WHITEPAPER

locate, communicate, accelerate

u-blox' GNSS and Wireless module philosophy

Focus on compatibility and upgradeability

Whitepaper by: *Carl Fenger,*
Communications Manager, u-blox

November 2012

3G.G3-X-12002

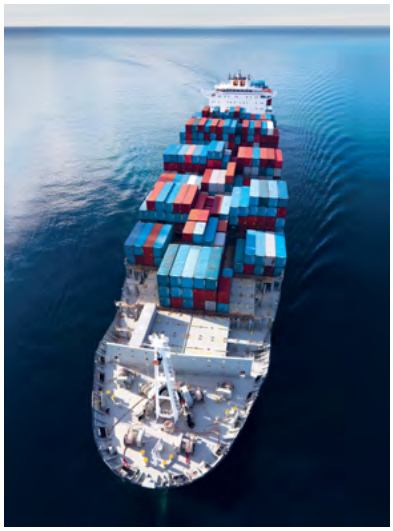
Table of contents

Executive Summary

In today's electronics industry, particularly for industrial machine-to-machine (M2M) applications such as fleet and asset management systems, product cycles are short, typically 9 months to a year for each product upgrade cycle, with overall product life-span lasting up to 10 years.

During this time, designers must continuously improve their products to meet emerging new technologies as well as address regional markets beyond the scope of their original design. This creates design challenges, especially when upgrading the positioning and wireless modem components to address new market requirements such as extended GNSS support, as well as compatibility with multiple mobile network standards.

This whitepaper examines some of these issues and recommended solutions.



How many different GNSS and mobile standards should a tracking system support?
Answer: as many as possible!

Global positioning - a moving target:
A typical machine-to-machine (M2M) communication, monitoring or control system incorporates both global positioning and embedded wireless communications capabilities. When upgrading an existing design to the next generation, there are therefore challenges on two fronts:

- Until very recently, GPS was the "only game in town", and designers could focus on incremental improvements such as upgrading to receivers with higher sensitivity or incorporating assisted-GPS functionality. That is no longer the case. With the Russian-based GLONASS satellite system fully operational since the end of 2011, a second navigation system now functioning in parallel to GPS means designers must cope with regional demands for GLONASS compatibility (for example the vehicle emergency call system in Russia, "ERA-GLONASS", for which the Russian government mandates GLONASS compatibility).

  On top of this, tracking applications are now calling for parallel GPS/GLONASS satellite tracking capability to improve performance in high-rise urban areas where satellites can be easily blocked (under the philosophy "the more satellites the better").

- The future will bring more complexity! The above situation will soon compound itself as both China and the EU deploy their own satellite navigation systems "BeiDu-2 (also known as "Compass"), and the EU's Galileo. Japan has also launched the first of a 3-satellite GPS augmentation system, "QZSS", to aid navigation in high rise areas such as Tokyo. In the near future, interoperability with 2, 3, 4, or even 5 of these "Global Navigation Satellite Systems" will be a standard requirement!

US-controlled NAVSTAR GPS: Available with high-accuracy since 2000

Russian-controlled GLONASS: Available since 2011

The EU's Galileo: Full availability expected in 2019

China's BeiDu-2 ("Compass"): Full availability expected in 2020

Japan's QZSS (actually a GPS augmentation system) Full availability expected in 2013

Mobile communications – a regional "mixed salad":

- For legacy reasons based on individual government policies, politics, and avoidance of already occupied spectrum, as well as the never-ending introduction of new standards supporting higher speeds, the world has devolved into regions and countries using multiple different mobile communication standards occupying many different frequency bands.

  Often multiple standards co-exist such as GSM (2G), CDMA2000, UMTS (3G) and LTE (4G). All 4 of these standards now operate simultaneously in North America! As supply chains for products ranging from cars to consumer goods typically span multiple countries, and even continents, tracking and asset management systems that need to report information on shipments or vehicles must overcome multiple regional compatibility issues in order to remain wirelessly connected.

As GNSS receiver and wireless modem components emerge to address these technological developments, the primary challenges to end-device designers is shifted towards more practical issues when considering the next product generation:

- How can I re-use my existing software and hardware R&D investments when designing the next generation?
- How can I keep my PCB layout changes and re-design costs to a minimum?
- Will my selected GPS/GNSS receiver or wireless modem (and indeed the vendor themselves!) be around in 10 years? This is a real concern in the current economic environment where many component manufacturers are operating at razor thin margins, or even at a loss.

- Innovation: does my vendor keep pace with market innovation cycles so that my end-product can offer the latest features such as multi-GNSS support and 2G/3G/4G mobile compatibility?

- Quality: does my vendor maintain a robust, industry-recognized automotive-quality grade program (e.g. AEC-Q100, ISO-16949, 16750), or are their quality programs ad-hoc? This is particularly important for vehicle based devices, as well as devices which must operate reliably in humid conditions (e.g. at sea), or endure high-vibration such as within shipping containers or railcars.

To address all these issues, when it comes to modules, u-blox adheres to a core design philosophy: maintain form factor and software continuity to allow customers to easily upgrade their products with each new generation of u blox global positioning or wireless modules. The key benefit is simple: customers do not need to keep changing their PCB designs whenever u-blox introduces an improved version of its module products. Simply drop in the next generation module on the existing PCB footprint and start testing!

Positioning modules			
Series		**Package/dimensions**	**Features**
MAX		18-pin LCC[1] 9.7 x 10.1 mm	High-performance, compact GPS/GNSS[2] modules
NEO		24-pin LCC[1] 12.2 x 16.0 mm	Flexible, configurable GPS/GNSS[2] modules
LEA		28-pin LCC[1] 17.0 x 22.4 mm	Feature-rich GPS/GNSS[2] modules
Wireless modules			
Series		**Package/dimensions**	**Features**
SARA		96-pin LGA[3] 16.0 x 26.0 mm	Small, scalable, low-power GSM/GPRS modules
LEON		50-pin LCC 18.9 x 29.5 mm	Full-featured GSM/GPRS modules
LISA		76-pin LCC 22.4 x 33.2 mm	Universal UMTS/HSPA(+) and CDMA200 modules

[1]) Leadless Chip Carrier
[2]) GPS, GLONASS, QZSS; Galileo and Compass ready
[3]) Land Grid Array

u-blox has established these compact Leadless Chip Carrier (LCC) form factors as de-facto industry standards for both GNSS (supporting GPS/ GLONASS/QZSS, Galileo and Compass ready) and mobile communication modules (supporting GSM, UMTS, and CDMA2000).

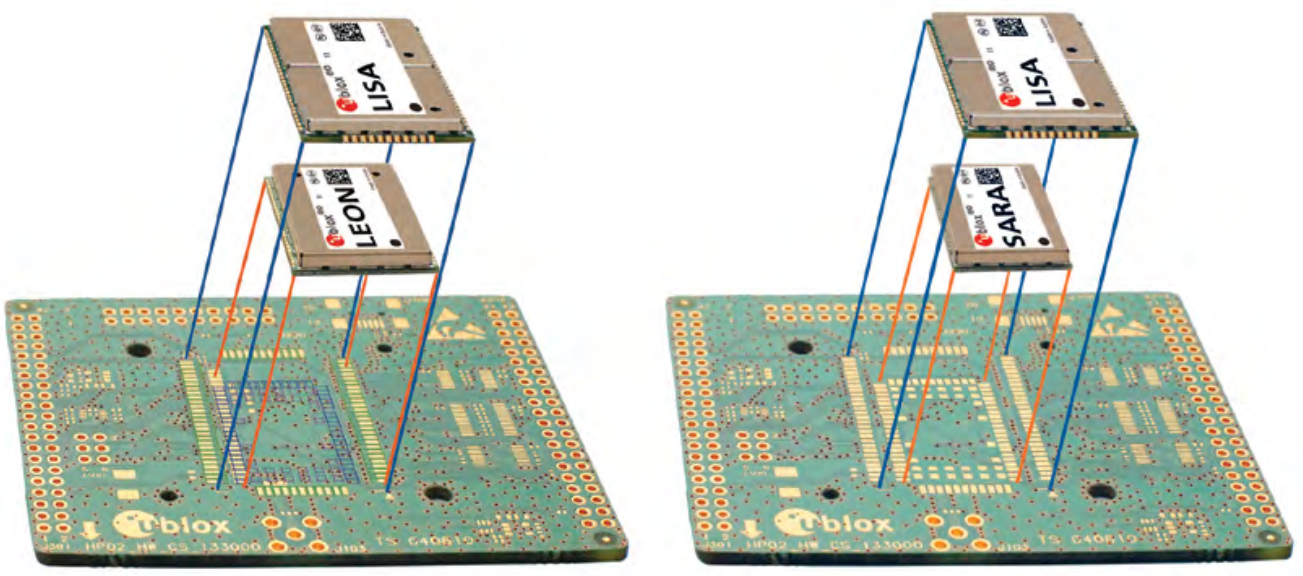
These surface mount form factors are the packaging foundation on which u blox' positioning and wireless module families are based. This form-factor continuity philosophy has been consistently applied throughout all previous product generations over 10+ years.

In addition to providing a smooth upgrade path for designs, form factor consistency allows for easy interchanging of module family members to adapt to end-product variants targeted at specific regions or feature-sets.

This philosophy is especially relevant for the wireless module products where mobile communication standards can vary significantly as well as co-exist on a regional basis.

Upgrade smoothly with nested GSM/UMTS/CDMA designs

When designing wireless modem products that must accommodate GSM, UMTS, and/or CDMA2000 variants, or region-specific versions requiring different frequency bands, PCB layout issues can generate a long list of expensive design and logistics problems.

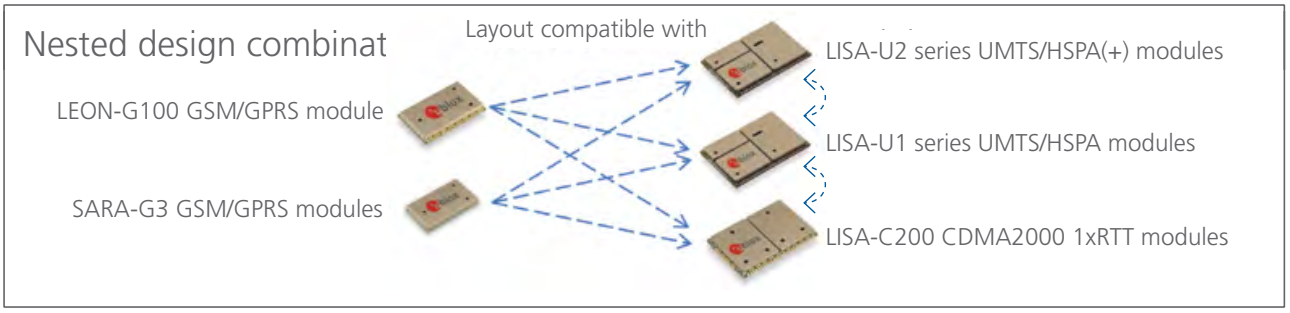


Examples of 2G/3G layout compatibility: nested design accommodates both SARA/LEON GSM and LISA UMTS/CDMA modules on the same footprint.

The best way to avoid this issue is simple: layout compatibility across the entire range of wireless modems. With this solution, a single PCB layout can be designed for use by all end-product variations. This is why u-blox has maintained form-factor compatibility throughout its GSM/GPRS (SARA/LEON) and UMTS/HSPA and CDMA2000 (LISA) wireless module families.

To facilitate nested designs, u-blox provides an application note and PCB reference designs with schematics, Gerber files and bill of materials for both 1.8 V and 3.0 V systems.

Nested design combination chart for u-blox wireless modules



The 4G future
It is clear that the future of mobile communications is LTE. It is the most cost-effective technology for high-speed mobile communications which means its ultimate deployment worldwide is a prime motivation for carriers around the world. This will have a direct affect on M2M and industrial applications that must also shift to 4G technology to remain network compatible, as well as upgrade to higher-bandwidth applications.

Two recent acquisitions by u-blox, UK-based Cognovo with 4G chip technology, and 4M Wireless with 3GPP-compatible LTE protocol stack means the company is well-positioned to introduce 4G module products in 2013. LTE module design is currently in-progress, and will also support the nested design philosophy to remain backwards compatible with 2G and 3G generations.

Focus on quality
u-blox places extraordinary emphasis on delivering high-quality, reliable GPS/GNSS receivers and wireless modules based on stringent standards and industry-recognized certifications. The company's internal quality control process extends to all its manufacturing partners who adhere to strict processes imposed by international standards, such as ISO9001 and ISO/TS16949. All automotive-grade GPS integrated circuits (ICs) are qualified according to AEC-Q100, the automotive standard that includes the requirements of the common JEDEC standard JESD47 for ICs.

u-blox GPS/GNSS single-chip and chipset receivers are manufactured by the following Tier 1 suppliers, chosen for their reputation and market-leading expertise in semiconductor manufacturing:

- Taiwan Semiconductor Manufacturing Corp. (TSMC), Taiwan
- GLOBALFOUNDRIES, Singapore
- Amkor, Philippines

Module manufacturing:
For the u-blox positioning and wireless modules, u-blox has selected Flextronics Corporation as our manufacturing partner in Austria and Brazil. Flextronics is a world leader in electronic manufacturing services (EMS) with large production capacity, global presence and excellent quality.

Wireless technology partner:
u-blox partners with Intel, a global leader in semiconductor chipsets and telecom stacks for cellular communications. The partnership, which includes membership of the Intel Intelligent Systems Alliance, gives u-blox a strong position in wireless technology to support OEM customers with wireless modules and proven reference designs.

Wrapping up…
The above approach to GNSS and wireless module-based designs for M2M applications allows developers to achieve the desired results when developing their next generation products:

- Maximize re-use of existing software and hardware R&D investments
- Avoid expensive PCB layout changes and hardware re-design costs
- Partner with an established, successful vendor
- Keep an innovate edge by taking advantage of the latest positioning and mobile communication standards
- Capitalize on quality by using components that conform to industry-recognized automotive-quality grade programs and quality grades

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).

Published by u-blox AG, November 2012

Any comments relating to the material contained in this document may be submitted to:

u-blox AG
Zuercherstrasse 68
8800 Thalwil
Switzerland
info@u-blox.com