The Role of Simulation in the Integration of GNSS Receivers

Adding Location Awareness

Spirent eBook

Location awareness has become one of the "must-have" features for all manner of equipment in both the professional and consumer sectors.

Whether for security reasons in tracking valuable assets or simply to enhance the social networking experience by highlighting the geographical location of a user's contacts, GNSS receivers can be used to add these facilities to a huge range of products at relatively little cost…

…in terms of hardware

However for many organisations GNSS technology is real rocket science. With no experience in the field, they find themselves facing two fundamental problems:

How to choose the most cost-effective receiver for the task in hand…

…and how to integrate that receiver into the end equipment.

Making the choice

In choosing the receiver, there are immediately two options that can be taken: a ready made receiver sub-assembly that can be simply "slotted in" to the equipment or a lower cost chipset that will require considerably more engineering effort, together with carefully chosen peripheral components.

And while the sub-assembly option has many advantages in terms of simplifying the engineering involved, manufacturers in high-volume consumer markets are always under pressure to reduce costs to a minimum. And that will dictate the use of component-level designs.

Benchmark trials of different receivers will involve making a number of different measurements on each receiver, depending on the demands of the application. These will include performance metrics such as time to first fix (TTFF), positioning accuracy and the speed of reacquisition of signals after outages.

Setting the benchmark

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, 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 propagation conditions due to the atmosphere and other outside influences will make a complete nonsense of any attempt to compare receiver designs.

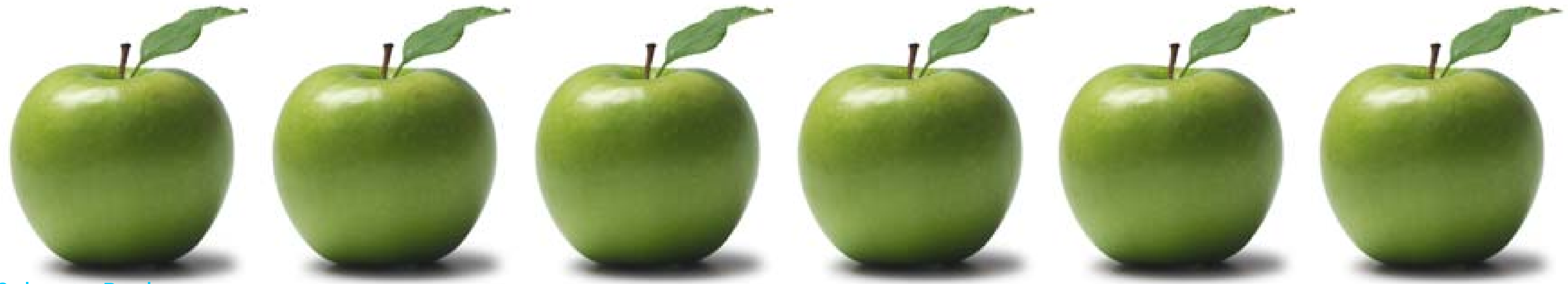
What's more…

...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.

The case for simulation

Clearly, to make repeatable and accurate comparisons between multiple receivers each receiver must be provided with an identical set of signals for each performance test. The task can also be simplified by the ability to select from a range of pre-defined scenarios including static, dynamic (land, sea, air, space) signals as well as impaired signals. This will allow accurate comparisons to be made after collecting and analysing the data generated by the receivers.



Logically, then, **the only acceptable solution** for comparing the performance of GNSS receivers is to use GNSS simulation. Not only can the simulator be relied on to produce exactly the same output for each test, the tests can be programmed to accelerate the process by running a series of pre-defined scenarios designed to fully exercise the required performance parameters.

Benchmark trials using a simulator can be run at weekends or overnight and do not require resources to be deployed on field trips.

With careful choice of tests, designers can be assured that they are choosing the correct GNSS receiver for application in their end equipment.

Return on investment

Of course, selecting the correct receiver for the job **is only half the story.** Integrating the receiver circuits with the other circuitry of the equipment is not exactly a "walk in the park" for the uninitiated. However, the same GNSS simulator used to test the various receivers will have a major role to play in ensuring that the end equipment performs exactly as intended.

Indeed, simulators have been repeatedly demonstrated to be the most efficient method of testing during the development and integration process. The lessons learned during the development of stand-alone GNSS receivers are all the more applicable to other equipment that integrates such receivers.

The cost of taking the equipment out into the field for live-sky testing is nearly always **hugely underestimated.** Indeed, a major global manufacturer of car navigation systems has reduced its testing programme from an average of eight to ten weeks, to an average of four to five weeks by changing from driving test-cars to using GNSS simulators.

Interference issues

The physical integration of a GNSS receiver chipset into a piece of equipment is not a trivial exercise. And the task is exacerbated by the dual pressures of cost reduction and miniaturisation. So while the cautious engineer will produce a well partitioned design in which there will be minimal chance of interference between the various functional blocks, the cost-conscious engineer will see opportunities to cut component count and bill of materials by sharing common circuitry such as power supplies and oscillators.

Interference is inevitable without suitable filtering, and that filtering can only be designed by simulating the correct operation of the system.

Regardless of whether the GNSS receiver is adequately partitioned from the rest of the design, the chances are that the overall equipment will incorporate other RF functions, which will inevitably produce signals many orders of magnitude greater than the signals the GNSS receiver is designed to receive. Jamming is possible and interference is likely. Again, simulation of the correct operation of the system will enable suitable filtering measures to be designed.

Continuing returns on investment

The GNSS simulator offers great flexibility to the development engineer from benchmarking the receiver architectures to managing the integration process. With suitable software control it is quick and easy to generate additional test cases or variations of existing test cases, and this enables the speed of test development to be significantly enhanced.

What's more, the inherent portability of the test scenarios from R&D downstream to integration offers a significant aid to troubleshooting the overall design. And it doesn't end there. The tests developed during the integration process can be cut down to their bare minimum guise to provide simple and quick functional tests for the finished equipment in the production area.

This application of the GNSS simulator through the entire process from design through integration to production ensures speedy returns on the hardware investment.

And the confidence of repeatable and accurate test results provides manufacturers with the confidence that their location-aware products will perform as designed under all operating conditions.

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