GNSS Update

Positive and Negative Developments

In the past few months a lot has happened regarding the implementation and testing of new GNSS frequencies. Not all results are positive however, especially with GPS there are some items that warrant attention in the long(er) run. Furthermore critics of the Galileo program seem to be proven partially right when looking at the more recent developments of the program. But not all is amiss in the world of navigation. The EGNOS signal is scheduled to become operational soon and WAAS has been put to use on a new aviation level in the United States.

By Huibert-Jan Lekkerkerk

Vice chairman of the European Commission Jacques Barrot (source: ec.europa.eu).

GPS

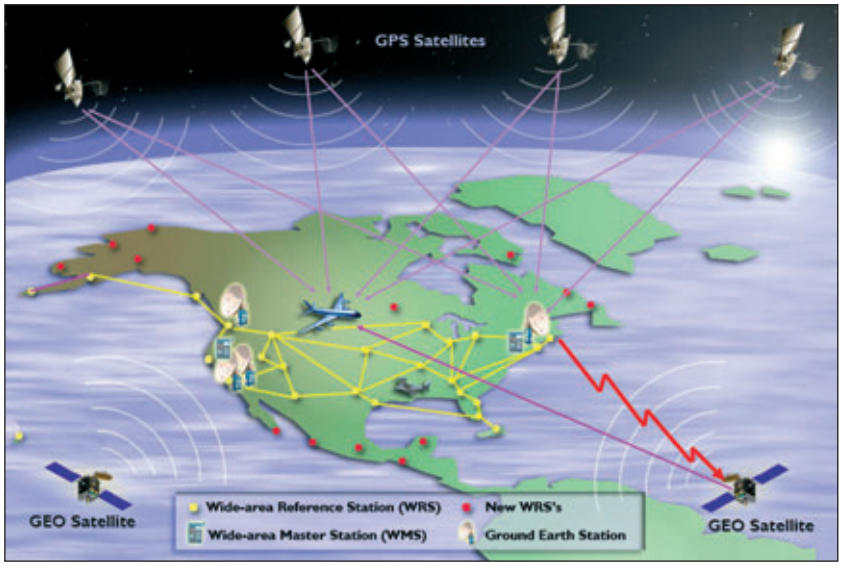
Potential problems with the modernized GPS signals

The first block IIR-M GPS satellite became active in December 2005, being the first satellite to transmit the L2C signal and to have a 'flexible power' option. The latter makes it possible to vary the power of the –military – P and M codes, making disruption of the signals more difficult.

However users of combined L1/L2/L2C receivers as used in survey applications for example have experienced problems during the short time that both the L2C signal and the flexible power option were tested. The main cause of the problems was a phase shift experienced during switching on the flexible power. There is however a deeper problem. If users are not informed of these types of changes in the future then more problems can be expected. Information can be distributed to the users by inserting it in the navigation message as sent by each satellite.

In a first reaction, the American government announced that they were unaware of the impact on RTK-like applications. Regular receivers will not experience these problems since they do not utilise phase measurements. Potential solutions are furthermore reported to be investigated.

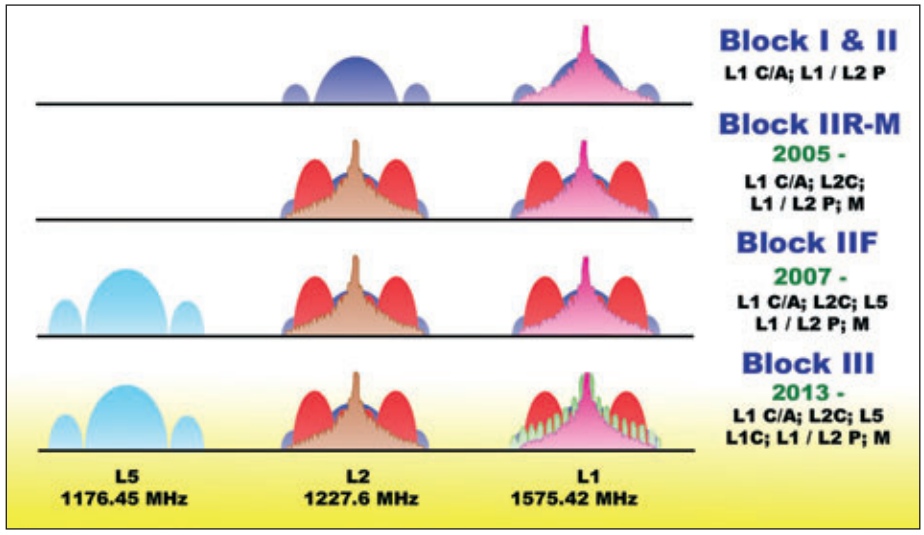
WAAS in the United States (source: gps.faa.gov [adapted])



L1C frequency

Together with the United States, Europe has published a recommendation for a joint signal structure with regard to the L1 and L1C signals as used by both the Galileo and GPS satellites. The chosen solution (multiplexed binary offset carrier) is cheered by suppliers of high-resolution GPS receivers. For the cheap(er) segments problems may arise since these use simpler receiver technology. As a result mobile receivers will have to operate with lower power and bandwidth which could result in a downgraded performance in urban areas. However the results obtained will still be improved when com-

pared to the results with the current C/A code.
The L1C signal, which will be transmitted on top of the current C/A code, will at the earliest be implemented in the block III GPS satellites. These are scheduled for launch in 2013 as a result of budget cutbacks by the American government.
And last but not least it has become clear that there is no serious consideration by the United States government to add a so-called integrity message to the GPS signal structure. The monitoring of the integrity of GNSS signals is important for critical applications like aircraft navigation and will be part of Galileo.



Current and future signals with the GPS system.

Galileo

Galileo signal specification

On May 19th the draft version of the Galileo interface specification was published. This specification describes the characteristics of the open signal structure like frequency and data messages. Part of the message specification is a correction for determining the time difference between Galileo system time and GPS time. This message is necessary to manufacture combined GPS / Galileo receivers.
A disadvantage of the specification is the restriction on the use for commercial applications. The comparable GPS specification does not impose any restrictions.
Manufacturers wanting to use the specification (for the development of Galileo receivers) need an additional license from the Galileo program. The main question therefore is how many manufacturers will want to participate in Galileo on this basis.

Progress of the Galileo program

According to vice-president Jacques Barrot of the European Commision the Galileo project is in accordance to the growth strategy. Barrot states the project will generate more jobs as well as innovation and progress for every European citizen. As far as budget is concerned it was deemed too early to state an exact figure. Exact figures will be set for the duration of the concession (20 years).
Around the same time the managing director of the Galileo Joint Undertaking, Rainer Grohe, announced that Galileo is currently 400 million euros over budget. As main reason miscalculations concerning the building and launch of Giove-A and B are named. Improvements on the security side also added to the current expenses of 1.5 billion euros. The total project budget is estimated at 4.5 billion euros. The contract to improve the security was awarded recently to LogicaCMG at a price of 20 million euros.

China and Galileo

China and Europe signed an agreement regarding Galileo in 2003. Purpose of the agreement is the exchange of knowledge and the stimulation of knowledge development. Europe has always regarded the agreement as a showcase for the worldwide application of Galileo. The agreement however ends at the end of this year as the Galileo Joint Undertaking formally comes to an end.
Recently it was rumoured that China may super impose their military Beidoe signal on the frequency of the secure Galileo services and maybe even on top of the military GPS signal. This will have far-reaching consequences for the reception of these signals and has caused great concern throughout the world.
Furthermore it has become known that China, who is contributing 200 million euros to the Galileo project, and India which is negotiating for participation, expect to take a leading role in the development of receivers and software. This could have far-reaching consequences for the expected 140,000 jobs Galileo is supposed to create. The latter has been a strong argument for the participation of many European countries.

Satellite dGPS Systems

WAAS

Recently the American aviation authorities (FAA) have granted permission to use WAAS, the American counterpart to EGNOS, for aircraft approaches up to 200 feet (60 meters) above airfield level. Below 200 feet aircraft will have to use the traditional systems.
During the last two years the coverage of WAAS over the United States has been around 99 per cent with an availability of 99.87 per cent of the time.

EGNOS in operation

Starting July 2006, EGNOS will proceed from the testing phase (ESTB – Egnos System Test Bed) to the operational phase. With that transition the reception in Northern latitudes should improve as well. For the moment the signals are transmitted on an 'as is' and 'as available' base. This signifies that the signals cannot be used for aircraft or other critical purposes such as emergency response.

EGNOS for the visually impaired

In Madrid a system was demonstrated whereby visually impaired got directions from GPS and EGNOS based systems. In this experiment a GPS phone was equipped with special software developed by ESA and the Spanish company GMS Sistemas. The navigation instructions were transmitted through an earpiece to the visually impaired who then could find his way through the city.
In this application the processing of the position data was performed in a central computer and then transmitted back to the user. The system is not meant to replace the guide dog or cane but is mainly an addition to these.

MSAS

The Japanese alternative to WAAS / EGNOS, the MSTS Satellite Based Augmentation System (MSAS), has come a step closer to completion with the launch of the new QZSS satellite. This satellite differentiates from all other satellite dGPS satellites in that it does not have a geostationary orbit but will rotate in short, figure eight type, orbits. This way the availability over Japan should improve dramatically.

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