Smart cities rely on smart signals

Smart cities are the cities of the future, with everything from refuse collection, traffic management and deliveries being automated using next-generation technology. However, such smart cities require fool-proof signal capabilities, necessitating more stringent technology than today's GPS.

Tom Gray, VP of Product and Marketing, FocalPoint

It's hoped that smart cities will improve traffic and public transport, monitor energy usage, and link residents and visitors to everything from real estate to utilities, from education to health and government services. One aspect of this is the roll-out of autonomous vehicles - helping to simplify deliveries, reduce human error on the roads, make public transport more efficient and even enable workers to maximise their commute as they work while their car drives them to the office or a meeting, unaided.

Smart city hurdles

However, there are two hurdles that need to be addressed before we can relax in the back of an autonomous vehicle on the streets of a smart city. The first is a perception problem. How will we be able to teach an AV the difference between a dog in the road or a plastic bag, or get them to 'understand' that someone stumbling along the pavement after a boozy lunch needs to be considered an unpredictable hazard? Anyone working with AI knows that this is a work in progress. However, a more immediate hurdle is the current inaccuracy of the positioning provided by satellite signals that autonomous vehicles rely on for navigation. Until the accuracy and integrity of GPS is improved, it will be impossible to see any city fully embracing smart technology and reaping the benefits.

Photo courtesy of Shutterstock

Tom Gray, VP of Product and Marketing, FocalPoint

Whether it's the Republic of Korea's purpose-built Songdo International Business District, or the •31 million project to turn Malaga into Spain's smartest city, all smart cities rely on GPS to provide location-based analytics, insights, and services to citizens. Toyota and NTT DoCoMo recently announced a $1.8 billion deal to develop a smart city platform, with Shinagawa Station in Tokyo and Woven City their testbeds. It's estimated that smart city technology investments will reach $61 billion by 2026. But each of these futuristic utopias will become just another urban sprawl without effective and immediate location orientation.

The way cities have grown, with many reaching for the skies to maximise space, means that most have become urban canyons, making them a challenge for GPS. GPS requires a straight line of sight to determine exact location. In an open landscape, it's possible to get a clear signal. However, in a built-up environment signals bounce off tall buildings, cars and other human made obstacles, which in turn results in less accurate GPS readings or (even worse) low integrity GPS - where a strong reflected signal can be interpreted as truth, causing location-based technologies to act with high confidence despite being incorrect. It's one thing to not get a signal and for the AV to pause – anyone who has waited for their wearable to give them a 'ready to run' message knows that this can take a while – it's another if the AV is mistakenly confident in the information it's receiving and moves ahead. For an individual using Google maps to locate an address, it's frustrating but not a big deal; for a drone

attempting to deliver a package, or an autonomous vehicle (AV) attempting to make a left turn, an error can be disastrous.

There are alternatives to GNSS for autonomous vehicles, such as LIDAR, but none are cheap, and they can be thrown off by poor weather conditions. In addition, these power-hungry solutions won't meet the energy efficiency goals that many governments have established as smart city objectives. Waymo - formerly the Google self-driving car project – recently announced its next generation tech but it is still dependent on light detection and ranging radar, so will have the same issues as other camera-reliant solutions. One can expect that LIDAR technology that's perched atop the roof of each Waymo to cost about $5,000, making it too expensive for a largescale roll-out, not to mention making it a theft risk. Mesh technology, 5G and street furniture are other options, but they require many sensors on the vehicles which ups the price and makes a large-scale project out of many governments' reach.

A classic imagining of a smart city is one with autonomous vehicles nipping through the streets, augmented wheelchairs making swift progress across pavements, defibrillator drones flying to patients, and robots digging and building with millimetre precision. However, in each case the reliance on precise location fixing is imperative. It doesn't take much imagination to recognise that if a GPS result is metres out, a smart city environment is going to be treacherous.

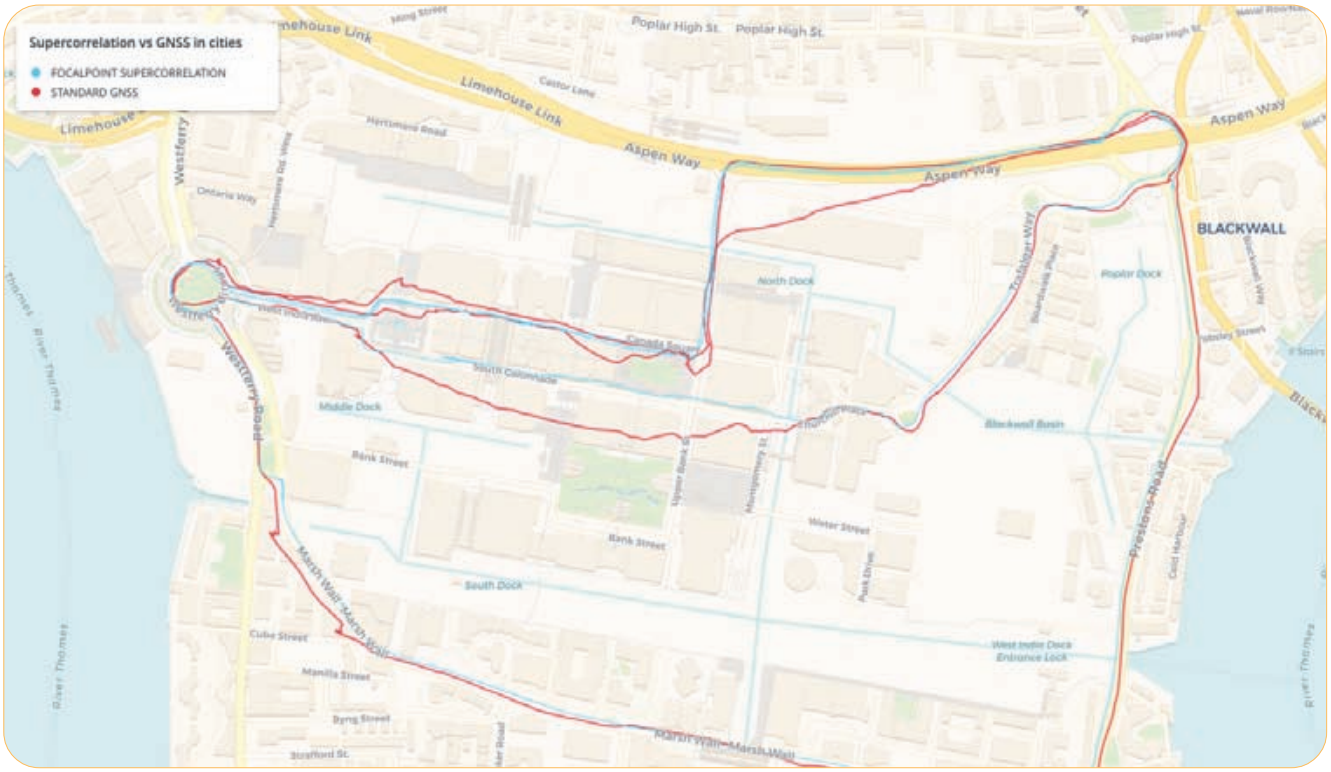
Combining sensor fusion, machine learning and signal processing

The demand to address these issues has inspired a new approach. FocalPoint's patented Supercorrelation technology uses sensor fusion, machine learning and signal processing to determine the arrival angle of signals and remove reflected and non-line-of-sight signals from positioning. This software upgrade, at the GPS chipset level, enables 10x improvement in GNSS performance on devices in urban environments, including urban canyons and indoors. We believe it's a game-changer and both the Royal Institute of Navigation and the US-based Institute of Navigation recently awarded prizes to Supercorrelation in recognition of its ground-breaking potential. The demand for the technology is strong and FocalPoint is working with leading chipset companies to bring it to market.

Smart cities must be secure cities. 'Honest' GPS can inform an AV which signals are useful, and which are not. It can also determine if people are broadcasting fake data. The civilian versions of GPS are currently unprotected and malicious individuals, who can purchase cheap equipment online and download free code, can broadcast spoof signals, disrupting radio mast signals, interfering with emergency services, even potentially interfering with financial trades. From a security perspective, broadcasting fake GPS signals (spoofing) to deceive a GPS receiver could cause significant problems for smart cities.

As well as spoofing to fake driving records, or even cheat on Pokemon Go (and potentially interfere with vital emergency, AV, or other smart city satellite signals), spoofing 'vessels in' locations could cause a billion-dollar maritime headache. Supercorrelation determines that any signal that is used, comes from the right place.

The world's governments are waking up to how a connected urban environment can benefit their economy and the wellbeing of their citizens. However, until the fundamental issues of accuracy and integrity of GNSS is resolved, it will be hard for smart cities to deliver more than a chaotic, expensive, and potentially hazardous future. ■



Driving a vehicle with a GNSS device onboard through Canary Wharf's urban canyon reveals the difficulty any GNSS-reliant AV would have to find its way. Photo courtesy FocalPoint