White Paper

Future Trends in GPS/GNSS Record & Playback Testing

Introduction

For any developer of location-aware products, field testing is an important part of the R&D process.

From GNSS chipset designers to automotive OEMs, companies need to know their navigation and positioning products will work as planned in the real world. A lot can be done with simulators in the lab, but ultimately, field testing with real signals is vital for characterising performance.

This white paper presents the latest trends in field testing and benefits that the record & playback approach brings.

Four trends driving up the cost of field testing

Field testing is by nature expensive and slow, eating into budgets and delaying time to market. And now, four inter-related trends threaten to make it even more costly and time-consuming.

The way developers respond to these trends will have a material impact on the speed and efficiency with which they can bring new, high-performing products to market.

In all cases, there is a powerful argument for replacing a significant proportion of field testing with an RF Record & Playback solution that can record real-world signal environments with high fidelity, and replay that environment to devices under test in the lab.

1. Increasing end-user expectations

Military, commercial and consumer users alike have become used to the convenience of being able to get an accurate position at any given time – on a variety of devices. Everything from smartphones and exercise trackers to offender monitoring systems, automated cranes and 4G networks now relies on continuous, accurate positioning and timing information from overhead satellites.

Many manufacturers rely on field testing to ensure these devices meet increasing user expectations. But when margins are thin and time is of the essence, any solution that can speed up field testing should be welcome. Manufacturers that invest in a RF Record & Playback system (RPS) can record real-world conditions once and replay them endlessly in the lab; enabling faster iterations on product designs and reducing the travel time and cost associated with field testing.

A challenge emerges with some existing RPS systems, however. Tests have repeatedly shown that receivers with higher bit depths are more resistant to interference, so many manufacturers are now developing 3- and 4-bit chipsets to ensure continuous service in the presence of signal interference.

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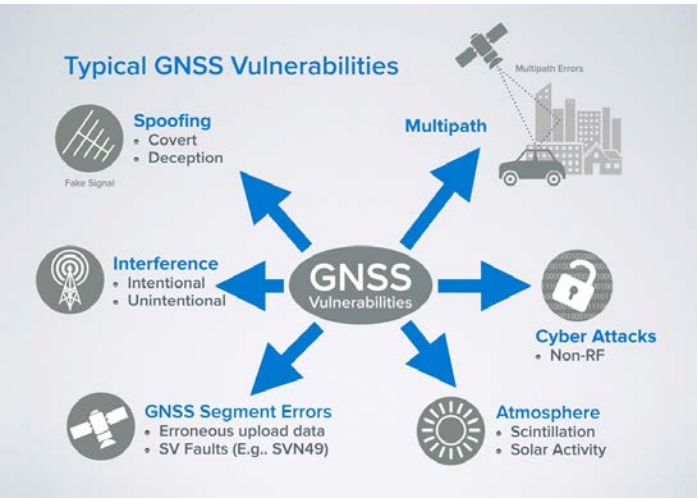
To accurately test the performance of those chipsets with an RPS, the recorded signal environment needs to be replayed at a higher fidelity than the device under test (i.e. higher than 4 bits). That's a challenge with many existing RPS systems, which only reproduce the environment at 1 or 2 bits.

Sophisticated Record & Playback systems are available at up to 16 bits, but these tend to be large, and inconvenient rack-mounted machines designed for military use. A portable 16-bit RPS would be a huge benefit to developers of commercial and consumer-oriented chipsets with bit depths greater than 2, and we should expect to see systems with this kind of specification on the market soon.

2. More Types and Sources of Interference

Not only are end-users becoming more reliant on a continuous, accurate GNSS signal, they're also becoming more reliant on it at a time when the amount of signal interference, and the number of different types of signal interference, are both increasing.

Atmospheric effects, multi-path effects from the signal bouncing off structures, and obscuration by terrain like mountains, buildings, deep cuttings and dense foliage have always affected GNSS signals. But now, manmade sources of interference are increasing too, ranging from intentional or unintentional jamming, interference from nearby cell towers, and even sophisticated "spoofing" (broadcasting of fake navigation signals).



The many sources of GNSS interference

Developers and manufacturers need to know how their systems will behave in the presence of interference: will the signal cut out entirely, or will it lose accuracy – and if so, to what degree?

Much of this can be tested with simulators, but simulators can't anticipate the full richness and variety of real-world conditions. Field testing is essential to characterise performance in real world interference conditions, but that testing can rack up time and expense.

Method / Attribute	Live-Sky	Simulation	Record & Playback System
Repeatable	×	✓	✓
Controllable	×	✓	Partial
Reference truth	×	✓	×
Realistic	✓	Representative	✓

There's a clear case here to use an RPS to record the live signal environment, with all of its interference waveforms, and use that recording to "field-test in the lab". This can be doubly advantageous for manufacturers who want to study interesting interference waveforms to understand what's causing them and how they can be mitigated against.

3. Hybrid Positioning and Sensor Fusion

In many modern applications, GNSS signals are used in tandem with data from other sensors within the overall system. Sensor fusion algorithms bring all of the data together, and are most commonly used to continue to calculate a position when GNSS is denied. This can be done by triangulating the device with nearby Wi-Fi access points, Bluetooth terminals or LTE cells, or by using data from dead reckoning sensors to continue to calculate a position when the device is indoors.

But increasingly, GNSS + sensor fusion is being used for other purposes, too. High-end fitness trackers mix GNSS inputs with data from heart rate sensors to map the effort put in by the runner at different points on their run, and in driver-assisted vehicles GNSS is used in conjunction with accelerometers, weather condition sensors and even driver history data to improve the car's Advanced Driver Assistance System (ADAS).

Hybrid positioning and sensor fusion often require extensive field testing to ensure the various data inputs are correlated accurately under real-world conditions. This process can be accelerated by using a Record & Playback system that's capable of recording multiple sensor data inputs coherently with the GNSS signals.

4. The Rise of Multi-GNSS and Multi-Frequency Receivers

One way to increase position accuracy and combat the threat of GNSS interference is to have the receiver support either multiple navigation satellite systems, or multiple frequencies of the same satellite system, or both.

Increasingly, manufacturers are developing multi-frequency, multi-GNSS chipsets that can process not just standard GPS L1 signals, but also newer L5 signals, and/or signals from other global navigation satellite systems including GLONASS, Beidou, Galileo and regional systems like Japan's QZSS and India's IRNSS.

Multi-GNSS systems demand more intensive field testing, to understand the performance of the receiver in different locations around the globe. This is another area where Record & Playback can significantly accelerate testing, by using recordings of the signal environment in different areas of the globe.

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About Spirent

Spirent Communications helps the world communicate and collaborate faster, betterand more often. The world's leading communications companies rely on Spirent to help design, develop and deliver world-class network,devices and services.

Whether it is service provider, data centers, enterprise IT networks, mobile communications, connected vehicles or the Internet of Things, Spirent solutions are working behind the scenes to help the world communicate and collaborate faster, better and more securely. The world's innovators rely on Spirent expertize to help them design, develop and deliver best-in-class solutions to their customers.

Spirent's positioning, navigation and timing portfolio includes a range of solutions to help technology developers and service providers to use GPS and other global navigation satellite system (GNSS) signals more accurately.

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Summary: More Complexity = More Field Testing

With more applications of GNSS, and more users relying on position, navigation and timing data, developers of location-aware chipsets, devices and systems have more testing to do.

But when budgets and time are both under pressure, many teams lack the luxury of being able to exhaustively field-test products in real-world conditions. A powerful, portable Record & Playback system is the key to being early to market with a system that will meet users' increasingly high expectations.

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