GNSS TODAY, TOMORROW, AFTER TOMORROW

WITH MORE AND MORE GNSS SYSTEMS COMING ONLINE, HOW CAN SURVEYORS FUTURE-PROOF THEIR PURCHASES? AND AS GNSS MATURES, WHERE WILL THE NEXT TECHNOLOGICAL ADVANCES COME FROM? BERNHARD RICTHER LOOKS FORWARD TO A FUTURE OF FUSION…

We live in a constantly evolving world. Mobile phones get smarter; laptops get smaller in size yet can store larger files; and apps have made homes and cars the basis of today's sharing society. The processing power of a modern smartphone is higher than that of a desktop PC in the late 90s, and the quality of the integrated cameras would outperform professional video cameras of the same age. As technology advances at breakneck speed, devices go obsolete faster and faster.

GNSS technology is certainly no exception to this norm. In the October 2014 edition of GeoConnexion International, I explored just how users could prepare themselves for global changes in the GNSS market. Since then, China's BeiDou has reached 21 satellites, with seven of them orbiting globally and a plan to launch four to five more this year. The system is on track to be fully operational by 2020. Though slower than expected, there is still reason to believe Japan's QZSS will deliver its first services next year.

In my previous article, I did not go too deeply into Galileo's progression, as Europe was still trying to recover from the 2008 financial crisis. There were no clear decisions on the budget to support Galileo then, but today the system is on the fast track (see page 22) and Galileo will have full operational capability by 2020.

I am convinced that by the end of this decade, we will have the luxury of four global-operating GNSS. Hundreds of GNSS signals from these multiple constellations will be received and processed reliably by GNSS receivers that fit in the palm of a hand.

Despite these advancements, many users face the challenge of their legacy GNSS receivers constantly becoming obsolete in the face of modernisation. Are we advancing too fast with too little benefit?

The answer is no. For professional users, multi-frequency and multi-constellation are a must today and moving forward. Soon, this will no longer even be a topic of discussion. Numerous performance tests in areas where local reference networks fully support the modern signals already indicate efficiency gains in urban canyons and under heavy canopy of more than 15%. Reliability and integrity have also seen significant improvements.

Less is more

Nevertheless, more signals do not automatically translate into better performance. The receiver needs to be smarter than before to adaptively select the best signal combination and not weaken the result with poor signals and to avoid burdening the central processing unit. In this case, the old adage 'less is more' rings true. Receivers that can automatically adapt to changing conditions and lock on to the signal providing the best output provide the user with as many precise positions as needed.

I see a clear trend – users entering the GNSS market today for the first time no longer buy GPS+GLONASS only, more than 30% buying systems with Galileo and BeiDou support as well. However, professional, high-precision GNSS equipment remains ahead of the curve in adopting new signals much faster than consumer devices do, with smartphone manufacturers only recently starting to include chipsets that are ready for Galileo and BeiDou.

One problem remains with regards to GNSS modernisation. Modernising expensive ground infrastructure of fast-evolving

The self-learning Leica GS16 GNSS receiver can automatically adapt to changing conditions and lock-on to the signal providing the best output

The most precise surveying instruments offer functionality where the receiver automatically switches between the best possible reference link, such as the GS16 with SmartLink

technologies with short life cycles always seems to be a challenge. The slow expansion of fibre-optic internet and the small number of charging stations for electric cars are just two examples.

In many cases, infrastructure decisions are politically driven and need commitment from governments. We all know it can take a long process to decide on essential investments and there is no difference when it comes to updating the infrastructure of public GNSS real-time kinematic (RTK) reference networks, which sometimes lag in upgrading to multi-constellation receivers. Late adopters for national infrastructure have the advantage as they can skip updating legacy receivers and move directly to these multi-constellation modern base station receivers. The rather slow momentum to upgrade local reference networks should nevertheless not stop users in investing in future-proof hardware, as it still works best in less modern RTK reference networks.

A communication link is vital to achieve survey precision. Reference networks provide the necessary link, but it is important to emphasise that precise point positioning (PPP) technologies have taken a giant leap forward since my previous article. Centimetre-positioning is now possible around the globe without the need for a local reference network and the most precise surveying instruments automatically switch between the best possible reference links, the goal being to fill in the gaps when standard RTK does not work because of cellular outages.

The future of future-proofing

Advancements coming purely from GNSS have matured and I do not foresee major performance improvements on the horizon. The benefits will instead come naturally through the launch of more satellites. However, for the end user, there remains a vibrant future for the market beyond just more satellites.

Sensor fusion particularly is the way ahead. Take for example the car industry. With the introduction of autonomous vehicles, an all-in-one system combining GPS, inertial measurement units (IMU), scanners and imagery is the big step forward. With such developments, these driverless cars will more easily differentiate positioning of themselves and obstacles on the road, such as a pedestrian or cyclist.

As micro-electro-mechanical (MEM) devices become more widely available, they also become more affordable. This class of IMU is found today in consumer cars and smartphones, and will be sufficiently accurate and usable for general surveying.

Simultaneous localisation and mapping (SLAM) engines and pointclouds are merging, not just in professional surveying equipment but also in consumer smartphones. This merger of technology should become more standard in all forms of surveying instruments.

Making a multi-sensor product is no easy task, though, and making a multi-sensor product that fits a particular market expectation is even harder. Take the commercial UAV market for example. Though the technology is exciting, there are extremely low barriers to entry that have enabled a flood of players into the market. With heavy competition, UAV producers are facing an uphill battle. As the market continues to mature, the players are converging.

As 'Gartner's Hype Cycle for Emerging Technology' predicts, the expectation claims are too aggressive to become viable again. To offer a true multi-sensor solution to the high-precision professional market too early proves detrimental to technology advancements.

Albert Einstein once said, "Technical progress is like an axe in the hands of a pathological criminal." If we are not careful to progress GNSS and sensor fusion for the sake of better technology and societal advancement, we face a future of subpar instruments and performance. But if we continue to make receivers smarter, instead of just adding more signals, we can certainly avoid this predicament. We are now on the path to a future where sensors will not only be together in one platform, they will be so merged there will be no telling where one ends and the other begins.

THERE REMAINS A VIBRANT FUTURE FOR THE MARKET BEYOND JUST MORE SATELLITES

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- when it has to be **right**

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