Location, location, location

Four important changes that go far beyond satellite navigation and the challenges they’ll pose for automotive electronics engineers. By Rahul Gupta.

Until recently, the relationship between vehicles and Global Positioning Satellite (GPS) signals was fairly simple. In-vehicle navigation systems, using signals from the US government’s GPS satellites, were smart, useful and comparatively reliable. But even so, positions could only be calculated to within tens of metres – and even that level of accuracy wasn’t a certainty in urban canyons, where multipath effects from signals bouncing off buildings could cause positions to be off by many tens of metres. However, that picture is changing rapidly.

New satellite constellations – like Russia’s GLONASS system, China’s BeiDou-2 and Europe’s forthcoming Galileo system – promise unprecedented levels of satellite availability. Simultaneous advances in sensor technology and in-vehicle connectivity mean OEMs and Tier 1 suppliers of navigation systems have a wealth of new positioning capabilities with which to develop innovative location-based services.

At the same time, legislative moves – such as the European Commission’s eCall initiative, Russia’s ERA-GOLONASS and the possible introduction of mandatory telematics in Brazil – could take in-vehicle location-based services from a ‘nice to have’ to a ‘must have’ technology. This is creating opportunities for fast moving OEMs, in-vehicle infotainment (IVI) and telematics systems suppliers alike.

Spirent has 25 years’ experience of providing test equipment and advice to engineers developing positioning systems across the automotive, aerospace, defence and consumer electronics industries. Based on this experience, the company has identified four areas that it believes will prove crucial in the next few years: multiple positioning systems; vehicle connectivity; advances in positioning techniques; and autonomous vehicles.

• From GPS to multi GNSS
Any positioning system that relies solely on GPS is increasingly at a disadvantage. The GLONASS system now has full global coverage and, with China’s BeiDou-2 now available in the region and Europe’s Galileo programme developing rapidly, there will be four times as many positioning satellites by the end of this decade.

Systems that support these new constellations in addition to GPS will deliver huge improvements in two areas: signal availability, more satellites means greater coverage; and reliability, with more satellites providing positional data, road users can have more confidence in the information generated by their navigation and IVI systems.

Receiver manufacturers are already bringing out multi global navigation satellite system chipsets, enabling greater accuracy, availability and reliability. During the next ten years, these chipsets will develop to make use of the multiple radio frequencies broadcast by each satellite system.

Today, multifrequency chipsets are used in applications like precision agriculture, to pinpoint the vehicle’s position to an accuracy of better than 10cm. While their high cost makes them prohibitive for general use, that cost is projected to decrease, bringing precise, multifrequency positioning within reach of automotive manufacturers.

Data from on-board sensors, Wi-Fi, Bluetooth and global navigation satellites can be combined to generate a continuous, accurate position.

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**Vehicle connectivity**

A car is no longer just an elegant piece of mechanical engineering designed to travel from A to B. The volume of on board electronics, data and connectivity is increasing at a ferocious rate, with vehicles moving from being standalone entities to becoming nodes on a network. In the not too distant future, that network may encompass drivers’ and passengers’ smartphones and tablets, roadside infrastructure, infotainment services, safety services like eCall or ERA-GLONASS and remote diagnostics.

The increasing electronic content in the vehicle means OEMs are having to think like consumer electronics businesses – and that means adopting a much faster cycle of innovation and product development. That’s already putting pressure on timescales for developing and testing new systems, at a time when in car electronics are becoming increasingly critical to safety, performance and comfort.

**Advances in positioning techniques**

While new satellite constellations will deliver improved coverage and reliability, real advances in positioning capabilities will come from integrating satellite positioning data with inputs from on board sensors and other radio frequency connectivity systems.

There have been huge advances in the number of on board sensors and their sophistication, measuring everything from wheel speed, heading and orientation to temperature, weather conditions and the proximity of other objects. When combined with the last known satellite positioning fix, sensor data can continue to generate a position and provide navigation for considerable amount of time, even when no satellite signal is available.

Meanwhile, the rise of in-vehicle Wi-Fi and Bluetooth can also help to generate an accurate position in areas where satellite signals are weak or denied (such as in tunnels or underground car parks). While wireless and Bluetooth positioning are in their infancy, the technique should develop rapidly over the next few years as Wi-Fi and Bluetooth become standard features in most vehicles.

**The road to autonomous driving**

Google’s driverless car has been making headlines – and many people find the idea of an autonomous vehicle difficult to accept. But, like other disruptive technologies, it will arrive gradually as the result of incremental advances in assisted driving technologies.

Assisted driving takes many forms. It can make use of radar and proximity sensors in the vehicle to warn drivers of approaching objects, imminent collision or lane departure. Navigation systems can take live data feeds – often via a connected smartphone – from meteorological and traffic management services to warn of congestion or poor weather ahead. In future, OEMs and navigation system suppliers will increase the use of “V2X” technologies, sensors and satellite based positioning to deliver more sophisticated services.

**What does it mean for engineers?**

These are exciting times for engineers, with huge opportunities for them to innovate and to gain competitive advantage. The challenges lie in being able to test new designs and prototypes quickly, efficiently and cost effectively. The positioning systems developed over the next few years will likely have to receive and process data from multiple satellite systems, fuse satellite data with sensor data, mitigate interference and integrate positioning data from Wi-Fi and Bluetooth systems in order to generate a precise, continuous and reliable position.

The level of testing required for these new systems is already making live driving tests too expensive. Future systems development will require a much greater degree of lab based testing, using simulators and recorded satellite signal streams to generate and run complex test cases and scenarios.

Automotive electronics engineers, will have to master new techniques and technologies, but they will be the forefront of developing technologies that will take the automotive industry into a new era.

**Author profile:**

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