic test equipment. The provision of industry-standard interfaces such as GPIB (IEEE 488), RS232 and USB eases hardware integration, and software libraries of ready-written test scenarios enable easy integration of tests into overall acceptance test routines. This can also extend to complex test routines that exercise the complete functionality of the end product, with responses received by the test system triggering the GNSS simulator, and vice versa. In this way, manufacturers of location-aware products can put in place quality assurance schemes that will guarantee the performance of their end products, ensuring customer satisfaction and protecting the reputations of their brands.

Spirent GNSS Simulators

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, multiconstellation simulators, suitable for the most demanding research and engineering applications.

For more comprehensive testing, Spirent also offers products that simulate additional system elements simultaneously with the GNSS constellation signals, such as inertial sensors, various automotive sensors, Assisted GPS (A-GPS) data, SBAS and GBAS augmentation system signals, and interference signals.

With almost 25 years of GNSS simulator experience, Spirent provides GNSS simulators with unparalleled performance, features and comprehensive support.

Spirent's Multi-GNSS simulation platforms

Spirent offers a wide range of test systems and capabilities to meet your Multi-GNSS test needs. Our Multi-GNSS systems are designed with future development in mind and are expandable to address tomorrow's test requirements as well as todays. Whether you are undertaking R&D performance testing, integrating devices into your product line, verifying performance or assessing manufacture of Multi-GNSS devices, Spirent has a Multi-GNSS test system available today to match your needs.

The **GSS8000** Multi-GNSS Constellation Simulator; Up to three RF carriers, selected from a range of constellations and signals (GPS, Galileo, GLONASS and Quazi Zenith Satellite System), can be accommodated in a single signal generator chassis. This enables multiple signals from a single constellation or hybrid systems with signals from multiple constellations to be tested. The architecture supports future Compass signals.

The **GSS6700** Multi-GNSS Simulation System offers up to 36 channels of combined GPS/SBAS, GLONASS and Galileo L1 signals from a single chassis, 12 channels for each constellation. The GSS6700 is available with one, two or three constellations enabled. Different software capabilities and flexibility are available to suit different test needs. For existing Spirent STR4500 or GSS6560 customers who today test GPS/SBAS L1 only, the GSS6700 offers the ability to simulate not only GPS/SBAS but also GLONASS and Galileo.

The **GSS6300** Multi-GNSS Signal Generator is designed specifically for production test applications where a single channel is required for controlled GNSS testing. The GSS6300 can generate a single, combined GPS/SBAS, GLONASS and Galileo signal to enable testing of GPS only or Multi-GNSS devices in a production environment. For existing Spirent GSS6100 customers, the GSS6300 has an identical capability, form factor and interfaces when specified in GPS/SBAS configuration. In addition, the GSS6300 offers the benefit of on-site (even in-rack) upgradability to add GLONASS and Galileo generation capability concurrently with GPS/SBAS.

Spirent GSS8000 Multi-GNSS Constellation Simulator

Spirent GSS6700 Multi-GNSS Constellation system

Spirent GSS6300 Multi-GNSS Signal generator

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