

TELIT

WHITE PAPER

GPS + GLONASS – USING THE BEST OF BOTH WORLDS

TABLE OF CONTENTS:

EXECUTIVE SUMMARY

1. GPS and GLONASS Technology - Background Information
2. Restrictions of GPS only
3. Combining GPS & GLONASS
 - 3.1. Test studies in Los Angeles & London
 - 3.2. Central Findings
4. The Telit difference
 - 4.1. Jupiter SL869
 - 4.2. Jupiter JN3
5. About Telit

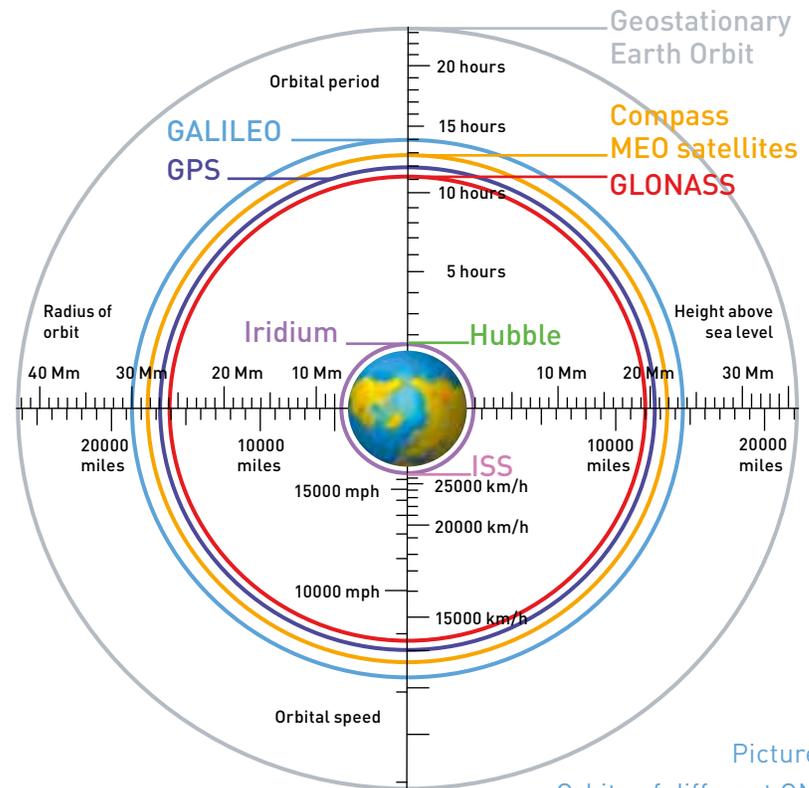
EXECUTIVE SUMMARY

At the end of 2011 the Russian government announced that GLONASS, the Russian Global Navigation Satellite System (GNSS), is fully operational and has global coverage. Experts at Telit decided to test what impact this has on satellite navigation and positioning. They conducted tests in Los Angeles and London to see the relevance of GLONASS for the whole world. The results clearly showed that the combination of GPS and GLONASS improves positioning tremendously. Especially in urban canyons with huge skyscrapers the receiver had the ability to track at least four satellites and thus calculate a fix – which was impossible to guaranty using only GPS. Thanks to the SL869, a newly released Global Navigation Satellite System (GNSS) module from Telit that has access to both GLONASS and GPS, blind spots were reduced and navigation performance was radically improved. This white paper shows the test set-up and examines the results. For the future further tests are planned, for example in South Africa.

1. GPS AND GLONASS TECHNOLOGY

Radio-based Global Navigation Satellite Systems (GNSS) are part of our daily life for navigation, surveying and mapping. Although there are several GNSS like the European Galileo or the Chinese Beidou, the US GPS is the most popular one providing global coverage and used widely in navigation systems. Today there are 31 GPS satellites that are operational, plus 3-4 decommissioned satellites that can be reactivated if needed.

Since October 2011 the Russian GLONASS has been fully operational with 24 satellites in orbit plus four in reserve and one currently undergoing trials. This is not only an alternative to GPS but, even more, the completion of a combined GPS/GLONASS system where there are in total 55 fully operational satellites in outer space in different orbits (see picture 1). For satellite navigation at least 4 satellites are needed to determine a position solution: three to provide the data for each space axis (x, y and z)



Picture 1:
Orbits of different GNSS

and one to provide the time sent. The more satellites that can be tracked, the more accurate the fix will be. In theory this is possible with GPS-only as there should always be at least 5 satellites visible anywhere on the Earth's surface. If

there is an unobstructed view of the sky even 12 satellites can be visible. But often there are buildings, trees, mountains or clouds blocking some of the GPS signals, and the GPS receiver is unable to obtain a position fix.

2. RESTRICTIONS OF GPS-ONLY

Especially in mega-cities with many skyscrapers, satellite signals are often lost. For fleet management as well as for other types of tracking applications this condition can be unacceptable. In addition there are further restrictions of GPS-only navigation: GPS satellites orbit the earth from a distance of 20,000 kilometers. Their signals are barely -130 dBm once they reach a terrestrial receiver, and are degraded even further in urban environments. This makes it a real challenge to isolate them from background noise.

To overcome these limitations the Telit engineers decided to launch a combined solution of GPS and GLONASS. The fact that there are now in total 55 satellites operating in different orbits covering the whole globe must have an impact on navigation and should provide advantages.

3. COMBINING GPS & GLONASS

3.1. Test studies in Los Angeles and London

In February 2012 the Telit GNSS engineers decided to run a field test comparing the navigation accuracy of GPS only receivers and GPS+GLONASS receivers. The team did seven test tracks between 11:00 a.m. and 3:00 p.m. in Downtown Los Angeles. They tested several standard GPS only units in comparison to the Jupiter SL869, Telit's new GNSS module which processes both GPS and GLONASS signals.

The results were always very similar: Combining GPS and GLONASS pro-

vided much more accurate and better positioning possibilities instead of GPS only – see picture 2. The picture shows a single test track. The red line represents GPS only. It shows that during the test track there were several instances where GPS was not able to determine a position solution. With a GPS+GLONASS receiver this didn't happen – the receiver never lost the signal.

Furthermore there is a huge difference in the accuracy of ground track. With GPS there were several meters tracked off-road, means the track was not on the street but next to it. With GPS+GLONASS the positioning was very accurate and it didn't happen at all.

Tracked way in Los Angeles.

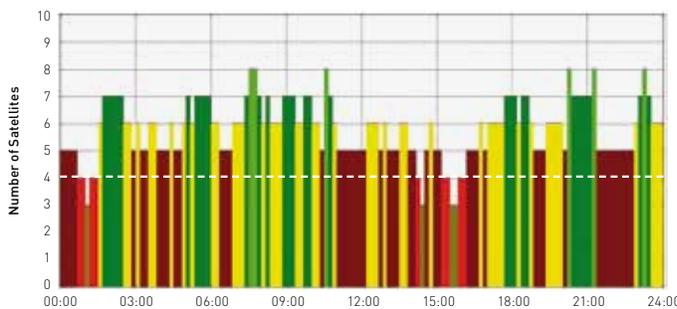


Picture 2:

Tracked way in Los Angeles. Green shows the route which was driven with GPS & GLONASS receiver, red the same route with a standard GPS-only receiver.

A similar study was conducted in London on March, 20th 2012 monitoring the number of satellites used by a GPS-only receiver and by a GPS+GLONASS receiver. The findings were the same as in Los Angeles: Because of signal blockages in London caused by five story buildings, the number of tracked GPS satellites dropped below four (picture 3). Thus the GPS-only receiver lost its fix point. This happened three times, of which the time around 3:00 p.m. was the most critical one. At that time the receiver had no track for app. 20 minutes.

Tracked satellites.



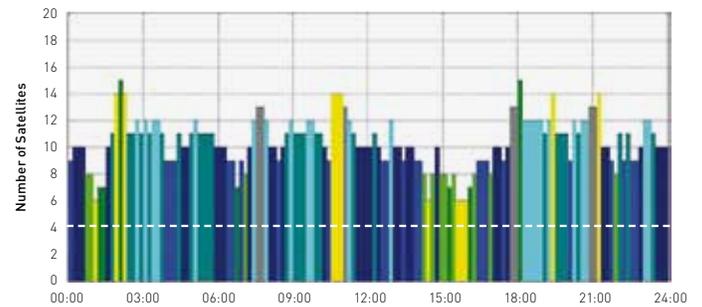
Picture 3:

The picture shows the number of satellites that were in track in London March, 20. Dark green shows times where the number of satellites drops below 4.

The same test tracking was done with GPS+GLONASS. It showed that there are always more than 4 satellites in track. A fix is virtually guaranteed (picture 4). In addition even

up to 15 satellites were tracked in the middle of London where it wasn't possible to track more than 8 satellites with GPS-only. That nearly doubled the available satellites.

Tracked satellites.



Picture 4:

The picture shows the number of satellites that were in track in London March, 20 with GPS+GLONASS. The number never drops below 6.

3.2. Central Findings

The tests showed that thanks to the addition of GLONASS, the number of tracked satellites never drops below six, and the problem of lost satellite coverage, especially problematic in urban canyons with tall buildings, is dramatically reduced. Furthermore the test showed that also the accuracy of positioning is significantly improved. In addition

the team noticed an improved time-to-fix which is for example vital for Stolen-Vehicle-Recovery where it is crucial to locate the vehicle no matter where it is. Accessing the combined GPS/GLONASS constellations is thus a major step forward in navigation, providing the best satellite geometry to obtain the most accurate position possible more often – not only in Russia but all over the world. Finally, this enables a more accurate positioning, a better “pinning” of a person, a car or an asset’s true location on a digital map. Further tests are on its way in South Africa. The Telit experts are very confident that the findings so far will be confirmed there.

4. THE TELIT DIFFERENCE

4.1. The Jupiter SL869 GNSS modules

In Los Angeles the Telit team tested the Jupiter SL869, a new series of GNSS modules from Telit. These tests clearly showed that the SL869 maximizes the performance over

GPS alone by utilizing both the GPS satellites plus the GLONASS. The results are: Higher percentage in navigation, faster acquisitions and more precise and accurate position.

The Jupiter SL869 is a state-of-the-art 32-channel global navigation module able to receive, track and navigate using the entire spectrum of GNSS systems available in the world: GPS, GLONASS and QZSS, furthermore it is Galileo ready.

The extreme low profile and small size of the LCC package enables the design of ultra-compact applications. The solution cost and required space is significantly reduced. With its ultra-compact design and extended temperature range, the Telit Jupiter SL869 is the perfect module for low, medium and high-volume M2M combined applications and mobile/tracking data devices.

Equipped with a powerful yet power saving processor, the module provides all the GNSS information via NMEA standard protocol on a serial interface. The Telit Jupi-

ter SL869 can efficiently retrieve the correct position in harsh environments using multiple GNSS constellations and SBAS as well as real-time ephemeris data.

4.2. Jupiter JN3 GNSS module

Although the combination of GPS and GLONASS provides huge advantages, there are also price differences. So in cases where a very accurate position is not needed, but cents make a difference to a competitor, a GPS-only module would be sufficient. Therefore Telit provides the Jupiter JN3 which is pin-to-pin compatible to the SL869. So customers need only one design for the two alternatives and can migrate whenever needed to one or the other without any problems.

The Jupiter JN3 is a state-of-the-art 48-channel GPS module with high sensitivity, extremely low power consumption, and extended ephemeris predictions for fastest TTFF. Coupled with a Telit GSM/GPRS module, the Jupiter JN3 represents the ideal wireless+GPS solution in terms of total cost effective-

ness and time-to-market readiness. The extreme low profile and small size of the LCC package enables the design of ultra-compact applications. The solution cost and required space is significantly reduced. With its ultra-compact design and extended temperature range, the Telit Jupiter JN3 is the perfect module for low, medium and high-volume M2M combined applications and mobile/tracking data devices. Thus Telit can always provide the perfect module for every need.

5. ABOUT TELIT

Telit Wireless Solutions is a brand of Telit Communications PLC (AIM: TCM), an enabler of machine-to-machine (M2M) communications worldwide providing wireless module technology, M2M managed services and value added services, including connectivity. Exclusively dedicated to M2M with more than 12 years of experience in the market, the company constantly enhances its technology leadership with six R&D centers across the globe. Telit offers an extensive portfolio of the highest quality

cellular, short-range RF, and GNSS modules, available in over 80 countries. By supplying scalable products that are interchangeable across families, technologies and generations, Telit is able to keep development costs low and protect customers' design investments. In addition, Telit is the only module provider in the market today to offer a value added services bundle including connectivity dedicated to simplifying the deployment of M2M applications.

Telit provides unmatched customer support and premier design-in expertise through its 25 sales and support offices, a global distributor network of wireless experts with more than 30 Telit-designated Competence Centers, and its online Telit Technical Support Forum.

Telit technology enables organizations to wirelessly collect, process and respond to real-time data from vending machines, utility meters, cars, remote health monitors and any other connected devices, creating new efficiencies and revenue opportunities as well as societal and personal benefits. Further information about Telit and its products can be found at www.telit.com.

Contact

EMEA

Telit Communications S.p.A.
Via Stazione di Prosecco, 5/B,
34010 Sgonico (Trieste), Italy
Phone: +39 040 4192 200
Email: EMEA@telit.com

 www.telit.com/ebook

 www.telit.com/techforum

 www.telit.com/facebook

 www.telit.com/twitter