

NO. 3 – MAY 2017



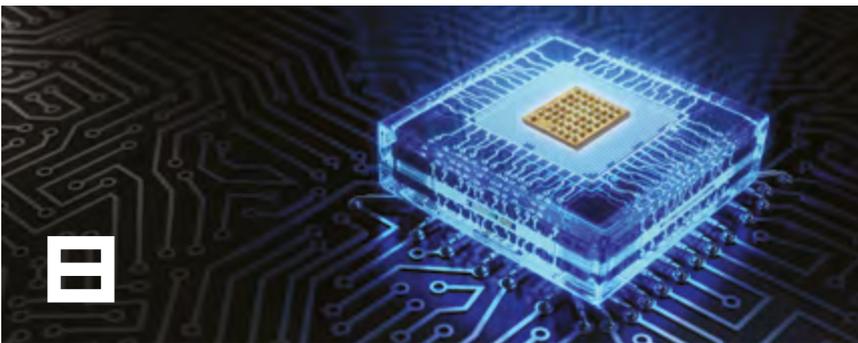
THE U-BLOX TECHNOLOGY MAGAZINE



BORN IN 1997

FROM VISION TO REALITY **P.4**
TWENTY YEARS OF INNOVATION THAT KEEPS
U-BLOX CUSTOMERS IN THE LEAD **P.8**





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IMPRINT

u – The u-blox technology magazine
 Published by: Thomas Seiler
 Chief Editor: Sven Etzold
 Senior Editor: Natacha Seitz
 Concept and Design: Identica AG, identica.ch
 © by u-blox AG 2017
 Circulation: 15'000, bi-annual
 Reader-Service: magazine@u-blox.com

Contributors: Michael Ammann, Christina Bjorkander, Sabrina Bochen, Gitte Jensen, Sara Moss

Printed on: cover 300 g/m² Supersilk offset, polished super white
 content 120 g/m² Supersilk offset, polished super white



U-BLOX AT THE CORE FOR 20 YEARS

Dear Readers,

We are delighted to present to you the third edition of the u-blox magazine. 2017 is a very special year, as u-blox is turning twenty.

Two decades is a long time in the technology world. And we indeed have come a long way from our first GPS receiver chip to the first LTE Cat 1 cellular module with our proprietary LTE modem technology. From a team of three post-graduate students at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland, we have expanded to 900 staff worldwide, and from a small office to facilities in 18 different countries. And the growth continues: we recently sold our 100,000,000th GNSS receiver.

By gradually combining diverse but complementary wireless and positioning technologies, we are striving to support each of our customers in developing the best, most robust and secure solution for their IoT applications.

Agile innovation remains our motto since 1997, and is a key element of our long-term strategy to develop wireless and positioning solutions for state-of-the-art connectivity in the realm of the Internet of Things.

And the best is yet to come!

Yours sincerely,

A blue ink handwritten signature of Thomas Seiler.

Thomas Seiler, CEO



Daniel Ammann,
Andreas Thiel and
Jean-Pierre Wyss

U-BLOX – FROM A VISION TODAY TO THE REALITY OF TOMORROW

The idea was as simple as it was ingenious: combining several electronic circuits with software to create a tiny but fully functioning positioning system.



In 1997 – just two decades ago – this vision of Daniel Ammann, Jean-Pierre Wyss, Andreas Thiel, all post-graduate students at the Swiss Federal Institute of Technology Zurich (ETH), appeared downright audacious. Nevertheless, the three researchers were able to convince their doctoral supervisor, Professor Gerhard Tröster, of the massive potential of their idea and that it would be possible to develop such products with the knowledge they had gained during their studies. Inspired by the pioneering spirit and entrepreneurial courage of his graduates, Professor Tröster went on to support the project from its outset in October 1997.

The first success was not long in coming: u-blox presented the market with the smallest GPS receiver in the form of a module. This milestone in the company's history immediately achieved commercial success - the Swiss toll system for trucks was equipped with the technology provided by u-blox. Then, while the founders continued focusing on developing new products, a global sales organization was established by the young company, enabling it to win clients quickly for its high quality, revolutionary components.

The founders, buoyed by these initial successes, then established a development process which would bring successful products to the market,

by coupling innovation with world-class, reliable product development. The successor to the company's first product also went beyond what was deemed possible at that time. The u-blox TIM module went on to establish itself as the de-facto standard for GPS receivers in industrial applications. The company's production concept facilitated a standard process in the assembly of components and continual product optimization.

The company did not rest on its laurels, but decided that it wanted to work independently of semiconductor providers. So, at the turn of the millennium, u-blox started to develop its own positioning chip. The risk of realizing this idea was enormous, as the semiconductor technology of the time was barely able to deliver the features required to produce a system as complex as a GPS receiver on a chip. u-blox therefore surprised the market by announcing the first GPS chipset of its own in 2002. In the same year, Thomas Seiler joined the company as CEO, a further important cog in the machine that would go on to secure a successful future.

Encouraged by the fact that success was possible in peripheral technical and economic areas, the management team drove the Swiss chip and module company on to further achievements. The u-blox 5 platform was introduced in 2006,

a perfected chipset that was produced in a partner factory as part of a direct supply relationship.

Through its continuous commitment to innovation and product development, u-blox achieved impressive financial results and marked the company's tenth anniversary in 2007 with a successful IPO on the SIX Swiss Stock Exchange.

The urge to make new discoveries and develop new products, and the drive to establish a company with a clear vision, became part of the u-blox DNA. In 2009, the company's management decided to add

tions of wireless communication underlines a further strength of the u-blox mentality today: u-blox employees understand the overall systems of their customers in which the chips and modules are used, without competing with these customers in their area of core expertise. This allows u-blox to provide expert, independent advice.

u-blox now has 26 distribution and development centers worldwide and has 900 employees, around 200 of whom are based at the company's headquarters in Thalwil, Switzerland.

“THE U-BLOX ENTREPRENEURIAL AND PIONEERING SPIRIT IS STILL REFLECTED IN ITS DAY-TO-DAY ACTIVITIES.”

wireless cellular communication technology as a further pillar to its flourishing positioning offering. Thanks to strategic company purchases (more than a dozen firms have since been acquired and integrated), the foundations were laid to provide the knowledge required to develop new products and the requisite resources for their successful distribution. The successful market launches of cellular radio module series, such as LEON, LISA, or SARA, further demonstrated how economic success can be achieved with entrepreneurial courage, clear vision, and technical excellence – combined with a healthy dose of pragmatism and decisiveness.

Following this rapid growth, with u-blox already employing 200 staff in ten locations worldwide in 2010, one may have expected a period of consolidation. However, the u-blox DNA shone through and the company's Executive Board – still including the three original founders from 1997 – together with Thomas Seiler and CFO Roland Jud, took the next step towards a future shaped by wireless communication. In 2014, the company added short range radio data transmission based on Bluetooth® and Wi-Fi technologies to its portfolio. The ability to offer combina-

The u-blox entrepreneurial and pioneering spirit is still reflected in its day-to-day activities. For example, a chipset for data transmission via cellular technologies is at the planning stage which, just like the company's GPS chipset of 15 years ago, will provide the basis for a family of modules.

Despite its growth, there has been no change in the company's research mentality and constant state of inquisitiveness, a fact that is strikingly reflected in its commitment to technologies such as lane-level accuracy positioning, real-time kinematics, high precision GNSS, LPWA, and Bluetooth low energy.

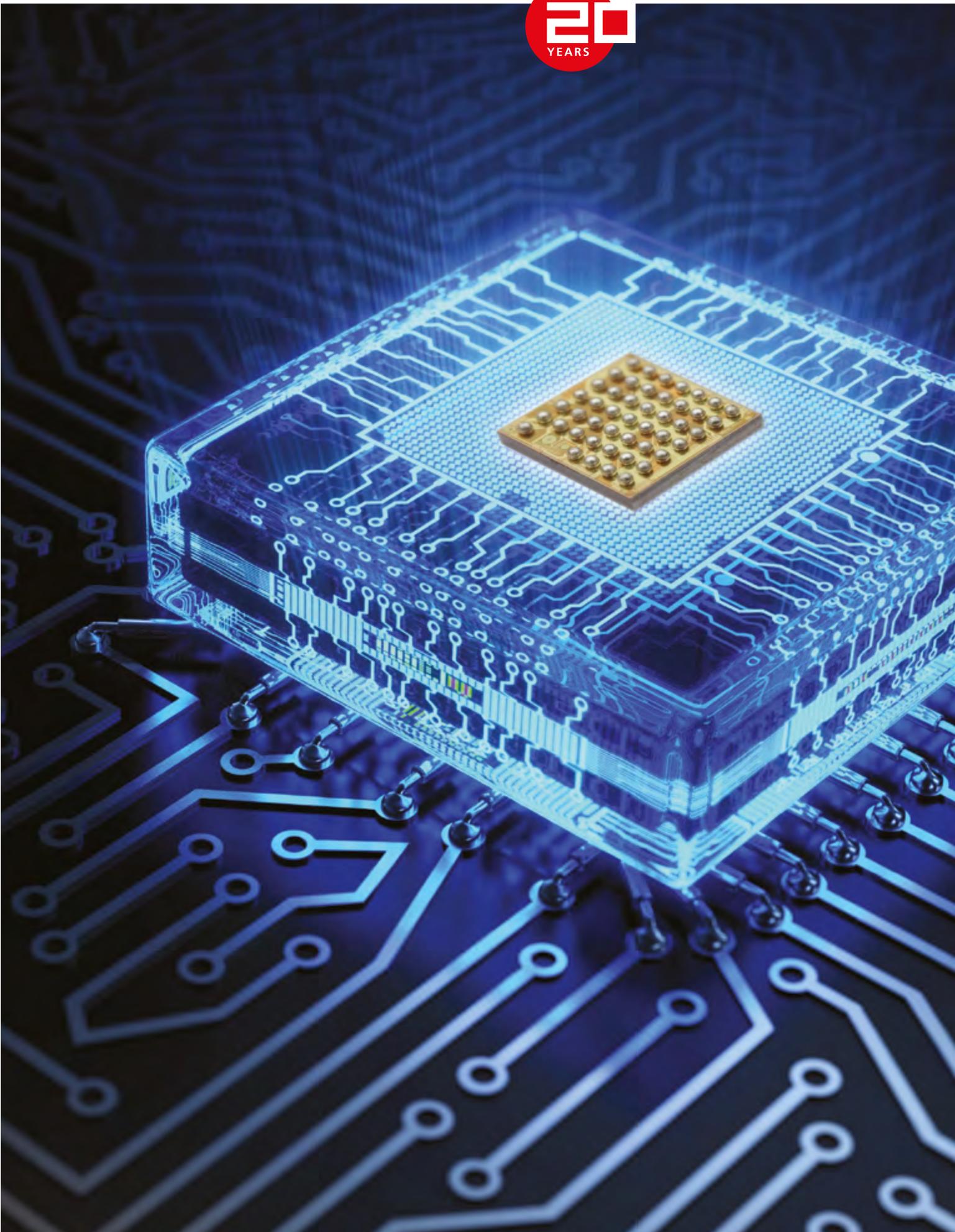
And, as was the case in 1997, the founders Daniel Ammann, Jean-Pierre Wyss and Andreas Thiel still agree: the best is yet to come! ●



2007: u-blox goes public.



1



TWENTY YEARS OF INNOVATION THAT KEEPS U-BLOX CUSTOMERS IN THE LEAD

The world is changing at an accelerating rate and technology underpins much of this change.

Advances in analog and digital electronics are the basis of technology innovations that empower people, and enrich and extend their lives. These advances enable us to build data centers and communications networks capable of handling zettabytes (10^{21}) of data each year. Without such developments, much of what we take for granted today would simply not exist: cellular phones, Wi-Fi, the Internet, Google, social media, Uber, Airbnb, Netflix – the list goes on.

The evolving capabilities of semiconductor integrated circuits – or chips – are at the very heart of technological change. The more transistors you can pack into a given area on a chip, the higher the potential performance, functionality and efficiency of the device, and the lower the cost-per-transistor. Transistors have shrunk dramatically in size as the so-called “process nodes”

– a measure of size – have fallen from around 350 nanometers twenty years ago to 10 nanometers today. The first 7-nanometer devices are expected to find their way to market in 2018.

What does this mean in terms of processing power? Well, in 1997, the year u-blox was born, Intel’s highest performance processor boasted 7.5 million transistors on a silicon area of 192 square millimeters. By 2016, its 14-nanometer process enabled the company to squeeze 7.2 billion transistors onto 456 square millimeters. That’s a density improvement of over 400 times, with a similar boost to processing power.

u-blox has fully exploited this trend, developing innovation after innovation to help its customers create wireless and positioning products that are smaller yet more powerful and more efficient.



Start by knowing where you are

The company's first product – a GPS module – represented a global breakthrough in size and performance. The module – measuring 2.54 x 2.54 x 1.02 cm – enabled customers to ditch the bulky, poorly-performing satellite receivers of the day and create products that were orders of magnitude better in every respect.

The pace of innovation has been accelerating over the last twenty years at u-blox. The company developed its own GPS chips to further boost the performance of its modules and to give customers the choice of purchasing chips or ready-certified modules. Since 1997, the sensitivity of u-blox GPS modules – their ability to receive weak signals – has improved by a factor of 1000, or 30 dB, making positioning infinitely more accurate and more reliable. This improvement in performance enables a host of new services to be delivered to consumers and businesses. In 2008, the year it

produced its 10 millionth GPS receiver, u-blox launched AMY, once again the world's smallest GPS module of its time. In December 2016, u-blox had already sold 100,000,000 GNSS modules and, in January 2017, launched another miniaturized multi-GNSS module, ZOE-M8G.

Recognizing the synergies between wireless and positioning technologies, the company expanded its offering into cellular radio modules and, later, into short range radio modules for Wi-Fi and Bluetooth. Some modules are designed for simple integration of a specific wireless technology, and some enable simultaneous operation of technologies. Industrial and automotive grade options are included.

It's this broad capability with complementary technologies that enables u-blox to address so many applications and to offer customers the flexibility to choose the best and most secure solution. Applications range from advanced driver assistance systems (ADAS) and

autonomous vehicles to infotainment, fleet management to usage-based insurance, and smart buildings and cities to agricultural and environmental monitoring.

For some applications, speed is everything

Applications determine communications network requirements. For video and other data-heavy applications, bandwidth is the critical factor. For example, Intel predicts that each autonomous car will generate 4,000 GB of data every day. Yes, that's right, 4,000 GB per car!

Here, LTE cellular technology performance matches or exceeds that of cable networks, with downlinks running at up to 450 Mbps. Smart antenna arrays, carrier aggregation and coordinated multipoint technologies are just some of the techniques used to optimize network performance and make these data rates possible.

For connections to premises, LTE eliminates the prohibitive

1

Autonomous cars will create a huge amount of data every day: 4,000 GB.

2

Smart cities need complementary technologies that u-blox offers.

3

Billions of devices will be connected to the Internet by 2020.

cost of delivering fiber to every building. But premises are becoming relatively less important according to Cisco. The company predicts that smartphone traffic will exceed PC traffic by 2020, so cellular networks are going to see the largest growth in demand as global Internet traffic grows to 195 times its 2005 level in just 15 years.

u-blox is at the forefront of developments with LTE, Bluetooth & Wi-Fi multiradio modules that deliver the high data rates needed for video transmission and infotainment connectivity. As u-blox also provides GNSS modules, the customer system can receive location-aware communications.

For the Internet of Things, low power is often the priority

At the other end of the bandwidth spectrum, many Internet of Things (IoT) applications, such as remote metering, only need to communicate tiny packets of information, and then only intermittently. According to industry forecasts, notably the analyst Gartner, there will be tens of billions of these devices connected to the Internet by 2020. The exact number is difficult to predict but connected physical object nodes will be found in industrial automation, autonomous vehicles, and consumer electronics. Health and fitness monitors that connect to the internet via smartphones are just one example of the IoT being put to good use for consumers.

Each edge node typically has a sensor that sends data information in response to an environmental change (temperature, humidity, light, pollution, etc.). The signal is processed locally and then communicated to an edge processor, a data center in the cloud or both. Often, the edge nodes will

not be connected to a grid power supply, so power consumption must be minimal to avoid the need for frequent battery changes, or to allow energy harvesting to be used as a power source.

To meet the requirements of these applications, low power short range wireless technologies are evolving. The company developed the world's first ARM® mbed™ enabled IoT gateway for Wi-Fi and Bluetooth, the ODIN-W2, the most powerful Bluetooth low energy module, the NINA-B1, and the industry's most secure Wi-Fi module, the NINA-W1. Together they shape a complete IoT hierarchy for Wi-Fi and Bluetooth sensor connectivity and intelligent IoT gateway functionality.

New cellular standards are also developed to meet the new demands. In June 2016, the standards body 3GPP finalized specifications for Release 13, which standardized both LTE Cat M1 and Cat NB1 (NB-IoT) technology, that had been tested for over a year. Both run over existing 2G, 3G or 4G network infrastructure and represent an economical choice for mobile network operators worldwide. In June 2016, u-blox announced the world's first standards-compliant NB-IoT cellular radio module, the SARA-N2, and, in September 2016, the world's smallest LTE Cat M1 module, the SARA-R4. In addition, u-blox has partnered with Ingenu, the creators of Random Phase Multiple Access (RPMA) technology, which is an alternative air interface specifically developed for communication between devices in the Internet of Things. Applications for the above technologies cover a huge range, including smart cities and buildings, utilities metering, white goods, and asset

tracking. They are also used in agricultural and environmental monitoring.

Staying ahead in a world of change

Geopolitical and technological changes are here to stay. In turn, they are creating changes in the way companies do business. To keep pace, one-time rivals are becoming partners, creating joint ventures to disseminate knowledge and accelerate the pace of innovation. Standards and platforms create the launch pads for new product innovation. Disruptive business models are appearing with increasing frequency. But look around. Almost all of these changes are only possible thanks to our recent ability to communicate data rapidly, reliably, securely, cost-effectively and wirelessly. Guglielmo Marconi's first complete wireless system was patented 120 years ago in 1897. In 1941, the famous Austrian-American screen actress, Hedy Lamarr, with co-inventor George Antheil, patented what is now known as "spread spectrum technology". This communications technique, originally developed for classified military communications, underpinned more efficient bandwidth usage in today's communication technologies.

Neither Marconi nor Lamarr could have imagined the seismic changes that wireless technologies would have on our lives today, or the likely impact during the coming decades.

At just twenty years old, u-blox is a relative newcomer in wireless. However, the company's youth has fueled a string of innovations unmatched by would-be rivals. Innovations that are helping its customers maintain their lead in the race to the future. ●



LARA-R3 – DESIGNED FROM THE GROUND UP FOR IOT

Built with the internally developed UBX-R3 LTE Cat 1 modem platform and integrated GNSS receiver.

In November 2016, u-blox announced its UBX-R3 LTE Cat 1 modem platform, marking the first milestone of a long-term strategy to create modules based on proprietary, internally developed low power wide area (LPWA) modems that are specifically designed for the Internet of Things (IoT) and Machine Type Communications (MTC).

Based on a deep industry understanding of the cellular modules business, u-blox mastered the complexity of the LTE technology socket in less than four years and is now the only supplier in the world with the ability to deliver an internally developed modem and GNSS receiver chipset as well as the containing module.

“The fact that u-blox was able to develop the UBX-R3 platform so quickly shows that we have the team, know-how and technology to shape the future of cellular IoT,” said Andreas Thiel, u-blox Co-Founder and Executive VP, Cellular Products & IC Design. “As a company, we have over 15 years experience developing cellular modems for M2M and IoT applications and this product was created by a highly capable and experienced group of R&D engineers that worked collaboratively from six locations.”

The first module developed based on the UBX-R3 LTE modem platform is LARA-R3121, which is scheduled for initial production in 2017. LARA-R3121 is a single-mode LTE Cat 1 module that complements u-blox’s existing LARA-R2 and TOBY-R2 product series, which are multi-mode LTE Cat 1 modules with 2G and 3G fallback.

ABI Research¹ foresees strong growth in the market for single-mode LTE modules, based on the rapid overall expansion of IoT markets and the need of mobile network operators worldwide to begin replacing legacy 2G and 3G technologies. They are predicting a market size of 41 million single-mode LTE Cat 1 modules by 2021, representing an annual growth rate of 68%. At the same time, high chipset integration levels will lead to the smaller package sizes and more cost-effective solutions required by both application providers and device makers.

Since the UBX-R3 modem platform was specifically designed for IoT customers, u-blox guarantees continued supply and availability for the long product lifecycles typically required by IoT customers, as well as full component control and traceability.

Trusted domain security on the UBX-R3 platform and the LARA-R3121 module provides tightly integrated end-to-end security between modem and module, encompassing features such as secure boot and firmware, secure transport layer and secure physical interfaces.

Unlike LTE modems developed by handset-focused silicon vendors, which are mainly designed for human type communications, u-blox provides a prioritized feature selection for IoT customers that includes signaling optimizations, congestion control and power savings mode. Signaling optimization and congestion control are especially relevant for Machine Type Communications (MTC), which is characterized by automatic data exchange and process-

¹ Source: ABI Research, M2M and IoT Embedded Modules, April 2016

ing between very large numbers of power-constrained devices (or intelligent machines) without human intervention. A typical example is when many devices are deployed in close proximity to each other and need to communicate at the same time – a very real scenario for IoT applications such as utility meters during an outage. Power savings mode further extends the battery optimization features of LTE Cat 1 and is especially relevant for applications that need to run on batteries over long periods of time.

“The UBX-R3 platform, designed for MTC also leverages u-blox’s global leadership position in the development of positioning modules and chips,” adds Drazen Drinic, Product Manager for the LARA-R3121 module. “Based on feedback from our customers, we integrated a GNSS receiver based on the u-blox 8 engine, which saves them the additional integration effort and provides a single support source for modem, GNSS and containing module.”

But UBX-R3 does not just provide standard GNSS positioning. Uniquely, it also includes u-blox CellLocate® indoor positioning, thus delivering hybrid indoors and outdoors positioning and accurate timing reference. GNSS is accurate and global, but does not work indoors, in tunnels or weak signal conditions. This is where u-blox CellLocate® comes in, which works indoors and outdoors as long as there is cellular coverage. CellLocate® provides faster start-up times and increased jamming robustness over stand-alone GNSS solutions.

Drinic further explains: “Hybrid positioning provides multiple and complimentary positioning methods that always provide location based on a single API for both methods, which makes implementation easier and safer.” He adds that “start-up becomes faster, because of rapid signal acquisition and it provides a fallback option to the cellular location, in case the signal is jammed.”

As an LTE Cat 1 module, LARA-R3121 is perfectly suited for use in a great variety of industrial M2M and IoT segments, such as smart meter gateways, connected health solutions for patient monitoring and stay-in-place solutions. It is also ideal for applications requiring low latency, like POS systems, and provides the data rates required for video streaming, such as security systems and video surveillance.

With the development of LARA-R3121 and the UBX-R3 platform, u-blox now has a suite of LTE technology IP in-house, which can be extended to additional LPWA technologies. ●



LEARN MORE:

www.u-blox.com/product/lara-r3121-module



Short range radio technology enables various industrial applications.

ROBUST AND RELIABLE SHORT RANGE RADIO IN A VARIETY OF FLAVORS AND COMBINATIONS

Short range radio has transformed most of our lives in recent years. Nearly all smart phones – as well as a host of other consumer, commercial, automotive and industrial products – now have built-in short range radios. These have given us the freedom to communicate from almost anywhere – our homes, at work, or on the move.

Bluetooth and Wi-Fi radios now come in a range of variants to satisfy the diverse applications in which they are found. Some variants are designed for lowest energy consumption to extend the operating life of battery-powered products. Others run at higher power levels to maximize the range over which they provide reliable communications.

Then there is V2X, a short range radio technology that encompasses vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications for assisted driving and autonomous vehicles. It enables 360° awareness to improve road safety, reduce traffic congestion and deliver a better passenger experience in cars and public transportation.

Through a series of acquisitions (connectBlue, Lesswire and Antcor), followed by further substantial investment in research and development, u-blox has moved to the forefront of developments in short range wireless mod-

ules. The company's executives are active participants in developing new industry standards, while u-blox's rapidly expanding product range addresses the most challenging applications in an ever-smarter world: industrial applications, healthcare, automotive and transport, smart home and buildings, retail, smart cities and more.

u-blox modules are characterized as compact, secure, robust and reliable. What's more, they are exceptionally easy to integrate. Some combine more than one short range wireless technology in a single module – the EL-LA-W1 multiradio modules for Bluetooth and Wi-Fi, for example. And some modules are ideal for specific sensor use cases, such as the NINA-B1 Bluetooth low energy modules and the NINA-W1 Wi-Fi modules, while are at the heart of more complex systems, such as the IoT gateway module ODIN-W2.

Whenever there is a need for wireless transmission of data – whether it is tiny data packets from utility meters (NINA series) or streaming of high bandwidth, high definition video in cars (JODY-W1) – there is a u-blox short range radio module that will do the job, and do it reliably. ●

LEARN MORE:

www.u-blox.com/short-range-radio-modules

THE EVOLVING SKILLS OF AN EMERGING MARKET LEADER AROUND THE GLOBE

To understand the evolution of skills within u-blox, there is no better place to start than the company's vision. u-blox aspires to be the nervous system at the core of the Internet of Things ecosystem and to make vision reality. We're focused on precision location technologies, wireless communications (voice, video, text and data) and accelerating the pace of innovation to keep our customers ahead of their competitors.

The past

In 1997, u-blox started as a manufacturer of highly reliable positioning modules. As with any start-up venture, the company had just a few customers at first. Its priority was to begin building a reputation as a high quality, reliable supplier of products that performed better than those of established competitors.

Automated manufacturing and testing, combined with developing an efficient and effective supply chain were paramount as the company sought to combine third-par-

ty semiconductors and software to create its first products. u-blox designed these products in close cooperation with its customers, ensuring that the products met their requirements precisely and cost-effectively.

At this early stage, u-blox needed to match design innovation to manufacturing and supply chain expertise, and to carefully handle the complexities of IP licensing and management. To make the company scalable, it then developed standard products that appealed to the wider market.

The global nature of GNSS positioning and communications markets dictated the next stage in u-blox's development. Its customers needed to be able to sell their products globally, so u-blox modules had to be usable in all major markets. This required a deep understanding of the various technical standards in these markets. At the same time, the company decided to ensure that local support was available wherever its customers needed it. To meet this requirement, u-blox established a carefully selected network of direct sales and distributors in Europe, North America and finally

in Asia. The company then proceeded to build up sales, marketing and distribution management skills internally.

Innovation in itself is not enough to guarantee success; products need to be differentiated in a way that brings tangible benefits to customers. To achieve this in its positioning products, u-blox decided to develop its own integrated circuit, rather than rely on standard parts from other vendors. In doing so, it was able to extend customer choice – they could now buy chips or modules – and improve the performance of its modules. In fact, the company achieved, and continues to achieve, best-in-class sensitivity, highest efficiency and smallest size. This is a direct result of taking control of the silicon at the heart of each module. Chip design, packaging and test expertise

were added to the growing list of skills the company had to develop and nurture.

Entry into the automotive market added further challenges. u-blox needed to understand the specific demands of this sector with respect to performance and, above all, quality. Initial partnerships with third-party test and qualification partners were soon complemented with a growing in-house resource of quality managers and test engineers, and rooms full of test equipment.

At the same time, u-blox began to look at the wider geographic opportunities to reduce costs without compromising quality. It introduced new processes and programs and began working in partnership with a global leader in electronics manufacturing

services, Flextronics, for some of its manufacturing.

Globalization continued quickly. In the lead-up to its successful Initial Public Offering (IPO) in 2007, u-blox recruited financial and legal expertise. A series of acquisitions followed, propelling the company to open specialist product centers. These drove innovation in cellular and short range wireless communications products. In many instances they complement the GNSS technologies upon which the company was founded.

The scale and pace of growth placed new demands on the company, and human resources specialists came aboard to manage recruitment and look after the welfare of staff.



From Zurich to the world.



Nearly one-fifth of revenues are invested in research and development to maintain a breathtaking pace of innovation.

The present

The phenomenon of the Internet of Things (IoT) is creating challenges and opportunities for u-blox. The world is being transformed by the power of the Internet. The delivery of location-based services and the exponential growth in Internet data traffic (video, voice and text included) are creating an insatiable demand for reliable, often location-aware, communications services and networks. High definition video is becoming the norm for visual entertainment over mobile networks and in the home. But even the tiny amount of data transmitted and received by a remote utility meter becomes an interesting communications challenge when there are millions of such meters. And these meters need to operate from minimal energy sources.

Understanding and responding to these challenges demands outstanding marketing and business management skills. Such skills complement those of technology innovators and manufacturing specialists. Deciding what constitutes the best products for a rapidly evolving global market with hundreds of different standards is critical to success.

Today, u-blox has 900 employees worldwide. Half of its revenue comes from Asia, 25% from North America and the other 25% from its home market in Europe. The company is a truly global business with 5,700 customers worldwide, 15 sales offices and a presence, either directly or through distribution, in 66 countries. Nearly one-fifth of revenues are invested in research and development to maintain a breathtaking pace of innovation.

The company's skilled workforce, originally founded on engineering innovation and manufacturing, has broadened into every discipline required by a fast-growing technology leader with customers throughout the world.

The one thing that hasn't changed is u-blox's focus on these customers: understanding their needs, responding to those requirements, and going the extra distance to exceed their expectations.

The future

The technologies grabbing the news headlines in the last few months reflect exciting changes to come, some of which are already with us. Artificial intelligence, sometimes referred to as machine learning, represents a quantum leap in computer processing power. Assisted driving is already with us in high-end transportation. Autonomous vehicles are being tested in cities around the world.

Cities, which will account for 62% of the world population by 2028, are becoming smarter: energy consumption is better controlled, pollution and waste are minimized, traffic is better managed, and the quality of lives is being transformed. Everything from connected home care to on-demand entertainment contributes to these trends.

Perhaps less widely reported, but equally important, industry is becoming more productive through connected technologies. Machine monitoring and control is making factories more efficient, farms more productive, and transportation more streamlined.



270_m
connected cars
by 2021



400_m
connected home security
and automation systems
by 2021



130_m
health device
shipments in 2021



70_m
drone shipments
in 2021



2.7_m
pets being tracked
by 2021



85_m
connected street light
shipments by 2021



660_m
smart meters
by 2021



73_m
connected Point
of Sale devices by 2021

Sources: ABI, Tractica, Bosch, Investor

Amazon has had its first trial customer deliveries by drone – something unimaginable just a few years ago. Like so many of the other applications described, the success of this service is dependent upon highly accurate positioning and robust communications technologies, both areas of expertise in which u-blox excels.

To continue to excel in tomorrow's world, u-blox will once again invest in its own optimized semiconductor technologies. It will recruit specialists in safety and security to satisfy growing concerns about these aspects of a connected world, and it will broaden its communications offering to encompass emerging 5G ultra-high

bandwidth networks on the one hand, and energy-constrained, low data rate applications on the other.

The company will integrate technologies to create multi-product solutions that enable customers to focus on their own product differentiation, knowing that wireless and positioning communications can be implemented quickly and easily. Last, but not least, u-blox will partner with other ecosystem leaders to build platforms that make the connected world a smarter and better place for its citizens. ●

REACHING FOR THE STARS

This year, u-blox celebrates its 20th anniversary. Three post-graduate students invented the world's smallest GPS module as part of their research at the Swiss Federal Institute of Technology (ETH) of Zurich and within a matter of months they teamed up with their professor and a well-wishing mentor and investor to found u-blox. Over the last twenty years u-blox has grown from a handful of employees to an international public company with 900 employees.



THE BRAINS BEHIND U-BLOX

It is 1997. Daniel Ammann, Andreas Thiel and Jean-Pierre Wyss are post-graduate students involved in an electrical engineering project at the Swiss Federal Institute of Technology in Zurich. In response to interest from the industry, they join forces with their professor, Gerhard Tröster, and entrepreneur and private investor, Hans-Ulrich Müller, to form a company.

You have been working together for over twenty years. Can you tell us how you first met?

JEAN-PIERRE WYSS (JW) – Dani and I met over 30 years ago and both studied Electrical Engineering at the Swiss Federal Institute of Technology (ETH).

ANDREAS THIEL (AT) – I'd just come down from Aachen University in Germany and joined Dani and Jean-Pierre just after they'd finished their degrees. We were part of a new research team under a new professor at the ETH.

DANIEL AMMANN (DA) – Back then we were focusing on research into electronics packaging – a long way from product development – and had no intention of founding a company.

back then was to turn a PhD thesis into a real product and ramp up production to about 100,000 units annually – which we now do in about eight hours!

DA – On a more romantic note, back in those early days we were more like a family. We'd all meet up on Friday nights for drinks and pizza. We still do it now in Thalwil and elsewhere, and it's a great way to improve team spirit.

AT – Yes, it was cool. We rented a small flat in Zurich that gave us everything we needed to run the business, but after a year, it was clear we needed something bigger, and that's when we moved to Thalwil. Since then we have expanded continuously, here and abroad.

AT – One of the key turning points was the decision to change our strategy by giving up the idea of making lots of little blocks and by focusing on our own chipsets. It gave our customers added value and made us really successful.

JW – Yes, the GPS technology was vital. And by 2004, we started to show profit, which made it easier to find other investors.

DA – I think if we're honest with ourselves, one of the most influential factors in our success was luck. We didn't consciously choose to go down the GPS route. There was simply a demand for it: we had the technology and we were able to package it attractively. And the financial constraints likewise forced us to focus on GPS. Luck was also a major factor in the IPO: we timed it – unwittingly – just a few months

AT U-BLOX INNOVATION IS "A SYNONYM FOR CREATIVITY" ... AND OFFERING CUSTOMERS AND PARTNERS "A SPECIAL LEVEL OF SERVICE"

So how did u-blox happen?

JW – We'd developed the world's smallest GPS receiver as part of a study. One day, Andy was talking to our supervisor, Gerhard Tröster, about the interest in the product from the industry. Then Professor Tröster made the suggestion that changed our lives: "Why don't you start up your own company?" he asked. So we gave up our doctoral studies and founded u-blox in 1997.

Could you tell us a little more about the early days at u-blox?

JW – At the beginning, we were five or six working on the project, and we still had an office at the ETH. The main challenge

What kind of challenges did you face when you started up?

AT – Initially, it seemed pretty easy because we had clients who were interested in our products. The real challenge came when we were forced to recognize that technology wasn't enough and that we needed more than one big customer if we were going to survive. It meant building up a worldwide sales organization to market our products and providing the support needed to keep our customers happy. That all involved extra financing.

Were there any specific milestones in the u-blox story that made the company such a success?

before the world financial crisis in 2008. No one had foreseen that, so the timing was brilliant. We managed to get a good price before share prices dropped drastically. We've done a lot of things well, but the determining factor was being in the right place at the right time.

AT – It was certainly lucky for us to get good sales people together from the start. We found people who were able to conjure up a sales organization out of nothing. Overall, I think we've done a good job of handling growth and getting the right people together. We've gone from 70 to 80 employees at the time of the IPO to 900 today. We appreciate talented people and I think it's fair to say that people like working with us.

How would you say u-blox has helped you with your personal development?

JW – When we started out, we were all engineers. Since then, we've become entrepreneurs and businessmen and learned how to make big decisions. Speaking personally, I learned an incredible amount from my time as CFO, working with the banks and potential investors, and as Head of Production and Logistics as a fa-bless company. The latter involved setting up reliable supply chains from beginning to end.

DA – Another major issue was learning how to delegate. As an engineer, you think you know best and want to be involved in the development process. For me personally, learning to let go of that

it's interesting working with them all. Even here at our head office in Thalwil, we have around 27 different nationalities and cultures. So apart from all the technological aspects, I think it's the people aspect of the business that's so exciting.

Where do you see yourself and u-blox in the next 20 years?

DA – Speaking for myself, I'll be around as long as the job and the fun of running a business continues to stimulate me, and as long as our customers continue to make attractive products with our technology.

JW – The same goes for me. As long as there are new challenges – as in the past twenty years – I'll be happy to carry on.

tion route. It's all we want to do, and it's borne out by the fact that we invest so much in research and development. But we're also involved in a process of constant reinvention internally.

AT – For me, innovation is a synonym for creativity. We want to make things better, and it's what drives us forward as a company. Being successful in this business isn't only about prices. Our customers need to know they're getting something better and more creative.

JW – Yes, I think it's important to recognize that we aren't just innovative on the product side, but also offer a special level of service, how we deal with customers and other partners. It's important for us to be innovative across the board. ●

“EVEN AT OUR HEAD OFFICE..., WE HAVE AROUND 27 DIFFERENT NATIONALITIES... SO APART FROM ALL THE TECHNOLOGICAL ASPECTS, I THINK IT'S THE PEOPLE ASPECT OF THE BUSINESS THAT'S SO EXCITING.”

and entrusting the work to other people who are better than me at what they do was a huge step. I think it was a major realization for all three of us that you can't always rely on mathematics or physics to make people and markets work the way you want them to.

AT – For me, it was learning how to liaise with so many people working in so many different countries. My own personal ecosystem ranges from Lahore in Pakistan to San Diego, California. These are all people with different mentalities, and

Growth brings all kinds of new questions with it, and it can be quite tough retaining the flexibility we've always enjoyed.

AT – It's all about new challenges. So while we're working with a great team, making products our customers want, and growing personally in the process, I see no reason for stopping.

What does innovation mean to you?

DA – Survival. The only viable strategy for a company like ours is to take the innova-



PROF. DR. GERHARD TRÖSTER

After earning a doctorate in electrical engineering at Darmstadt Technical University, Germany, and being involved with industry research projects centered on components for ISDN and digital mobile phones, Gerhard Tröster joined the Swiss Federal Institute of Technology (ETH) in Zurich as head of the Electronics Laboratory in 1993. At that time, mobile phones were bulky, heavy and looked more like bricks. Tröster's aim was to miniaturize the electronic components that went into them. To assist him, he brought in three outstanding engineers: Daniel Ammann, Jean-Pierre Wyss and Andreas Thiel.

After pursuing your personal vision of miniaturizing electronic components for several years, you became a co-founder of u-blox in 1997. Can you tell us how and why it all happened?

GERHARD TRÖSTER (GT) – As you say, our initial aim was to reduce the size of the electronics for our systems. At some point, someone on the team had the inspired idea of building a GPS system as a way of demonstrating miniaturization in practice. That, it turned out, was the starting point for everything that followed. When we first embarked on our journey, it felt like we were entering uncharted territory. We had no role models to base our-

al parts: as senior mentor, supervisor and CEO, and even Chairman of the Board for two years until the end of 2000. After my two-year term was up, I had to set about finding a successor. Fortunately, I found an eminently qualified individual and former Mercedes-Benz CEO, Edzard Reuter, who was delighted at the prospect of coming on board with a start-up company.

Who were u-blox's first customers?

GT – We had a few small customers back at the beginning, and some of them were quite unusual. For instance, I had a colleague at the University of Zurich, a professor of anatomy, who took a special

ing the company's success to date.

Speaking of success, can you perhaps tell us what is u-blox's recipe for success?

GT – Apart from the people factor, one of our prime advantages was being able to supply our customers with the right technology at the right time, cutting their time to market and giving them a competitive edge over their rivals. We weren't afraid to make crucial, often difficult, decisions, such as giving ourselves another leg to stand on by extending our products from GPS to wireless communication. And even when things went off course, we believed

“ ... THE FACT THAT SO MANY VEHICLES ARE STILL DRIVING AROUND USING OUR GPS SYSTEM 20 YEARS LATER IS VERY PLEASING ”

selves on, and spin-offs in the technology field were virtually unknown. So, we built our GPS system, and at the time it was the smallest of its kind worldwide. It generated an enormous amount of interest in the press and the media, and we were soon asking ourselves: Where do we go from here? Anyway, my three assistants came into my office one day in 1997, sat down and asked me how I felt about founding a company to commercialize the GPS systems we were developing. I thought about it for a second and said, “OK, let's do it.” And that's how it all started.

Could you tell us a little about your role at u-blox back in those early days?

GT – In the beginning, I was playing multiple roles. I was the supervisor of my three students and also their partner. I was also de facto the company's official contact person with the ETH and handled all the negotiations with the ETH. My background in the industry had also given me the know-how needed to talk to potential investors. So, there I was, playing sever-

interest in homing pigeons. He asked us to come up with a GPS system that would help him understand how pigeons could find their way back home from take-off points thousands of kilometers away. But our first big client was FELA, the company responsible for putting the Swiss national road pricing system into action. We won the order against a remarkable amount of competition, which was gratifying. And the fact that so many vehicles are still driving around using our GPS system twenty years later is also very pleasing.

What has it been like guiding a company over a period of 20 years, through both good and difficult times?

GT – One thing we've all learned to appreciate is the value of finding the right people. The fact that we're all still involved, twenty years on, says a lot about our ability to jell. Of course, over time we've managed to get other outstanding personalities on board, people like Hans-Ulrich Müller, Edzard Reuter and Thomas Seiler. They've all played key roles in orchestrat-

that the best course of action was to remain solid, keep on doing what we were best at, and stick by our guns.

How do you see things developing in the future?

GT – Before I comment on that, I should point out that we were naive, or at least overly optimistic, when we started out. Our business plans were out of touch with the realities of growing a business in a hotly contested market. We misguidedly believed we'd get to the IPO stage in three or four years. That's all changed now. On the basis of experience in the first couple of years, we have a much clearer idea as to how to develop the business and we've made some very sensible decisions: to go down the “fables” path, to make modules the heart of our business and to invest in wireless and short range technology. I'm confident that the course we've taken over the years will enable us to meet the challenges that lie ahead and to go from strength to strength. ●

HANS-ULRICH MÜLLER

An electronics engineer by profession, Hans-Ulrich Müller had a successful career in the Swiss semiconductor industry and as venture partner at Partners Group before joining u-blox.

One day in 1998, Professor Gerhard Tröster called him up to tell him about a small group of engineers who wanted to form their own company and to ask whether he would be interested in taking a seat on the board. He didn't hesitate for a second.



You came on board at an early stage in u-blox's development. What motivated you to invest in the company?

Hans-Ulrich Müller (H-UM) – In 1997, after twenty years in the electronics industry, I decided to set up my own consulting firm. I received a call from professor Gerhard Tröster in 1998 and met him and the founders who were then interested in setting up a company. They made a very professional and positive impression. The idea of miniaturizing high-tech GPS components appealed to me and fitted in perfectly with my field of interest. As a sign

to supply 60,000 GPS units for the Swiss road pricing system. After that, Benefon – a Finnish company that needed a GPS unit for its mobile phones – contracted us to produce 50,000 units a month. We found an additional investor, set up production and started delivering in the second quarter of 2001. By mid-2001, Benefon was bankrupt and left us sitting on 140,000 units with a 9-million-euro debt to our suppliers. As a result, the new investor pulled out, and the banks insisted on repayment. Then came 9/11, which paralyzed business until the end of 2001. At that point, Partners Group insisted that I

Dr. Fritz Fahrni, who defined a new strategy with a much broader product portfolio, and we went into the wireless business because most of our customers needed these products.

Where do you see u-blox in the next 20 years?

H-UM – We're extremely well positioned for the Internet of Things, which is a booming market. It requires lots of high-end products, but also simple, reliable, low-cost components suitable for many fields, such as positioning, Bluetooth and

U-BLOX STANDS FOR “...STATE-OF-THE-ART TECHNOLOGY IN THE GPS AND WIRELESS COMMUNICATION FIELDS”

of my commitment, I put up 50,000 Swiss francs of my own.

What was your role during the start-up phase?

H-UM – During the first year, I acted as a coach and mentor. We considered the pros and cons of the venture, drew up a new business plan and worked out how much money u-blox needed. I also provided contacts with the industry and potential investors.

What has it been like working so closely with a group of entrepreneurs?

Things have always gone smoothly. The only problem appeared if they got too technical. Then I had to ask the founders to explain things in terms potential investors and I could understand (*laughs*).

Can you tell us more about your role with u-blox?

H-UM – The first two years were amazing. We won a 12 million franc contract

acted as ad-interim CEO until we could find a permanent one. My first job was to get an extension with our creditors and the suppliers.

In this difficult period, we could win Thomas Seiler as an experienced CEO, willing to jump in and also to invest his own money. He was thinking way ahead and making decisions aligned with goals, which is also one of the reasons why u-blox is successful today.

u-blox went public in 2007. What was your involvement in the IPO?

H-UM – We developed our next-generation GPS components, branched out into Asia and, by 2004, showed our first profit. After 2004 we had much higher margins and started considering an IPO. In mid-2007, we figured the time was right. Partners Group had about 45% ownership of the company, so we began talking to banks, establishing contacts and setting pricing. The IPO went ahead successfully in 2007. I then found a new Chairman in

Wi-Fi. I think u-blox will also play a central role in the automotive sector, an area where we have a lot of expertise. And I see u-blox playing a role model: I think it's excellent how we find talented employees all over the world and integrate them into our constellation. ●



u-blox shared its positioning technology with do-it-yourself drone makers and 3DR already 10 years ago.

CREATING THE CONNECTED WORLD OF TOMORROW

Just a few years ago, innovation was solely the domain of engineers with access to expensive hardware, tools and methodologies. Today, electronics vendors are putting accessible, affordable technologies in the hands of new groups of inventors – the makers – and the results are transforming the world.

Examine any maker project today – especially one targeting an Internet of Things (IoT) application. The chances are it hinges on two crucial elements: wireless connectivity and accessible, affordable, hardware. These are the twin engines of electronics design today, a symbiosis that is propelling IoT development to new frontiers.

Consider some popular Hackster.io projects:

- The ThingSpeak Weather Station
- My Kid's Driving Habits project
- A cellular connected power outlet

In the case of the weather station, a u-blox-powered Particle Electron module, coupled with SparkFun Weather Shield hardware, allows users to quickly assemble a weather station. It can be deployed anywhere there's a 2G/3G network. Data storage and programming are cloud based. The device allows a user to monitor home temperature while away, measure a car's humidity during long drives, or analyze weather

data when connected to the Internet. Not long ago, this type of system cost thousands of dollars and its use was restricted to weather professionals who could afford it. Today, anyone can build and use the system.

The driving-habits project plays directly to parental concerns about young driver safety. The concept is to create a device that a parent can attach to a vehicle to understand a child's driving patterns when the parent is not in the car. Do they brake too abruptly or hit the gas pedal too aggressively? Do they follow the car ahead too closely? Some auto-insurance companies offer a discount if customers install a similar device that plugs into a car's OBD (On-board diagnostics) port to monitor driving, but the vehicle owner doesn't own the data. The driving-habits system includes a Particle Electron (u-blox SARA-U series modem), a Particle asset tracker shield, a Sharp distance measurement sensor, external GPS antenna, external cellular antenna and battery.

In the cellular-connected power outlet project, the idea is to have a device the user can control via a cell phone to trigger lights, toasters, a TV, or a Wi-Fi router. In fact, it can control anything that's normally plugged into a mains power socket. Inside the device is a Hologram Dash, a micro-controller with a built-in u-blox cellular modem.

The winner of the AT&T Hackathon in 2016 is another great example of how technology is now the bedrock of innovation. Called the “Thank You” app, it’s a service that encourages courteous driving by rewarding drivers for their good driving behavior. This might be giving space for a car exiting a driveway or merging into another lane. A driver can initiate a “Thank You” to the driver of the other vehicle using a simple voice command or a hand gesture. This event triggers all nearby vehicles to upload their recent GPS data to the cloud after receiving a Bluetooth beacon signal. The AT&T Flow service coordinates the reception of the data. It is then sent to an IBM BlueMix data analysis service, which processes data in the cloud, to determine which vehicle deserves the thanks. This pushes a notification to the relevant driver’s phone. The thanked driver can also view a sponsored “Thank You” message and receive AT&T data rewards for their courteous behavior.

The common denominator in these projects is an affordable, compact wireless module (the Particle Electron or the Hologram Dash). This type of module-centric electronics innovation is spurring invention in non-traditional groups removed from engineering. It also serves to help

innovators and entrepreneurs effectively “prototype” whole new markets while containing risk.

Origins of Innovation

Here u-blox finds itself right in the middle, partly by accident and partly by design. u-blox started sharing its positioning technology with do-it-yourself drone makers such as Drotek and 3DR more or less by accident. That was about 10 years ago, several years before drone making became a high-volume industry with the emergence of companies such as Parrot and DJI.

Three years ago, u-blox started working with the maker community, first in collaboration with ARM®, then more individually, supporting – with its cellular/short-range technologies – various Kickstarter projects and hackathons in the United States, Sweden and Switzerland. This is where the concept of “prototyping” market segments comes in: products are being sold, but these are small-scale projects that allow backers to gauge market interest. The products might turn into a larger industry very quickly. Drones are a good example. Or they may not, but the development methodology is low risk.

u-blox decided to dive into the maker community to help put the power of modular design into the hands of consumers and inventors. This gave the makers the opportunity to learn about the u-blox brand and to contribute to the connected world of the future with their inventions.

Projects like the Electron – a tiny Arduino-like development kit for creating cellular-connected electronics projects and products – make it easy for that community to create IoT devices and applications. They are easy to use and put powerful development potential in the hands of a much broader audience – including people who have no engineering background.

Innovation is exploding because technologies and development tools are far simpler to use and more accessible than even five years ago, and they are available to diverse new groups of inventors with different perspectives, needs and ideas. These ideas include DIY weather stations, driving monitors, wall-mounted IoT modems, and rewarding “Thank You” messages for courteous drivers.

And it’s just the start. ●

1

Parents can monitor a child’s driving patterns when not in the car.

2

The Electron is a tiny development kit for creating cellular-connected electronics projects and products.

ADDRESSING THE NEEDS OF TODAY'S WORLD

Drivers

With some 16 billion active IoT devices predicted by 2021¹, society stands on the threshold of a momentous change in the ways we do business and organize our lives. However, this market will only develop its full potential if the devices flooding the market are perceived, by both manufacturers and consumers, to generate real, tangible benefits at the right functionality, quality and price.

The move towards easily integrated IoT devices not only takes much of the hard work and unpredictability out of manufacturers' operations but can also help them streamline their service offering and find new ways of engaging with their customers. For manufacturers, the communication revolution means they no longer need to waste valuable time or resources trying to locate devices and also gives them access to copious data, which provides invaluable input on their sales and marketing efforts, improving products and after-sales support. For consumers, who are used to having instantaneous data about everything in their lives, from their cars and washing machines to their CCTV security systems, two factors are essential: cost and convenience.

Recent achievements

u-blox has established its position as a leading supplier of positioning chips and modules on the strength of its unmatched research, development and technological expertise. But there is another element that has played a central role in our success: the company's ability to match its product offering closely to the needs of specific markets. The NEO-M8U, for example, the industry's first untethered dead reckoning (UDR) module, addresses the needs of the automotive industry, both the first mount and after-market sectors, for a device that combines simple installation with leading positioning capability. Or, SARA-N2, a low-cost, low-power consumption module designed for a vast range of Narrowband IoT applications where whole-life cost is a critical factor. At the short range end of the market, the Bluetooth-capable NINA-B1 has the ability to reliably track multiple mobile devices and equipment moving around in relatively confined spaces, such as factories or hospitals. As a result, tools and other equipment do not go missing and can be located instantaneously.

Future focus

At u-blox, we will be focusing on three prime areas as part of our drive to keep existing customers satisfied, to acquire new ones, and to secure a larger share of the market.

- Security
To help our customers to create secure products we are adopting a set of fundamental design principles across our product range. The security features will allow our components to ensure customers' product and data integrity, and to resist malicious attacks from cyber hackers.
- Autonomous car
Autonomous vehicles require high-precision positioning as a critical component of multi-sensor systems. This calls for high-integrity data and continuously safe operation (ISO 26262). Autonomous vehicles will also communicate with each other and roadside infrastructure (V2X communication). In both these areas, u-blox is developing core technologies to meet market needs well into the future.
- Open platforms
Many u-blox products are designed to enable customers to host their applications within the module, saving cost and space, both which are critical to IoT success. To do this, u-blox provides the tools and software environments that make the process efficient. For "big" applications, customers can incorporate their specific software into a Linux OS. "Small" applications can be developed and directly loaded onto the module, for example through the ARM® mbed™ Device Platform. ●

LEARN MORE:

www.u-blox.com/u-blox-products

¹ Source: Ericsson Mobility Report 2016

POSITIONING



NEO-M8P

Bringing centimeter-level positioning accuracy to the mass market, the NEO-M8P is the smallest GNSS RTK module available. Unlike previous enhanced positioning technology solutions, the module combines a compact design, reduced weight and high precision with reduced power consumption and low cost, and is suitable for a vast range of applications, from UAVs through to robotic guidance systems.



NEO-M8U

The industry's first untethered 3D dead reckoning (UDR) module combines multi-GNSS with an onboard 3D gyro/accelerometer and provides accurate positioning even in tough environments such as urban canyons, tunnels or parking garages with weak GNSS signals. It needs no connection to the vehicle other than power, leading to one of its key advantages: ease of product development and installation.

CELLULAR



SARA-N2

The world's first Narrowband IoT (NB-IoT) module delivers easy, affordable low power cellular connectivity for low-data-rate IoT applications. Designed for smart buildings and cities, utilities metering, white goods, asset tracking, agricultural and environmental monitoring among others, the module can operate for 10 to 20 years with a single-cell primary battery.



LARA-R3

The internally developed UBX-R3 chip lies at the heart of the LARA-R3 LTE Cat 1 module, underscoring u-blox's commitment to deliver end-to-end low-power wide-area (LPWA) technology that is specifically designed for IoT and M2M applications. Developed in response to customer feedback, it complements u-blox's existing LTE Cat 1 portfolio by integrating an on-board u-blox 8 GNSS receiver to provide positioning information.

SHORT RANGE



NINA-B1

The NINA-B1 series is the most advanced Bluetooth low energy 5 ready modules on the market ideal for a vast range of IoT applications. Certified to global radio type approvals, it comprises an antenna, radio transceiver and Cortex M4 microcontroller. Supporting ARM® mbed™ OS 5 and Nordic SDK, the module and its evaluation kit are open for designers who wish to embed their own application on top of the Bluetooth low energy stack.



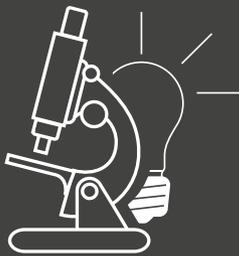
ODIN-W2

The ODIN-W2 is a compact and powerful stand-alone multiradio module, designed for Internet-of-Things gateway applications. The module features dual-mode Bluetooth, dual-band Wi-Fi and an open CPU to run customer applications. In fact, the ODIN W2 is the only ARM® mbed™ OS 5 enabled Wi-Fi board on the market. The module is complete with embedded Bluetooth stack, Wi-Fi driver, IP stack, and an application for wireless data transfer, all configurable using AT-commands.

HOW WE CREATE VALUE

Our values make us unique. They range from agile innovation to seamless quality for fables manufacturing, all on a global level. And tying it all together is our dedication to working with our customers as with partners.

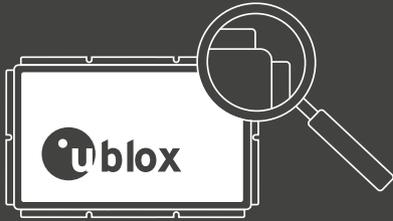
INNOVATION



Comprehensive product lines and IP

Our success depends on our ability to deliver continuous innovation to our customers. We therefore direct our research and development efforts to the development of ever smaller, higher performance products. We have also amassed an extensive intellectual property portfolio.

QUALITY



Focus on quality

From product concept to final shipment, our quality systems ensure that every component we deliver is of the highest quality and reliability while supporting environmental sustainability.

RELATIONS



Close customer relationships

We are a close and reliable partner to our customers, fully supporting them from prototype to final production. Providing the highest levels of local technical and customer support is essential for our customers to achieve fast time-to-market.

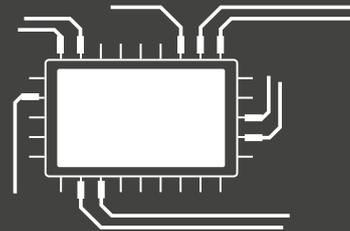
GLOBAL



Global presence

With physical presence in all the world's main markets, we stay close to our customers to make sure our innovation cycles are in synch and to ensure our customers get their products to market fast.

FABLESS



Fabless business model

Working with leading semiconductor fabrication and module assembly companies allows us to focus our resources on research and development in order to deliver the breakthrough technologies that our customers need to stay ahead of their competitors.

KEEPING ON TRACK WITH U-BLOX

Ready-Set-Go! Keeping fit at u-blox

Employees make a company, and at u-blox the company is active and full of energy. On any given day, a few employees will arrive by bicycle, and others will go for a run or play tennis at lunchtime. Beyond the everyday activities of individuals, u-blox has chosen to sponsor employee participation in a number of races, one which has special significance to us.

Originating as an ETH (Swiss Federal Institute of Technology) spinoff company, it is fitting that u-blox participates in the annual Sola Stafetta – a 116 km, 14-part relay race that takes place each year in May in the greater Zurich area. In addition to entering teams in the event since 2011, u-blox first contributed their GPS positioning technology in 2006 for tracking on the route.

u-blox has sponsored employees in other running and cycling events, as well. In the Schweizer Firmen-Triathlon, Swiss companies strive to be among the fittest in the land. Companies enter as many trios of swimmer, cyclist, and runner as they can. In 2016 for the first time, u-blox also entered three relay teams in the Rapperswil Half Marathon. And for a few years now, u-blox has sponsored employee participation in the

Zürcher Silvesterlauf, a 10 km running race that takes place in the center of Zürich in December.

Since 2012 u-blox has participated in the Zurich Bike-to-Work challenge, in which teams of four commit to commute to work by bicycle as much as possible during the months of May or June. Bike-to-work is a great event, because in addition to promoting fitness, it encourages people to use their own “green” power to travel to work.

Sporting events are not limited to the surroundings of the company headquarters in the Zurich area. u-blox has sponsored a running event in the UK, Ringsjön Runt bicycle event in Malmö, Sweden, and other cycling events.

Whether u-blox employees train daily at lunchtime or participate in a sponsored event, the sport culture at u-blox plays an important role in unifying people. It is easy to find others to work out with, and it brings together people from different departments, who then learn more about other aspects of the company as a result. Many of the runners, cyclists, and swimmers swear by their activity – it clears the mind, bringing increased creativity and efficiency to their work. ●

1

SOLA-Stafette: the tracker with the LEA-4 GPS module.

2

Firmen-Triathlon: employees make a company.



1



2

The SOLA-Stafette

The SOLA-Stafette is an annual 14-part relay race organized by the ASVZ (Academic Sport Club of Zurich) that takes place in Zurich each spring. During the years 1974 to 1985, the race was from St. Gallen to Zurich, and starting in 1986 it was reorganized to take place in the greater Zurich area. By the 2000s the race had reached a large number of participants. In order to manage the pack of runners and be able to deliver medical assistance if needed, tracking the runners' locations became of importance.

In 2006, u-blox together with former u-blox employee and now Professor at HSR (University of Applied Sciences) Rapperswil, Switzerland, Heinz Mathis, and his team from ICOM (Institute for Communication Systems) provided the technology to track the course. As this was during the pre-Google-Maps era, in addition to building the satellite receiver tracking device, they had to prepare their own map data. They were truly pioneers in race tracking, which has since become commonplace, with apps on smartphones providing similar functionality.

All the trackers were mounted on bicycles that accompanied the runners, most importantly to provide the location of the first two or three

runners and the last runner. Since then, all motorbikes accompanying the athletes also carry trackers in order to get medical help to the spot where needed as fast as possible.

That first SOLA tracker used a u-blox LEA-4 module to receive and process the GPS signals. Since 2006, ICOM has scaled up the operation, gradually complementing and replacing the original custom-made trackers with commercial asset trackers, which also use u-blox technology.

The use of trackers in events such as the SOLA-Stafette demonstrates how the positioning technology of u-blox helps the doctors do their duty and react quickly during the races. And this is increasingly an important issue, since the number of SOLA participants has by now exceeded 14'000.

The now 15-year-long collaboration between u-blox and ICOM has resulted in other applications deploying u-blox technology, and other collaborations with GPS application providers. Such applications in Switzerland include tracking of participants in races, tracing of post deliveries, and an anti-collision system for buses.

The use of trackers in the SOLA-Stafette is an example very close to the heart of u-blox, but just one example of how the technology can help to solve very real needs. ●



U-BLOX AT 20: SUCCESS THROUGH CUSTOMER-LED INNOVATION

Since its foundation in 1997, u-blox has enjoyed outstanding success through a clear vision and sustained commitment to its well-defined strategy. In positioning and communications technologies, customer-led innovation underpins everything the company does. But it's a unique understanding of global trends, standards and customer challenges that has enabled u-blox to create innovative integrated circuits and modules with class-leading performance at competitive cost. Equally important, the u-blox brand has become synonymous with quality and reliability in even the most demanding environments. Twenty years on, the pace of innovation is accelerating. That's why, in some ways, the u-blox story has only just begun.



1997 U-BLOX FOUNDED

The idea was as simple as it was ingenious: combining several conductors (chips) with software to create a fully functioning positioning system. In 1997 – just two decades ago – this vision of Daniel Ammann, Jean-Pierre Wyss and Andreas Thiel, all post-graduate students at the Swiss Federal Institute of Technology Zurich (ETH), appeared downright audacious. Inspired by the pioneering spirit and entrepreneurial courage of his graduates, Professor Tröster went on to support the project from its official setup as a start-up company in October 1997.



1998 - 1999 FIRST SUCCESS STORY

Its first success was not long in coming: u-blox presented the market with the smallest GPS receiver of its time, in the form of a module. This milestone in the company's history also represented a commercial success, as the Swiss toll system for trucks was equipped with the technology provided by u-blox. At almost exactly the same time, a global sales organization was added to the young company's structure, enabling it to win clients very quickly for its high quality and visionary components.



2000 - 2002 ACCELERATING BUSINESS

In house at u-blox, however, there was no sign of the company resting on its laurels with this success. The small module manufacturer had decided that it wished to work independently of semiconductor providers and, at the turn of the millennium, started to develop its own positioning chip. The risk of realizing this idea was enormous, as the semiconductor technology barely possessed the features required to reproduce a system as complex as a GPS receiver on a chip. All the greater was the surprise when u-blox announced the first chipset of its own on the market in 2002. In the same year, the financial crisis ensued and challenged the company. Hans-Ulrich Müller jumped in as Interim CEO until Thomas Seiler was brought in as the company's new CEO, marking another milestone on the way to a successful future.



2003 - 2005 GOING GLOBAL WITH ITS OWN TECHNOLOGY

The small team of seven employees then established the development processes which would bring successful products to the market thanks to innovation and first-class, reliable product development. The successor product also went beyond what was deemed possible at that time, with u-blox launching the TIM module, which went on to establish itself as the de facto standard for GPS receivers in industrial applications. The innovative production concept allowed for a standard process in the assembly of components and continual product optimization. In 2004, sale of the one-millionth GPS receiver was achieved.

~~SIX~~

2007 GOING PUBLIC

In addition to its continuous innovations and new products, the company was also able to impress on the financial stage and, to mark the company's tenth anniversary in 2007, it launched a successful IPO on the SIX Swiss Exchange. The company had now sold 5 million GPS receivers.



2009 ADDING CELLULAR TECHNOLOGY

In 2009, the company decided to add a further pillar to its flourishing positioning technology offering: wireless cellular communication technology. Thanks to clever company purchases (more than a dozen firms have since been acquired and integrated into the company), the foundations were laid to provide the knowledge required to develop new products and the requisite resources for their successful distribution. The successful market launches of cellular modules further demonstrated how economic success, shaped by a clear vision, can be achieved on the basis of entrepreneurial courage and technical excellence combined with a healthy dose of pragmatism and decisiveness.



2017 EXTEND MARKET LEADERSHIP

u-blox now has 26 distribution and development centers worldwide and has more than 900 employees, around 200 who are based at the company's headquarters in Thalwil, Switzerland. The company's entrepreneurial and pioneering spirit is still reflected in its day-to-day activities. Despite its size, there has also been no change in the company's research mentality and constant state of inquisitiveness. And, as was the case in 1997, the founders Daniel Ammann, Jean-Pierre Wyss and Andreas Thiel still agree: There is still a long way to go before the team reaches the pinnacle of its achievements!



2014 - 2016 SHORT RANGE RADIO: THE THIRD TECHNOLOGY PILLAR

In 2014, the company added its Short Range Radio area (Bluetooth® and Wi-Fi technology). The ability to offer combinations of wireless communication underlines a further strength of the u-blox mentality today: u-blox employees understand the customer systems in which their chips and modules are used. u-blox does not compete with these customers in their area of core expertise, which allows u-blox to work in an advisory capacity.



2010 - 2012 FROM STRENGTH TO STRENGTH

Following this rapid growth, with u-blox already employing 200 staff members at 10 locations worldwide in 2010, one would actually have expected a period of consolidation. However, the u-blox DNA shone through and the company's Executive Board – still comprising three of the original founders from 1997 – together with Thomas Seiler and CFO Roland Jud, continued building the organization and our in-house expertise.



u-blox.com