

u-blox' comprehensive approach to multi-GNSS positioning

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Table of contents	Executive Summary	3
	The state of GNSS	4
	Russia	4
	European Union	5
	China	5
	Japan	5
	Other GNSS augmentation systems	6
	Beyond GPS: u-blox 7	7
	Evaluating u-blox 7 multi-GNSS chips and modules	8
	About u-blox	9

Executive Summary

GPS has been around for 30 years, becoming the global defacto standard for navigation and positioning. This situation is rapidly changing. To reduce or eliminate the reliance on the US-based GPS satellite network for both government and civilian navigation and positioning systems, Russia, China and the EU are deploying their own parallel, large-area Global Navigation Satellite Systems ("GNSS"). Japan has also started to deploy its own satellite augmentation designed to improve GPS performance in Japan and areas of Southeast Asia and Oceania. To address this expanding array of new GNSS systems, u-blox has introduced low-power, multi-GNSS capability into its newest generation satellite positioning platform u-blox 7.

The state of GNSS

The reason for the appearance of numerous new GNSS systems is clear: many countries do not want to be 100% reliant on the US controlled GPS system which could in theory be deactivated or restricted. Designers of GNSS systems are now faced with new motives for designing systems that support multiple GNSS standards:



GPS is no longer the only game in town for satellite positioning

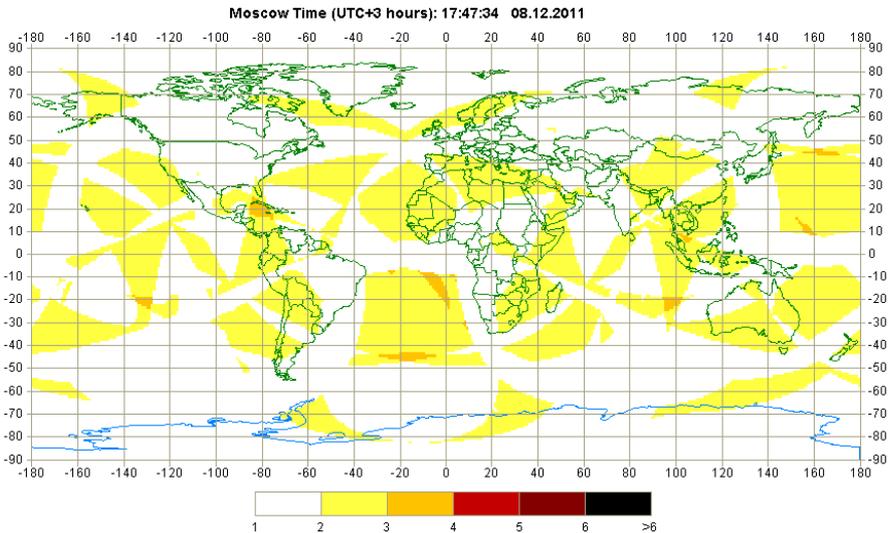
- Government mandate and legal requirements to support own GNSS system inside one's country (in addition to GPS)
- Availability / redundancy: increased reliability by removing the dependence on any single positioning system
- Increased performance in cities: the rapid growth of high-rise buildings means visibility of satellites belonging to any one system may be poor, in which case simply use a different one
- Accuracy: the (often perceived) increase in accuracy derived from using more than one system simultaneously

Russia

The first additional GNSS system to come online is Russia's **GLONASS** (**GL**Obal **NA**avigation **S**atellite **S**ystem). GLONASS became fully operational in 2011 with 24 satellites. Like GPS, GLONASS provides global coverage, with positional accuracy typically less than 7 meters in Russia, and less than 9 meters outside of Russia. Occupying a frequency spectrum only 25 MHz away from GPS, GLONASS operates via frequency division multiple access (FDMA), while GPS utilizes Code Division Multiple Access (CDMA) to distinguish between satellites. One of the first applications of GLONASS is ERA-GLONASS, an automated vehicle emergency response system similar to the EU's eCall system. GLONASS is functional today.



GLONASS global coverage: areas with lower PDOP (Position Dilution of Precision) values have best reception





European Union

The EU is deploying its own satellite network called **Galileo**. There are currently 2 satellites in orbit with 2 more planned for 2012. The final deployment of a total of 30 satellites (27 operational and 3 backup) is planned for around 2019 when the system should be fully available. Based on an advanced version of CDMA, Galileo will operate over a very similar frequency band as GPS. The system is designed to support sub-meter accuracy. In addition to positioning, Galileo will provide additional "Search and Rescue" services which incorporate 2-way data communication with satellites, something no other GNSS system currently supports. Galileo is still in a test phase.

GPS, GALILEO and GLONASS L1 Frequencies



China

China is developing their own GNSS system called **BeiDu-2**, also referred to as **Compass**. Also based on CDMA, the system currently has 10 satellites in orbit, offering navigation and positioning services to users in China and Southeast Asia. It will ultimately rely on 35 satellites to provide positioning capability over its free service to within 10 meters with global coverage. The global version of Compass is scheduled for completion in 2020. The state of Compass can be characterized as early local deployment and trial phase.

Japan

Due to the high-rise nature of many of Japan's cities, **QZSS (Quasi-Zenith Satellite System)** was defined as an augmentation system to aid GPS in urban canyons. The system will consist of 3 satellites which will transmit an array of correctional data to improve GPS performance to sub-meter accuracy. The first of 3 "Quasi-Zenith" (meaning "approximately directly overhead") satellites was launched in Sept. 2010. In addition to positioning, QZSS will also deliver communications services targeted at mobile devices. With one QZSS satellite currently in orbit, the full complement of 3 satellites is expected to be completed by 2013. QZSS is already functional with one satellite in orbit, and supports devices operating in Japan, parts of Southeast Asia and Australia.

Other GNSS augmentation systems

Accurate positioning is highly dependent on atmospheric conditions, specifically the delay of GNSS signals while traversing the ionosphere. The 3 augmentation systems listed below (systems that aid GPS) have been available for some time now and are routinely used by GPS receivers to improve accuracy in specific geographic regions:

- WAAS (Wide Area Augmentation System, available in North America)
- EGNOS (European Geostationary Navigation Overlay Service, available in Europe and Russia),
- MSAS (Multi-functional Satellite Augmentation System, available in Japan)

Use of these augmentation systems is not limited to improving GPS performance; they can and will deliver the same benefits to other GNSS systems such as GLONASS and Galileo.

Beyond GPS: u-blox 7

To help system designers address the expanding range of GNSS systems and augmentation services, as well as other demanding criteria such as low power consumption and small size, u-blox has paid special attention to the following design considerations with the release of u-blox 7, the company's fifth-generation GNSS receiver platform based on the new UBX-G7020 multi-GNSS receiver chip:



u-blox multi-GNSS chip
UBX-G7020-CT
3.0 x 3.4 x 0.6 mm
(Chip Scale Package)



u-blox multi-GNSS chip
UBX-G7020-KT
5.0 x 5.0 x 0.6 mm
(QFN-40)



u-blox multi-GNSS chip
UBX-G7020-KA
5.0 x 5.0 x 0.6 mm
(QFN-40, automotive)

- **Low power consumption:** as GNSS is mainly used in small, battery-powered mobile devices (positional information, after all, is most useful when tracking moving objects with no access to the power mains), power consumption is the most important feature of u-blox' multi-GNSS receiver chip. Consuming only one-third the power of the nearest competing solution, typically only 35 mW in continuous mode and 6 mW in power-saving mode, the UBX-G7020 is the lowest power multi-GNSS receiver IC on the market. It supports GPS/GLONASS/Galileo/QZSS and all SBAS augmentation services.
- **Small size and flexible interfacing:** for chip-based designs, a small yet easily mountable chip with low eBOM and flexible interfacing results in the most compact design. The UBX-G7020-CT provides these features in a 3.0 x 3.4 mm chip scale package (CSP) supporting USB, I2C, SPI and UART interfaces. With built-in LNA, LDOs and DC/DC converter and on-chip ROM, a complete GNSS system can be realized with only 8 external components on a PCB area of less than 30 mm².
- **Module form-factor continuity:** for module-based designs, the constantly moving target of GNSS systems and their availability means each successive design upgrade should be possible without expensive hardware change: simply interchange the receiver module on the same footprint and upload new firmware. u-blox continues this "future-proof" tradition of form-factor and layout consistency with u-blox 7 and its industry standard LEA, NEO and MAX modules.

- Design flexibility: u-blox supports all deployed GNSS systems while at the same time providing “hardware-ready” receivers that can adapt to systems that are not yet available or fully characterized. u-blox supports this philosophy as it allows designers to create devices supporting deployed standards based on ROM-based modules, yet with flash versions available to adapt to satellite systems which are still in the trial phase such as Galileo and Compass.
- Standard and automotive grade: the UBX-G7020 continues u-blox’ support of applications in consumer, industrial as well as automotive markets (UBX-G7020-KA conforms to AEC-Q100 and ISO/TS 16949 quality and manufacturing standards). Typical applications for u-blox 7 multi-GNSS receivers include portable consumer electronics (cameras, notebooks, tablets, portable navigation devices, and personal trackers), industrial electronics (fleet and asset management systems) and automotive applications (emergency call, anti-theft and vehicle navigation systems).

Evaluating u-blox 7 multi-GNSS chips and modules

To evaluate the performance of u-blox’ latest generation multi-GNSS platform, two evaluation kits can be ordered (available August 2012):

	Type		Features							Supported products
	GPS, QZSS	Sequential GLONASS	Programmable (Flash)	Data logger	Best Noise Figure	TCXO	RTC Crystal	DC/DC bypass		
EVK-7N	•	•	•	•	•	•	•	•	UBX-G7020 chips MAX-7Q, MAX-7W NEO-7N	
EVK-7C	•		•	•	•		•	•	UBX-G7020 chips NEO-7M	

Some key features:

- Supports both u-blox 7 GNSS chips and modules
- Multi-GNSS support
- Supports designs based on standard and temperature-compensated crystals
- Flash memory
- Built-in data logging function

For more information about the u-blox 7 multi-GNSS platform, [contact u-blox](#).

About u-blox

u-blox is a leading fabless semiconductor provider of embedded positioning and wireless communication solutions for the consumer, industrial and automotive markets. Our solutions enable people, devices, vehicles and machines to locate their exact position and wirelessly communicate via voice, text or video.

With a broad portfolio of GPS modules, cards, chips, and software solutions together with wireless modules and solutions, u-blox is uniquely positioned to enable OEMs to develop innovative solutions quickly and cost-effectively. Headquartered in Switzerland and with global presence in Europe, Asia and the Americas, u-blox employs over 200 people. Founded in 1997, u-blox is listed on the SIX Swiss Exchange (www.u-blox.com).

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