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GLOBAL NAVIGATION SATELLITE SYSTEM

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Abstract: GNSS (Global Navigation Satellite System) is a satellite system that is used to pinpoint the geographic location of a user's receiver anywhere in the world. The developing Global Navigation Satellite Systems (GNSS), for example the Russian GLONASS system and the emerging European Galileo and Chinese BeiDou systems is expanding exponentially. Current and future utilization, research, and application developments are becoming key to most walks of life and hence prevalent within government, commercial industry, research communities as well as for the citizen. The ability to accurately locate and relocate, to navigate and track and to synchronies data streams has made this a technology that we all utilize, whether we are aware of it or not. Current GNSS drivers with in the engineering community are to improve efficiency, to provide better customer service, to enhance health and safety provision and as an aid to meet industry regulation. Augmenting GNSS devices with other positioning tools (whether they be ground penetrating radar, inertial devices, lasers, tachographs, etc) can provide a total solution when they are appropriately combined together.

Keywords: Global Navigation Satellite System, Global Positioning System

I. INTRODUCTION

Global Navigation Satellite Systems (GNSS), which was started with the launch of the U.S. Department of Defense Global Positioning System (GPS) in the late 1970s. Early applications of GNSS were developed for the military and soon expanded to the survey and mapping industries—driven largely by the tremendous advances in accuracy, efficiency as well as cost reductions. Now, vehicles, whether on land, in the air or at sea—routinely rely on the precise positioning information provided by GNSS technology. In fact, the ready adoption of the technology, from mining to unmanned, and the increasingly complex requirements for positioning, anywhere, anytime, is driving innovation in the industry that includes the integration of GNSS technology with a variety of other sensors and methodologies. This multifusion approach is sure to drive innovation in the industry for many years to come.

II.SATELLITE NAVIGATION SYSTEM:

A satellite navigation system with global coverage may be termed a global navigation satellite system (GNSS). A satellite navigation or satnav system is a system that uses satellites to provide autonomous geo-spatial positioning. It allows small electronic receivers to determine their location to high precision using time signals transmitted along a line of sight by radio from satellites. Satellite-based navigation systems use a version of triangulation to locate the user, through calculations involving information from a number of satellites. Each satellite transmits coded signals at precise intervals. The receiver converts signal information into position, velocity, and time estimates. Using this information, any receiver on or near the earth's surface can calculate the exact position of the transmitting satellite and the distance (from the transmission time delay) between it and the receiver.

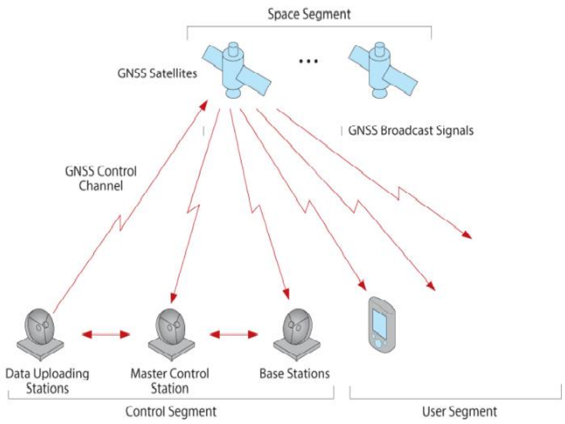

Figure 2 GNSS Segments

Coordinating current signal data from four or more satellites enables the receiver to determine its position. The original motivation for satellite navigation was for military applications. Satellite navigation allows the precision in the delivery of weapons to targets, greatly increasing their lethality whilst reducing inadvertent casualties from mis-directed weapons. Satellite navigation also allows forces to be directed and to locate themselves more easily, reducing the fog of war. The ability to supply satellite navigation signals is also the ability to deny their availability. The operator of a satellite navigation system potentially has the ability to degrade or eliminate satellite navigation services over any territory it desires. Current GNSS drivers within the engineering community are to improve efficiency, to provide better customer service, to enhance health and safety provision and as an aid to meet industry regulation. Augmenting GNSS devices with other positioning tools (whether they be ground penetrating radar, inertial devices, lasers, tachographs, etc) can provide a total solution when they are appropriately combined together. GNSS is now used to control plant across the site, leading to thepotential for it to become truly autonomous. Map matching techniques can be used which exploit the intelligence within digital mapping to allign a user's GNSS track onto the right road – useful in vehicle tracking applications.

III.GNSS

A GNSS receiver knows where each satellite is in its orbit and compares it with the time required to receive each satellite's signal. The receiver uses these measurements to calculate its specific position on Earth.

A GNSS receiver can only track satellites orbiting above the horizon. Typically there are between six to twelve satellites visible above the horizon at any one time. The receiver will try to track all visible satellites. If some satellites become blocked or "shaded" by tall buildings or other major obstacles, the receiver automatically will try to reacquire the blocked signals. Although a GNSS receiver needs at least four satellites to provide a three-dimensional solution (latitude, longitude, and altitude), it can maintain a (latitude-longitude) position using three satellites. GNSS constellations are designed to provide worldwide positioning services with an accuracy ranging from 5 to 15 meters. More precise accuracies are not possible with standard GNSS due to minor timing errors and satellite orbit errors, plus atmospheric conditions that affect the signals and their arrival time on Earth. However, there are ways to improve GNSS accuracy using additional services. There are four primary services available, each capable of improving position accuracies to better than one meter,

Growth in GNSS: One straightforward way of depicting the growth in the use of GNSS is through looking at the predicted revenue from GNSS receiver sales over the next 15 years. In 2001 this stood at €15 billion, by 2020 this is predicted to be €150 billion. The mass markets will be in personal navigation and telematics, followed by transport, emergency services and the surveying / engineering / asset management industries. The accurate timing that GNSS also provides is exploited to enable the synchronisation of communications networks, electric power distribution and banking. This current popularity and future explosion in the use of GNSS can partly be traced to the coming together of a variety of factors; the advances and increased use of telecommunication technologies and geographic information systems, together with the availability of geospatial information. This has combined with the overall decrease in cost, size and power consumption of satellite navigation receivers.

IV.USER APPLICATIONS

GNSS has a plethora of possible applications; from road (road user charging and navigation), rail (safety and positioning), offshore (navigation) and air (routing), to construction and engineering positioning to the location and relocation of utility assets. Cross-cutting measures are being implemented to foster GNSS pervasiveness in general and to enhance innovation. For instance, the European Commission funds R&D activities through the Seventh Framework Programme of the European Union for research, technological development and demonstration activities (2007-2013), in particular related to the reduction of EGNOS/Galileo receiver costs and supports the establishment of an international prize to promote innovative EGNOS/Galileo-enabled applications. GNSS awareness raising will be promoted through an international Galileo Application forum, the establishment of a virtual information centre and with a dedicated action towards SME through instruments of the Entrepreneurship and Innovation Programme (EIP).

Mapping and Surveying: Surveying has been one of the very first civil domains to use GNSS: In the early '80s, manufacturers of both GNSS systems and surveying instruments started to understand each other's markets and products. GNSS benefits mainly to centimeter applications such as property cadastre, topographic survey, maps, engineering survey (staking out) and perpetuation of evidence. The use of GNSS solves the issue of line-of-sight and allows to survey 30-60 km per day. Meanwhile, GNSS is the preferred technology for surveyors without which this profession would not be conceivable anymore. With the advent of Galileo and multi-constellation, dual-frequency technology evolving quickly and prices decreasing GNSS will gain even more ground in this sector in the future.

Surveying activities are sub-divided in Land Surveying and Maritime Surveying which operations and needs are very different. Land surveying covers many applications from forest management to building deformation control. Corresponding accuracy requirements are variable from sub meter to sub centimeter. Maritime surveying refers to: Hydrographic surveying (national mapping and coastal surveying operations) , Off-shore surveying (survey operations for commercial applications such as oil and gas exploration).

Agriculture: By integrating Galileo signals with other technologies, the agriculture community can benefit from improved monitoring of the distribution and dilution of chemicals, improved parcel yield thanks to customized treatment and more efficient property management.

Different applications can benefit from the added value of GNSS technology:

- Tractor guidance makes use of a digital display to help an operator on board of the vehicle to follow a predetermined path, thus minimizing risks of overlap/gaps. This application is often the first GNSS application a farmer adopts.
- With VRT (Variable Rate Technology), precise location information is used to guarantee a precise control over farming inputs (e.g., fertilizers), thus further enhancing the added value of tractor guidance/ automatic steering applications.
- Automatic steering is the most advanced of these applications and allows a vehicle to be automatically driven along a predetermined path. This application is used mainly in large farms.

Fisheries: The fishing industry will see more effective information exchange between vessels and stations and improved navigation aids for fishermen. Civil Engineering, Accuracy and reliability are absolute requirements in civil engineering. Combined with digital mapping, Galileo offers a powerful tool for decreasing cost and increasing productivity while maintaining the highestconstruction standards, from the planning of structures to the maintenance and surveillance of existing infrastructure.

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Finance, Banking, Insurance: Galileo's extremely accurate clock makes it formidable instrument for authentication and 'time stamping' of financial transactions. In today's information society, security, data integrity, authenticity and confidentiality have emerged as major issues in the exchange of electronic documents and computer files.

Certified time stamps are necessary for applications such as electronic banking, e-commerce, stock transactions, quality assurance systems and services. Galileo will play a key role in the protection of such information, using the latest authentication techniques.

V.CONCLUSION

The future for GNSS is very exciting over the next ten years where we could see more than 120 positioning satellites available to be used.The acceptance and use of GNSS within civil engineering, often when combined with other measurement or sensor technology, will continue to flourish. GNSS is now used to control plant across the site, leading to the potential for it to become truly autonomous.

VII. REFERENCE

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