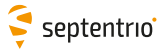


NEW ERA OF POSITIONING TECHNOLOGY FOR TERMINALS

"FOR KALMAR, SEPTENTRIO'S SOLUTIONS HAVE PROVEN TO BE UP TO THE COMPLEX CHALLENGES AND DIFFICULT OPERATING ENVIRONMENT OF CONTAINER PORTS."



Jack Donnelly, Editor, Port Technology International, featuring interviews with **Stef van der Loo**, Market Access Manager, Septentrio, and **Pekka Leikas**, Product Manager, Kalmar

The logistics landscape is complex and challenging with constant change. Cargo volumes are changing, infrastructure, operations, vehicles, and processes are evolving over time.

When evaluating positioning technology, this is not an exception. Satellite receivers and inertial systems have become more accurate, reliable, flexible and configurable than ever before. The age-old belief that positioning requires an expensive infrastructural overhaul is now outdated and invalid. Yet hardware and technology used in, for example, container terminals to track vehicles and accurately provide a position at all times, is often outdated, complex or expensive.

THE LEGACY SYSTEMS

Older PTS, DGPS or non-GNSS systems* out there rely on other technologies and methodologies to function; for example, the use of transponders in the asphalt or concrete. They have proven to be accurate enough to run an autonomous operation, however a considerable investment is needed for such an infrastructure.

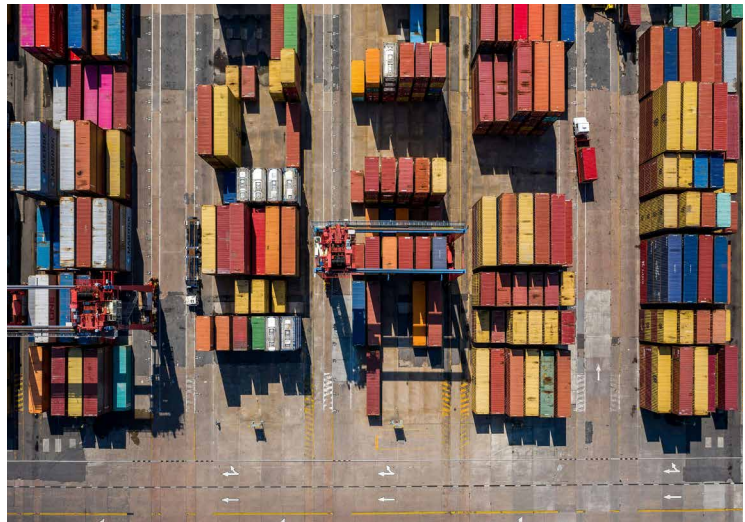
Not only this, but transponders require a fixed layout, are time consuming to install and in need of intensive maintenance. Radar or fixed Real-Time Locating Systems (RTLS) are fairly expensive, and intensive maintenance and installations are needed.

GNSS SUITABLE FOR COMPLEX PORT ENVIRONMENTS

Often a terminal has its own heritage of processes and common use, and is therefore

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GNSS/INS is suitable for all terminal vehicles from terminal trucks to reach stackers to straddle carriers and RTGs. It provides positioning and orientation for real-time vehicle or container tracking, record keeping, machine automation and autonomous navigation.



GNSS/INS EXPLAINED

Global Navigation Satellite Systems (GNSS) are made up of satellites which broadcast signals from space with positioning and timing information. These signals are picked up by receivers which then use this information to determine their geographic location in terms of longitude, latitude and height. So what is the difference between a GPS and a GNSS receiver? A simple GPS receiver only makes use of one global navigation satellite system, while multi-constellation GNSS receivers get information from many such systems at the same time, including GPS, Galileo, BeiDou and GLONASS. This allows them to 'see' many more satellites at any given time. Septentrio multi-frequency GNSS receivers connect to all signals from any GNSS satellite for maximum positioning availability and accuracy down to sub-decimetre level, referred to as RTK accuracy.

While GPS/GNSS provide absolute global positioning, the Inertial Navigation System (INS) uses an IMU sensor to determine a relative position and orientation angles: heading, pitch and roll. It accomplishes this by using gyroscopes and accelerometers to accurately measure its rotation and acceleration. INS relative positioning is used to 'bridge' areas where the line of sight to GNSS satellites is temporarily lost, such as under cranes or between container stacks.

INTERFERENCE RESILIENCE EXPLAINED

By the time they reach earth, GNSS satellite signals are weak in power. This means that they can be 'jammed' or overpowered by other electromagnetic radiation such as radio signals on nearby frequencies or even radiation from nearby electronics. Illegal devices called 'jammers' are sometimes used by truck drivers who try to avoid road tolling, and can knock out GPS signals in of radiuses of hundreds of metres. Technologies such as AIM+ Advanced Interference Mitigation at the receiver core use notch filtering and integrity algorithms to stop jamming from affecting the positioning solution.

Spoofing is a smart form of interference when an attacker transmits wrong signals into a GNSS receiver to hijack its positioning output. GNSS spoofing has been in the news during the last few years often around ports or marine vessels. To avoid the trap of spoofing Septentrio receivers are equipped with ASP+ technology on both software and hardware levels, including the latest OSNMA signal authentication mechanism.

decentralised in its IT partners and other systems in the facility.

Terminals have many challenges to overcome. Including many various infrastructure installations and layouts, mixed fleets of equipment and vehicles used, different types of configurations, and multiple needs per terminal or customer. For the successful installation of high-accuracy GPS/GNSS positioning in the port environment, there are also additional challenges related to satellite signals. Users of satellite positioning solutions frequently deal with phenomena such as multipath (reflection of signals), security concerns (replicated unsecured signals), jamming (disruption of signals), but also obstacles, safety of life, accurate output, integrity of a product, and trustworthiness of the data.

POSITIONING SYSTEMS FOR LOGISTICS AND TERMINALS

A standalone GNSS/Inertial Navigation System (INS) receiver – positioning solution – can cover almost all areas of a terminal nowadays. Septentrio is a worldwide leader in providing

highly accurate positioning systems for safety critical applications that operate in challenging environments.

Its portfolio allows multiple options for various operations: whether it is used for real-time tracking of vehicles or containers, record keeping or for any other automation/autonomous solution.

For over a decade, Septentrio has been providing positioning solutions for some of the largest ports in the world such as Port of Antwerp and Port of Houston, as well as other major players in the supply chain, providing robust, easy-to-integrate positioning solutions. The ports and terminals sector in addition to many others (rail, defense logistics automation, mining logistics automation, collision avoidance, personnel safety tracking and more) benefits from reliable high-accuracy GNSS.

ADDRESSING TODAY'S PORTS' CHALLENGES WITH SEPTENTRIO'S LATEST POSITIONING TECHNOLOGY

Septentrio has proven to solve the detailed industry challenges with a comprehensive product range and a special fit for logistics



ABOVE

GNSS/INS installations on equipment and vehicles are scalable and repeatable reducing infrastructure investments and improving time-to-market. These can be retrofitted or designed-in from the start.

operations. Every system is standalone and can be easily mounted on any type of vehicle. Whether you want to integrate a board in your own sensor stack, or simply mount a IP68/69 rugged box on a vehicle, both options are possible. No intensive installations nor any changes to the infrastructures are needed.

The company's products include OEM boards, GNSS/INS systems, dual antenna heading solutions and compact modules. Septentrio systems are connected and used with various other systems, allowing their positioning systems to seamlessly integrate.

One of the benefits, therefore, are that major investments are no longer needed and you can maintain a level of flexibility to change your port layout.

Sub-decimetre accuracies can be reached, which is well suited for full automation, and the integration of inertial sensors allows for bridging GNSS "dark spots" under the crane for instance, providing a continuous positioning output with the company's proprietary algorithm technology FUSE+.

Septentrio receivers have been extensively used for autonomous

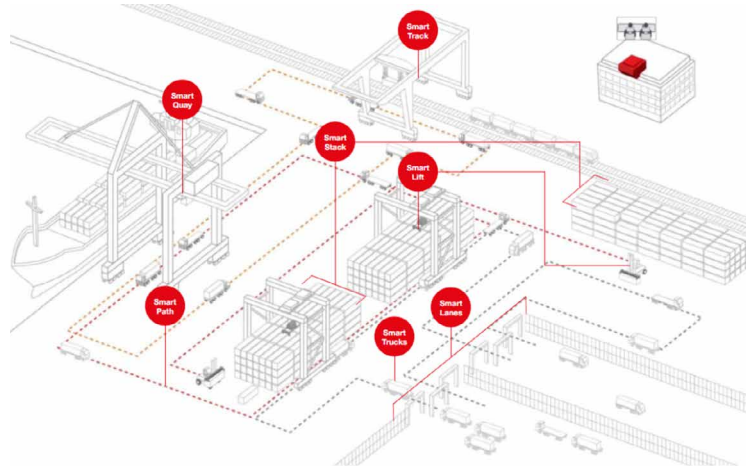
operation in other industries as well, including autonomous driving of mining trucks and agriculture robots. The reason for the success of this automation is the high level of integrity provided by the receiver, including honest uncertainty limits for positions in challenging environments.

Reliability of positioning is crucial in ports because of crowded areas, tight spaces, expensive and large assets, personnel safety and demand for efficient continuous operations. GNSS positioning can be trusted because in challenging situations higher errors will be flagged by the integrity algorithm.

Stef van der Loo, Market Access Manager, Septentrio, explained: "GNSS technology has been improving over the last several decades, and especially over the last few years we have made several development breakthroughs in receiver reliability, availability and ease of integration."

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Kalmar SmartPort solutions use GNSS/INS receivers and take container terminal and logistics operations to the next level by gathering more and better-quality data about containers, terminal equipment and vehicles.



Instead of metre accuracies, van der Loo added, Septentrio products now achieve sub-decimetre accuracies, an incredible feat considering the signals are coming from a satellite. "Logically, now, more companies such as Kalmar are leveraging the latest GNSS/INS technology for reliable high-accuracy positioning," he said.

The Septentrio solutions are perfect for integration with many

types of vehicles, while maintaining the scalability and repeatability needed. Moreover, the time to market and thus fast deployment is very favourable, whether it is a retrofit installation or factory install.

Pekka Leikas, Product Manager at Kalmar, added: "We've had several generations of different types of position detection systems in use. A few years ago we were looking for the best possible technology and

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provider for our next generation SmartPort products. We needed to improve the position accuracy for better quality of data, for example wrong coordinates caused failures in container stack inventory. For Kalmar, Septentrio's solutions have proven to be up to the complex challenges and difficult operating environment of container ports and improved the reliability of our SmartPort solutions and decreased the need for manual corrections."

SEPTENTRIO GNSS/INS USED IN KALMAR SMARTPORT

Kalmar SmartPort solutions take container terminal and logistics operations to the next level by gathering more and better-quality data about containers, terminal equipment and vehicles. This helps improve the flow of containers around terminals or yards, remove bottlenecks and congestion, reduce errors, increase speed, productivity and safety.

As part of the SmartPort systems vehicles are equipped with an AsteRx SBi3 Pro+ GNSS/INS receiver, which delivers sub-decimetre positioning together with accurate orientation information. The installation and integration of the stand-alone GNSS or INS receiver is easy, with the help of the intuitive user interface. The GNSS receiver is part of a hardware and software kit on the vehicle that is connected to the Terminal Operating System (TOS). This receiver enables job optimisation and automated data collection for receiving an exact position of the stored container into a stack.

The AsteRx SBi3 Pro+ is robust inside and out. Its rugged box is IP69 compliant withstanding vibrations and shocks according to MIL-STD. The positioning output is trustworthy which is crucial for reliable operation and liability. Septentrio's proprietary RAIM+ integrity algorithm, based on two decades of field data, ensures reliable positioning by giving honest error estimates at all times.

There are many signals and other electromagnetic noises in a terminal



yard, which makes it a challenging environment for reception of GNSS satellite signals. AIM+ Advanced Interference Mitigation technology uses sophisticated signal filtering to protect the receiver from GNSS interference referred to as jamming. In fact, interference resilience is what Septentrio receivers are recognised for, and the company's equipment is often used for highly secured or defensive operations.

When assistance is needed, Septentrio can provide worldwide support. "We have been happy with the support Septentrio has provided to us," said Leikas.

"They have developed their products based on our needs and wishes. We have been working together with Septentrio to make sure the GNSS receivers are a perfect fit for the harsh conditions we face in terminals. Septentrio continuously improves their products with market or use-case specific feedback to overcome all the specific challenges."

Septentrio positioning solutions are not only easy to install, but very scalable, which makes them also attractive for smaller fleets and integrators. These GNSS receivers are perfectly suited for port asset tracking, as well as stand-alone solutions for yard vehicle tracking and automation. In the case of vehicle tracking the positioning information is used for choosing the nearest vehicle, for safety tracking, collision avoidance or geo-fencing. Full vehicle automation is achieved with high-integrity positioning for reliable

vehicle navigation and control.

In the last few years GNSS positioning technology has taken several strides forward, which now allows it to be the positioning technology of choice for major logistics solution providers such as Kalmar. There are many receivers on the market offering varying degrees of quality when it comes to positioning. Choosing for receivers with a high degree of integrity ensures reliable and effective asset tracking or logistic machine automation.

ABOUT THE AUTHORS:

Stef van der Loo holds the role of Market Access Manager at Septentrio. With his extensive background in electronics and over 10 years of experience in the logistics, autonomous vehicles markets, robotics and agriculture markets for which he developed many successful go-to-market strategies for software and INS/ MEMS orientation solutions.

ABOUT THE ORGANISATION:

Septentrio designs, manufactures and sells highly accurate GPS/ GNSS receivers, for demanding applications requiring accuracies in the decimetre or centimetre range, even under difficult conditions. For over two decades Septentrio has been working with some of the largest ports in the world and major players in the supply chain, providing robust, easy-to-integrate positioning solutions for reliable high-accuracy GNSS.

www.septentrio.com