Five Steps to Simpler GNSS Testing

A Spirent eBook

SPIRENT

Introduction

Global Navigation Satellite Systems (GNSS) have been with us for 20+ years, giving rise to a wealth of positioning and navigation technologies for military, civilian and consumer use.

Today, as new satellite constellations come on stream and the boom in smart consumer devices takes off, we're entering a new era of experimentation and innovation in satellite and hybrid positioning.

But before any of those innovations come to market they must be thoroughly tested – to ensure they function as envisaged, and the end user experiences the best possible performance.

This rigorous testing is essential, especially for applications that have a bearing on human life. But in-depth testing can also increase costs and lengthen the timescales involved in R&D, commercialisation and production, which can have a knock-on effect on commercial success.

This eBook outlines five ways in which GNSS testing can be simplified and accelerated, without compromising accuracy, quality or rigour. It’s designed predominantly for people and organisations who are relatively new to GNSS testing, though old hands may also find some new ideas here.

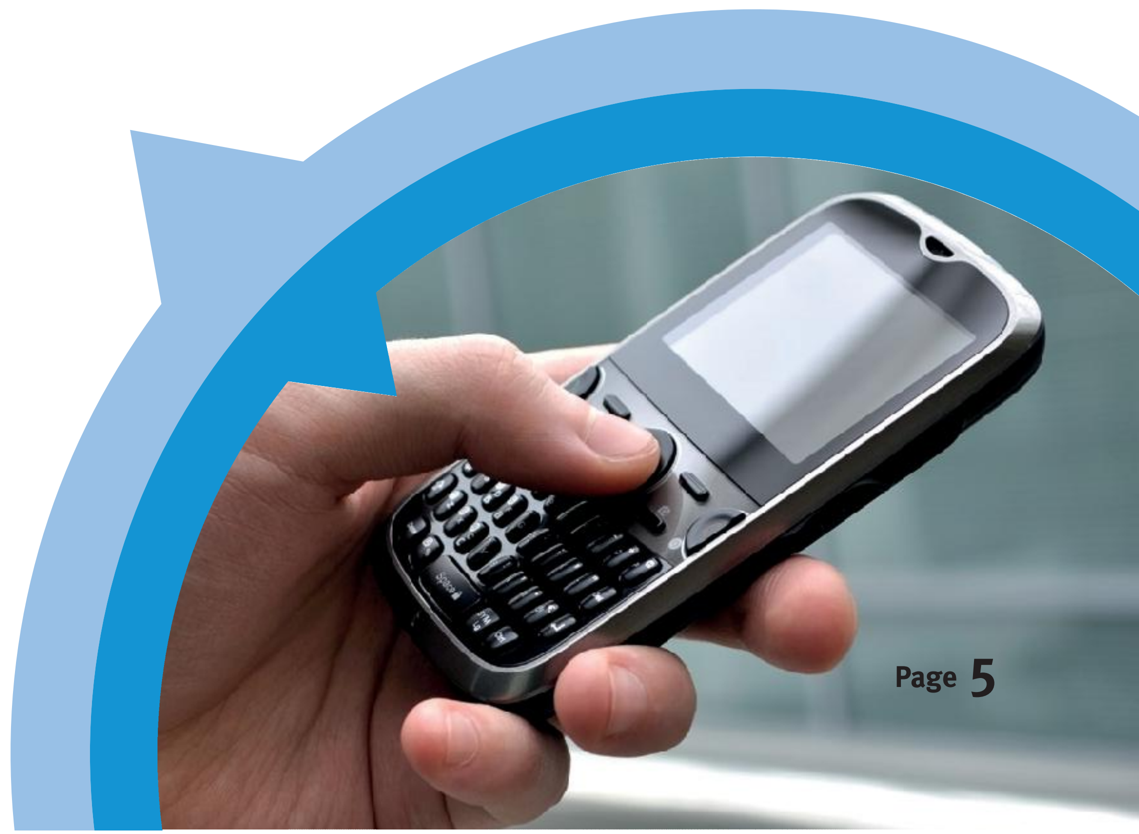
We hope you find it useful. If you’d like more information about anything you read in this eBook, please don’t hesitate to contact us at gnss-solutions@spirent.com

Five Steps to Simpler GNSS Testing

As the market leaders in GNSS testing, we’ve worked with hundreds of military, civilian and consumer-oriented organisations over the past 25 years. During that time we’ve developed a very clear picture of testing best practice for all kinds of GNSS-enabled equipment and applications, from high-precision aerospatial instrumentation to the latest consumer smartphones.

Drawing on that knowledge, in this eBook we outline five ways in which testing processes can be simplified without sacrificing accuracy, quality or rigour:

1. Specify
2. Simulate
3. Choose the Right Equipment
4. Automate
5. Standardise



1. Specify

The first step to a simplified testing process is to specify the capabilities of the receiver or device that you need to test, and the conditions under which you want to test it.

Capabilities: While a receiver's desired capabilities will vary depending on its intended use, Spirent recommends nine basic tests to verify the performance of any GNSS receiver.

1. **Cold-start time to first fix:** starting a receiver from scratch – the first experience a user will have

2. **Warm-start time to first fix:** as above, but with the time and almanac in the receiver's memory

4. **Acquisition sensitivity:** the minimum received power level at which the receiver can obtain a fix

5. **Tracking sensitivity:** the minimum power level at which the receiver can maintain lock

6. **Reacquisition time:** time taken to reacquire the signal after passing through an obstacle

7. **Static navigation accuracy:** taking into account the many internal and external variables that can affect receiver performance

8. **Dynamic navigation accuracy:** accuracy while the receiver is in motion on one, two or three axes

9. **Radio frequency interference:** susceptibility to incidental or intentional ('jamming') radio interference

Conditions: Depending on how the product will be used, this category may include a basic range of conditions (such as different orientations, motion speeds, urban or open country environments, basic atmospheric interference), or a large and complex range of conditions, including different pressures, temperatures, rates of acceleration, satellite constellations in use, and multiple types of interference.

Specifying the capabilities and conditions you want to test will make it quicker to set up and run the tests. It can also help to establish an efficient, standardised testing culture across your value chain, which we'll look at it in more detail later.

2. Simulate

Once you’ve specified what you want to test, by far the most efficient and accurate way to conduct those tests is to use radio frequency (RF) simulation in a controlled lab environment.

An RF Constellation Simulator models the signals from a given satellite constellation or group of constellations, and allows you to specify conditions such as vehicle and satellite motion, signal characteristics and atmospheric and other effects.

Testing a receiver using an RF simulator will cause it to navigate according to the parameters of the test scenario you have chosen, exactly as it would in real life under the same parameters.

Conducting the bulk of your tests in the lab using RF simulation simplifies testing in four key ways:

1. **It's faster:** much of the testing with RF simulation can be automated, meaning tests can run constantly, including overnight, with no human intervention. It's also much quicker to get going in the lab than it is to transport vehicles, staff and equipment to and from field test locations.

2. **It's cheaper:** RF simulation removes the logistical cost of field testing, and its high level of automation means it requires fewer man-hours and can be completed with smaller testing teams.

3. It's more accurate: in contrast to the 'live sky' environment, which is constantly changing, simulated scenarios can be repeated again and again. This enables accurate comparative testing (e.g. of different chipsets during the vendor selection process) and removes any uncertainty around whether changes in performance are due to the signal environment or the product design.

4. It's more flexible: lab simulation lets you generate any combination of signals and conditions that you need to test. You can model constellations and signals that do not yet exist in the real world. You can also easily test hybrid positioning capabilities by modelling combinations of satellite, Wi-Fi and sensor signals.

For these reasons, lab testing with RF simulation has emerged as industry standard best practice for the bulk of the testing process.

You will still want to do some testing in live sky conditions, but here again, you can maximise speed, efficiency, accuracy and cost-effectiveness by recording live signals using a record and playback unit, and replaying them in the lab under controlled, repeatable conditions.

For more about the benefits of RF simulation, read our eBook: Simulation vs Real-World Testing

3. Choose the Right Equipment

There is a wide range of GNSS testing equipment – both hardware and software – available, ranging from basic single-constellation RF simulators with a set of built-in scenarios to infinitely configurable, multi-GNSS and hybrid testing environments designed for military, aerospace and maritime use.

To get the best results in the fastest time, and to avoid wasting money and effort on equipment and training you may not need, it's essential to choose the kit that's right for the kind of testing you need to do.

- For end-of-line production testing, you may only need to briefly conduct some of the key tests we looked at in section 1, in which case a basic single-constellation or multi-GNSS simulator with pre-built tests and scenarios may be the best option.
- For consumer R&D, integration and certification, you may want to test performance more thoroughly, by simulating multiple GNSS constellations and a broad range of conditions including vehicle motion, orientation, interference and signal errors.
- For military, aerospace, maritime and advanced civilian applications, you will want a feature-rich environment that provides the ability to simulate the widest possible range of signals, and the flexibility to specify and generate every scenario in which the device needs to function.

Choosing the right equipment for your needs – including future needs as well as current ones – can save time and money, letting you develop new products faster and more cost-effectively.

For more about how to choose the simulation environment that's right for you, read our eBook Choosing a GNSS Simulator.

4. Automate

If you're already using RF simulation as your primary testing method, you'll already be getting a lot of the benefits covered in this eBook. But there are ways to make your testing process still more streamlined and efficient, notably through the introduction of greater automation.

Many organisations today write custom code to generate scenarios or to control the simulation unit. Others run tests manually, writing up their results before reconfiguring the test unit for the next scenario. All of this takes time and expertise that adds to the length of the test cycle and ties up skilled personnel who could be more usefully deployed elsewhere.

Using off-the-shelf software to generate scenarios, run suites of tests, and provide automated reports, can save significant amounts of time and money.

It's also another good way to standardise testing throughout the production value chain, improving communication and ensuring faster handover from R&D to testing houses, certification authorities and integration and production partners.

5. Standardise

As production value chains become more complex, involving external design partners, testing houses, certification authorities, OEMs, integrators and contract manufacturers, process inefficiencies and duplicated effort can cause considerable time delays.

In industries where bringing high-quality products to market very quickly is critical to business success, those delays can be costly and damaging.

Creating a **standard test culture** throughout the value chain is a good way of reducing inefficiency and wasted effort. Tests, scenarios and test cases specified during R&D can be propagated across the value chain, so that performance can be evaluated in the same way at each stage. This means any anomalies or changes in performance can be quickly identified and addressed.

While some types of GNSS receiver are already subject to industry standard testing requirements, particularly those that are used to safeguard human life, many emerging consumer applications are not yet regulated by a standards body.

In the absence of an industry standard, organisations that specify, publish and adhere to a standard set of tests will be better able to demonstrate product quality (and their commitment to ensuring quality) to testing houses, certification authorities, customers and supply chain partners.

We hope you found this **Five Steps to Simpler GNSS Testing** E-Book of interest.

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