NO. 1 – APRIL 2016

THE U-BLOX TECHNOLOGY MAGAZINE

UDR – GETTING TO THE NEXT LEVEL **P.3**
TOP-NOTCH QUALITY GRADES **P.46**

THE CONNECTED VEHICLE

u blox

CONTENT

FOREWORD

THIS IS NOT A CAR.

Dear Readers,

We are delighted to present to you the brand new u-blox magazine. This first edition will inform you of the latest trends in the automotive industry. The advent of the Internet of Things (IoT), expanding at a dizzying pace, has literally revolutionized the concepts of the future car. No longer solely a mode of transport, it is gradually evolving into a highly intelligent computerized device. And it wouldn't exist without reliable, robust and secure wireless connectivity and satellite based positioning, technologies that are u-blox core competencies. In other words, the car of the 21st century is connected, and on a tremendous scale.

A cloud-connected car reinvents traditional mobility patterns and expands the driver's experience in ways never seen before. Supported by an intelligent infrastructure via Vehicle to Everything (V2X) wireless technology, it can reduce the number of traffic-related accidents. Thanks to the development of smart features, it offers greater entertainment and better comfort. Even the environment is greatly benefiting from it. Real-time map, traffic, weather and parking information shared directly with the drivers via data sent over to the cloud from other cars or infrastructure is making driving smoother and more ecological. The cloud maintains the car with optimized software during its whole life time.

We wish you informative and smart reading.

The next edition is in the works, designed for you.

Yours sincerely,

Thomas Seiler, CEO

THE WORLD OF TRANSPORTATION – RELOADED

When Karl Benz received a patent for his first car on 29th January 1886 he started a revolution that he may well have imagined. However, the changes that are happening now must surely have been beyond his wildest dreams.

Today, it is estimated that over 1 billion cars travel our roads and over 60 million new ones are made each year. Car manufacturing is a key economic driver in many of the leading developed and developing nations around the world.

One hundred and thirty years after Benz's groundbreaking patent, the automotive industry is in the midst of a new revolution of epic proportions as it carves out its place within the Internet of Things. Underpinning this second revolution is the concept of connected cars – cars that communicate with each other, with the local environment, with the world at large via cellular radio networks and satellites. Cars that have real-time connectivity to cloud computing services, and cars that have new ways of delivering information and entertainment to both drivers and passengers. Cars are evolving from simply being transportation tools to becoming elements within integrated systems in a wirelessly connected world.

Gartner, Inc. predicts a quarter of a billion connected cars on our roads by 2020. According to PWC consultants, the connected car technologies market will be worth an impressive €122.6 billion by 2021 and both premium and volume car makers see the adoption of these technologies as vital to their future success.

Of course, wired or fiber connectivity within vehicles is continuing to advance: Controller Area Network (CAN), Local Interconnect Network (LIN), Media Oriented Systems Transport (MOST) and FlexRay are complemented by the growing presence of Ethernet – a wired technology that is familiar in our homes and offices. ABI, a research firm, estimates that 40% of cars will include some form of Ethernet connectivity by 2020, up from just 1% in 2014.

However, satellite positioning and wireless connectivity, the latter both inside and outside of the vehicle, are at the heart of the bigger changes in the market. And while futuristic autonomous vehicles are now widely featured in consumer news, the connected car is a multi-faceted concept with at least some aspects of the technology already appearing with each new vehicle announcement from the major car makers.

There is enormous potential to improve safety by wirelessly connecting vehicles to each other (V2V) and to the infrastructure around them (V2I). Short range and cellular radios, combined with accurate positioning data, will dramatically reduce the number of deaths and serious injuries on our roads. This is achieved through advanced driver assistance systems (ADAS) that include the provision of better driver information. Drivers will be able to "see" beyond the vehicles directly in front of them to better anticipate conditions on the road ahead, whether in daylight or at

or for remotely controlling entertainment from smartphones and other mobile devices. Social media integration also opens up a multitude of interesting possibilities and potentially disruptive business models. These range from the delivery of location-aware advertising by local businesses to enabling automatic check-in as you approach your hotel. The more "the system" knows about the individual's personal profile, the more tailored these messages and services may become.

All this entertainment will be enjoyed in

In the event of an accident, these services will contact the emergency services over cellular radio networks, relaying impact sensor information, including the status of airbags, together with positioning coordinates. Even where the driver is totally incapacitated, potentially life-saving help is still summoned.

A recent IBM executive report states that connectivity in vehicles is the key to unlocking a new mobility ecosystem. Recognising the challenges of clogged road infrastructures, particularly in urban areas,

"CONNECTIVITY IN VEHICLES IS KEY TO UNLOCK A NEW MOBILITY ECOSYSTEM."

night. Some ADAS features will enforce better driving with functions such as automatic braking and lane control.

The driving experience is becoming ever more convenient. The integration of Wi-Fi, cellular and GNSS technologies enables the navigation system to more accurately determine its position. With advanced dead reckoning technologies this is even achieved in built-up areas or in car parks where satellite reception may be poor or completely blocked. What's more, services are emerging that enable drivers to pay for parking, road tolls, fuel and other incidental charges through V2I wireless connectivity, saving a great deal of time and effort.

In-car entertainment is transforming with the rollout of always-on, low-latency 4G connectivity. Passengers can enjoy all of the online services they experience at home, from HD video streaming to peer-to-peer gaming. In fact, some 4G implementations may permit simultaneous streaming of up to eight HD video channels. Only in recent years have we been able to enjoy that level of bandwidth in our homes. Wi-Fi is used to stream signals around the car, while the different flavors of Bluetooth can be used for high quality stereo sound transmission and reception,

greater comfort than ever before. Car seats will become intelligent – sensing how drivers and passengers feel before automatically adjusting airflow through the seats or even creating a personalized in-seat massage. Smartphone and tablet screens will be mirrored in the car's central console for easy access using touch screens, some of which may use haptic feedback to simulate mechanical switching, or the screens may be controlled using mid-air gestures where there's no touch involved at all.

Better vehicle management is another major benefit of the connected car. Connected telematics will help car owners and service centers monitor engine performance, implement preventative maintenance and improve health and safety by monitoring driver behavior. Operators of commercial fleets or rental cars will know where their vehicles are at all times, and how they're being driven. This will help with everything from generating revenue by delivering location-aware services to implementing cost-saving, usage-based insurance. It will also enable more effective servicing and maintenance through remote monitoring of technical parameters. Automated emergency call services like Europe's eCall, GM's North American Onstar Service, and Russia's ERA-GLONASS system.

car makers need to consider how subscription services may replace or extend how drivers use their vehicles. The report cites access to occasional-use vehicles, peer-to-peer vehicle sharing, ride sharing and parking as examples. Crowd sourced data will be analyzed in the cloud to help drivers avoid traffic jams and guide them along the best routes to their destinations. Other services could be bundled too, including shared insurance and road charging. Such changes require the development of complex new business models. However, if the industry can demonstrate to consumers how this delivers more convenient and lower cost travel, the mobility habits of future generations could look very different from those of today.

Smarthome integration is also coming to the connected car. Smarthomes will know when a car is approaching so they will be able to open the garage door and switch on heating and lighting for the driver's convenience. Homes will also be able to communicate with cars that are parked outside, perhaps automatically downloading music or route plans for calendar appointments made on the home computer. The connected home and connected car are already talking to each other. Positioning and wireless connectivity technologies not only make this possible, they make it

easy to implement.

Technology continues to progress towards the autonomous vehicle. Until very recently, who would have thought that a company founded on an Internet search engine and another on personal computers would rise to rival traditional car makers in the US$2.6 trillion automotive industry? But that's what's happening at Google and, allegedly, at Apple today. Once again connectivity is the enabling technology that underpins their challenge to the status quo. Autonomous vehicles are simply not viable without reliable and robust V2V and V2I wireless connectivity.

Google seems to lead the industry here, having announced its first "road ready" driverless car back in December 2014. The firm now has over 1 million miles of autonomous vehicle testing under its belt, albeit with human drivers providing a safety net in the cars.

Google has a vision of everyone traveling easily and safely, regardless of driving ability, and without the limitation imposed by public transportation timetables. Citing that 94% of fatal accidents in the US are

caused by human error, the company also sees the autonomous, connected car as a life saver. Literally.

The autonomous connected car concept is being taken very seriously by established car makers too. For example, General Motors has invested US$500 million towards funding the US$1 billion development of an autonomous vehicle by the car sharing firm, Lyft. The goal is to build a network of on-demand autonomous vehicles that will make getting around more affordable, accessible and enjoyable.

In summary, the connected car means safer, more convenient, more comfortable and more enjoyable driving. And the same benefits apply if you're just along for the ride.

Of course, without positioning, short range wireless and cellular radio technologies of the kinds developed by u-blox, none of these exciting developments, of which Karl Benz would surely approve, would be possible. ●

1
Modern in-car entertainment.

2
Also trucks are driving autonomously.

3
Connectivity and precise positioning is a must also under rough conditions.

4
Carl Benz in his first model 1 patent motor car from 1886.

1

2

3

4

HIGH SPEED CONNECTIVITY – RELIABLE AND SECURE

Say hello to THEO, an automotive-grade, dedicated short range communications (DSRC) module for single or multiple channels, and diversity operation at 1 km or more.

When we connect our car to another, or to the infrastructure around us, a combination called "V2X" communications, we need to know that the connection is reliable, robust and, above all, private and secure. After all, it's a connection that could save our lives by alerting us to hazards, or simply make life easier through automatic payment of road tolls or parking.

A V2X wireless connection must work at high speed, be equally effective in every direction, and have a range that goes well beyond line-of-sight. ●

LEARN MORE:
www.u-blox.com/theo-p1

For "V2X" communication THEO is the perfect fit.

HIGHER LEVEL PERFORMANCE AND EMBEDDED SECURITY

The new u-blox M8 Firmware Version 3.01 is another step towards accuracy and reliability.

u-blox is at the forefront of satellite positioning technology and is continually enhancing the performance of both its chips and modules.

New generations of products keep delivering better sensitivity, greater accuracy, improved reliability and robustness, together with lower power consumption.

The latest u-blox M8 chips and modules now offer access to up to three concurrent Global Navigation Satellite System (GNSS) constellations, including the European Galileo system, which will give access to 24 additional satellites.

There's an optimum product for every application. Professional and automotive grade versions, including some with an operating range of -40 °C to 105 °C, comply with the most stringent automotive and industry standards. Every device incorporates security features to protect against malicious attacks and interference, plus a host of other unique features.

The M8 firmware release increases sensitivity and security.

GOING TO THE NEXT LEVEL

Enhancing our driving experiences in the connected car requires that our position is known precisely, always. Buildings, bridges or tunnels must not block the flow of information.

120

satellites orbiting the earth are transmitting extremly accurate time information. Comparing signals received from four or more satellites allows calculation of the receiving position on earth.

Reliable positioning also in tough environments and under weak signal strength.

Connecting GNSS positioning systems to vehicle sensors, such as wheel-tick counters, has been successful in meeting that challenge but it means extra wires and cost to link the vehicle sensors to the GNSS engine.

Now there's a better way. Untethered Dead Reckoning, or UDR, is a technique that fuses data from a tiny accelerometer and gyroscope – sensors measuring motion and angular changes – with the GNSS signal. All realized in one compact module.

UDR takes car tracking to another level, boosting the accuracy and availability of positioning information, without adding complexity. ●

LEARN MORE:
www.u-blox.com/udr

CONNECTIVITY FOR THE FUTURE

The automotive ecosystem is seeing one of its biggest shifts in years, with a steady and drastic advance of a multi-faceted connectivity in the car.

Car connectivity: not without cellular technology. The number of connected vehicles benefiting from both internal and external Internet access along with a wealth of ever-growing smart options is increasing at such a pace that it is expected to reach 152 million by 2020, according to IHS Automotive. Major OEMs are already heavily investing in further development of connectivity for applications ranging from security services, including stolen vehicle recovery, to infotainment such as video streaming. As a result, the car is rapidly evolving from a mechanical transportation means into a highly intelligent computerized device, with enhanced features making it akin to a smartphone.

The comparison with a smartphone doesn't stop there. Of the various wireless technologies at the service of the connected car and given the huge amount of data that must be conveyed to the cloud from a vehicle, cellular connectivity and its various standards (2G,

3G, 4G) is essential. Surveys suggest that safety ranks at the top of the list of customer requirements for a connected car, and enhanced safety features couldn't be offered without cellular connectivity. A case in point is the eCall mandate of the European Union, which as of 2018 will require all new vehicles to have pre-installed devices that will automatically dial emergency services in the event of an accident. Alongside safety, cellular data streams need to provide map, real-time weather, traffic and parking data. And for automobile diagnostics and remote engine control, cellular data is used to communicate different levels of speeds, throughput, reliability and availability. Such is the trend that mobile operators see the connected car as yet another device to be added to their networks.

Car manufacturers are increasingly embedding connectivity directly into the vehicle to offer a connected experience similar to that of a smartphone. ●

152^M

Number of connected vehicles benefiting from both internal and external Internet access by 2020.

Safety first: Cellular connectivity enabling enhanced safety features.

HANDS OFF!

By 2020 consumers will be buying cars that drive themselves, starting on highways. Safe and convenient autonomous driving will transform mobility.

The concept of self-driving vehicles relies upon knowing the positions and speed of travel of cars accurately under all driving conditions. This is a matter of integrating diverse, complex technologies: GNSS, sensors (radars or cameras), cellular connectivity, and secure and reliable communications between vehicles (V2V) and from vehicles to the infrastructure that surrounds them (V2I).

u-blox is at the forefront of technologies required to make autonomous vehicles a practical proposition. A leader in satellite positioning since it launched the world's first surface mount GPS module in 1998, u-blox now offers robust, automotive-grade GNSS integrated circuits and modules that provide reliable multi-satellite reception for all of the world's major satellite constellations: GPS, GLONASS, BeiDou and Galileo. Concurrent reception of three constellations is supported in several products.

Some u-blox GNSS modules integrate superior Dead Reckoning technologies to ensure accurate positioning even where satellite navigations signals are impaired, such as in dense urban environments, garages or at multi-level road intersections. All u-blox devices are designed to mitigate errors caused by multipath reception and other real-life issues. What's more, the accuracy and reliability of positioning can be enhanced using u-blox services such as CellLocate®, which merges cellular mobile network data with satellite signals and AssistNow™, a service that accelerates the reception of positioning data.

For assisted driving and autonomous vehicles, GNSS will be an instrumental part of the system. It's vital that position can be determined in 3D, for example to account for multi-level intersections. High levels of accuracy, down to the lane-level (which means ±1.0m) will be required at 95% of the time with fast availability. This level of accuracy will require access to data correction services that are more accurate than those currently available.

Integrity and functional safety are of course key consider-

ations throughout the entire communications chain to the car. u-blox products are already secure against spoofing, jamming and other kinds of malicious attack. The next generation will go further and integrate all the innovations required to deliver the required level of system safety.

u-blox offers a modular approach to all of the wireless technologies needed for assisted and autonomous driving: GNSS, V2X, WiFi and cellular radio modules. The products are specifically designed for

automotive applications, complementing each other and can be quickly and easily integrated together and into vehicle systems. ●

TECHNOLOGY FOR A GLOBAL MARKET

In North America, not only are traditional car makers once again on a strong growth path, led by General Motors and Ford, but disruptive innovation is everywhere.

The connected car concept is being embraced throughout the world. Many new cars incorporating u-blox technology are redefining the automotive landscape and billions of dollars are being invested in developing autonomous vehicles. This investment comes not only from established car makers, but from remarkable new market entrants such as Google.

The car industry remains the growth engine of Europe's economy, where many of the world's most prestigious brands originate. It is also where u-blox modules are designed, manufactured and

qualified to the highest automotive standards. The mandatory requirement for the eCall emergency call systems to be integrated into every new car as of 2018 will create even greater demand for u-blox cellular radio technologies.

Throughout Asia, from the established car makers of Japan and Korea to the emerging ones from China, growth in the automotive sector is accelerating. In particular, China shows enormous new potential and offers the biggest potential of all.

For the connected cars made in all of these markets, u-blox

already offers a proven and broad portfolio of multi-satellite GNSS, short range wireless and advanced 2G, 3G and 4G cellular radio products. Perhaps more importantly, the company innovation roadmap ensures that partnering companies today will be able to offer their customers the very best that these technologies can deliver in future. ●
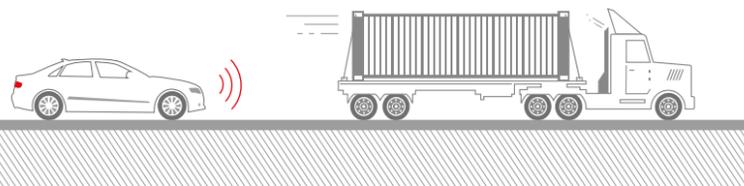
CARS SOLD BY REGION IN 2015:
Total 72.41 Mio. cars sold

Western Europe
12.95 M
+7,9% *

North America
20.64 M
+6,5% *

Eastern Europe
3.8 M
-10,3% *

Asia
32.29 M
+1,8% *

South America
3.5 M
-15,7% *
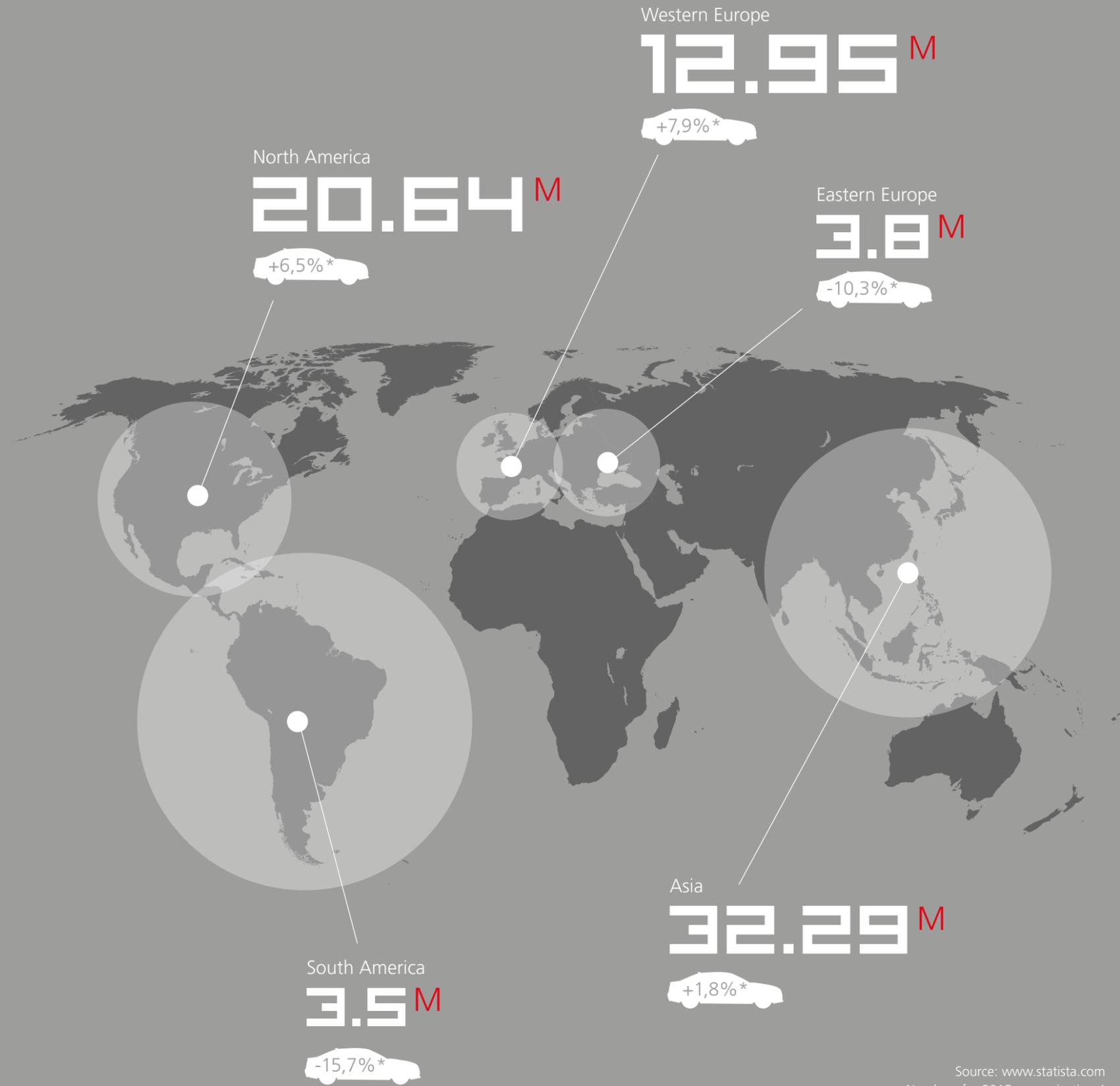
Source: www.statista.com
Numbers for 2015 are projections!
* Compared to previous year

NEW KID ON THE BLOCK: NARROWBAND IOT

Narrowband IoT is the first cellular radio technology designed exclusively for the Internet of Things

Many IoT applications need a technology that is ultra-low power, low cost and able to provide coverage in hard-to-access areas such as underground or indoors.

Smart utility meters, smart lightning and building automation are perhaps obvious examples, but the same characteristics apply to tracking and monitoring devices, from consumer wearables to animal tracking products.

These applications, often requiring just small amounts of infrequently transmitted data, demand robust connectivity. This is why u-blox is a participant in the 3rd Generation Partnership Project (3GPP), which has developed a Narrowband IoT communications standard, NB-IoT.

NB-IoT is a low power wide area network (LPWAN) technology for IoT applications. It works over existing cellular networks, so no new infrastructure is needed. And it combines very low power consumption – up to 15 years operation from a tiny battery – with better signal penetration and lower cost than GSM. What's more, its simplified network topology means it is easy to deploy secure, authenticated connections that are network-scalable when capacity requirements increase. ●

LEARN MORE:
www.u-blox.com/nb-iot

1 + 2

When the refridgerator initiates its own refill, NB-IoT plays a key role.

SECURITY – AS IMPORTANT AS THE DEVICE'S FUNCTION

Connected cars will require end-to-end security if they are to win the trust of consumers.

Complete security demands that every link in the chain is secure, from sensor nodes to cloud services, and everywhere in between.

At sensor nodes, device firmware needs a **secure boot method** where each stage is authenticated before the next step is taken.

The communications transport layer must include a mechanism for the device to **authenticate** itself with the server and vice versa using secure keys. This will protect against man-in-the-middle attacks.

A **process for the formal authentication** of APIs needs to be established and followed.

It must also be possible to **detect jamming or spoofing** of the input to a GNSS receiver or other external sources of data to prevent interference with the end applications. ●

THE CAR IS THE NEW SMARTPHONE

What is state-of-the-art and what are the latest trends in the automotive industry? We asked an ABI analyst and the CEO of u-blox, who sees the future of the company as part of the answer.

Dominique Bonte,
Vice President and
General Manager,
B2B at ABI Research.

Thomas Seiler,
CEO u-blox AG.

What are the major trends in today's automotive industry?

DOMINIQUE BONTE – I think what we see now as trends are active safety, ADAS, collision avoidance and obstacle detection, and of course autonomous driving. Technology and electronics are moving beyond the confines of the dashboard or cockpit. While we still talk about the software-defined cockpit, increasingly now the entire vehicle becomes software-defined and connected. It needs to be powered by many control units and the software of those systems must be updated, so we should start speaking about the software-defined car and ultimately the self-driving vehicle. It is a little ironic that the same acronym SDC can alternatively describe the Software-Defined-Cockpit, the Software-Defined-Car and ultimately the Self-Driving-Car. And connectivity is empowering and enabling these trends.

THOMAS SEILER – Yes. We see that very similarly. I think the big change lies in having much more computing power in the car than ever before. All these new functionalities are only possible if you can process huge amounts of data, mainly visual information, but also general sensor data, which can be captured and uploaded via cellular connectivity. It is quite a challenge to integrate such computers into the car and the computing power needed to make this happen is so huge that we speak of teraflops, trillion floating point operations per second, of processing power. Such devices are super computers, nothing else. However these in-vehicle computing devices should consume only a few hundred watts and shouldn't cost more than a few hundred dollars, and that's a big step. The requirements for such advanced functionality are technically doable, but I think the integration into the car is still a challenge.

D.B. – An onboard computer is important, but at the same time a lot of the processing of the sensor data will not always be happening in the car, but will also be sent to the cloud. Parking spaces, traffic, or weather information is collected from the cars, analyzed and processed in the cloud, and then made available again for alerting other cars, for instance about ice on the road or heavy rain. It is this balance between computing in the car and cloud-based data mining that makes connectivity so important.

T.S. – It is always a mixture between the two, and the autonomous part is absolutely essential. Without connectivity, from a safety point of view but also from a usefulness and applicability point of view, it is essential that the car be autonomous. Essential functions must reside in the car.

D.B. – The decisions needed to avoid collisions must indeed happen in the car.

T.S. – Yes, everything to do with driving of course. It is an autonomous decision and this is how a car maker thinks: I cannot count on having connectivity only and it has a lot to do with functional safety.

D.B. – True. Functional safety means that whatever happens in the vehicle, which-ever component fails or malfunctions, the end result should be that there are no fatalities and that the car can react appropriately, or go into a fail-safe mode in the case of driverless cars. For the whole automotive supply industry, from the semiconductor players all the way to the car manufacturers, it is very important to make sure that everybody contributes to functional safety compliance.

Do you think customers are looking forward to the possibility of autonomous driving or is it more of an industry's dream?

D.B. – I think there are two groups. Surveys show that the younger people, the Y generation, have no problems sharing transportation and they are fine with embracing technology. They are the social networkers, sharing information on Facebook so for them it's very natural to expand that sharing to cars. On the other hand, you have the silver agers, who still very much value their privacy and car ownership as a kind of status symbol. But 20 years from now, I think these age groups will evolve and, like the adoption of the cellphone it will spread across the entire population. It is also a matter of money, as it is clear that car sharing will reduce the cost of transportation by the very fact that the utilization rates of cars will increase. Nowadays, on average people use their car 2.4% of their time. The rest of the time, the car is at the parking of the shopping mall, in your garage or at the company where you work. With car sharing we might reach utilization rates of

"TECHNOLOGY AND ELECTRONICS ARE MOVING BEYOND THE CONFINES OF THE DASHBOARD OR COCKPIT."

DOMINIQUE BONTE

50, 60 or even 70%. Cars are an expensive asset and are going to be utilized more efficiently, resulting in a lower cost per mile.

T.S. – For me the interesting question is: what is the transition? How will the current individually-owned car driving change to a system that is more automated, shared and autonomous? It's not so obvious how these steps will occur, because it cannot be an overnight change.

D.B. – I think the whole discussion about autonomous and driverless cars goes in two directions. The first trajectory is incremental, including ADAS, blind spot detection, lane changing, automated braking and parking. These are small steps we are taking right now, and in the next five years we will see many more of them, but it's still a car with a driver. The big transition you refer to is the move from a highly autonomous vehicle with a driver to a fully self-driving vehicle without a driver. And that's a matter of legislation, of functional safety, cyber security, and consumer acceptance. Because, as we travel in a car, we feel more comfortable knowing that we can still take over control if something goes wrong. Surveys show that people are a little nervous when being driven in a car at 150km/h without any means, such as a steering wheel, to control it.

How do you think the autonomous car will impact city life?

D.B. – I think that the biggest use case for driverless cars will not be highways, but city centers. Smart cities. This is where we have congestion, pollution and a lot

of accidents. Driverless cars will be adopted there first, because average city traffic speed are lower than 30 km/h. There would be less concern of not having control of a vehicle going at low speed. I think the industry focuses too much on highway driving for this kind of technology.

T.S. – But of course from a technical point of view, the highway is the simpler case. It is easier to make a car autonomous on a motorway as it is a relatively confined environment, whereas a city is highly complex. Hence the need for teraflops of computing power to handle all these exceptions.

D.B. – Car sharing and driverless cars: this is where I think smart cities will come into play. Surveys show that people spend up to an hour circulating in cities until they find an available parking space, which adds to the congestion. If we have fewer cars, there will be less demand for parking and there will be less hassle to find parking. Actually we won't even need parking, because vehicles will keep circulating, dropping off one passenger and pick up the next.

T.S. – Do you know of any study about cities with such a concept? How many fewer cars would be on the road?

D.B. – I have seen a couple of crazy numbers. Somebody says that the number of cars could go to a tenth of what we have now! I think that's a little exaggerated, because for that to happen you need to have a lot of driverless cars available and that every consumer can find one wherever he

wants to get one. Of course it will take a long time before we get there. So in the meantime, we'll have efficiency rates of a shared car maybe replacing up to 5 vehicles. I think that's a little more realistic. But it could still reduce the installed base of vehicles by a factor of 3 to 4. However, whether it is to solve congestion or urbanization or climate change, I think car sharing is the way forward. That's why the importance of driverless cars is not just a gimmick. This will really help us address the big issues in smart mobility.

What makes the automotive industry so attractive?

T.S. – For us as a supplier, I think the main reason is that a car becomes more intelligent beyond being just a metal shell with a motor inside. It has become an electronic device, like a smartphone – a highly intelligent piece of equipment with extraordinary computing power. We, as u-blox, deliver a certain part of the capabilities and intelligence, and therefore it's highly attractive that the car industry itself is going in this direction. It's not just because it's nice to have an autonomous car, but it is because of traffic congestion, environment problems, and energy problems; it's a problem of pure capacity of what transportation can deliver.

D.B. – Also, the semiconductor bill of material (BoM) of a car keeps increasing. I have seen numbers showing the total semiconductor BoM cost in a car is now USD 500, including analogue components like filters. This is obviously going to go much further with the software-defined

1
Accurate position also on multilevel lanes is a must.

2
When the car takes the driving control the driver can relax and enjoy.

3
Not far from now: the car can be surveilled and controlled by mobile apps.

"YOU ARE IN THE MIDST OF THE CONNECTED CAR, WHICH IS A DATA HUB CONTINUOUSLY SENDING DATA."

THOMAS SEILER

Passengers can enjoy online services in the same quality and as comfortable as at home.

High speed connectivity allows V2X communication enabling safety features.

Paying insurance fee based on the driver's behaviour is trend in the insurance industry.

The integrated emergency call system saves time – and lives.

As a car's position can be fixed precisely, a stolen car can be identified and returned to its owner.

Reliable and precise positioning of the connected vehicle makes toll stations dosolete – and opens the door for new business models.

car, with hundreds of ECUs, multiple computing platforms and many sensors. The addressable market of automotive semiconductors will increase dramatically, taking a larger share of the USD 1 trillion supply chain value. Furthermore, it isn't just about driving, but about the car taking on new use cases and values. I think that's how we should see the Internet of Things (IoT). It's not just about looking at automotive or healthcare or retail, but it's about how to link all these industries together, and I think the connected car is a central piece.

For instance, Vehicle to Everything (V2X) technology defines how cars will communicate with traffic lights and other external infrastructures. The whole Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) discussion is certainly very important from an IoT perspective, allowing the cars to communicate with the rest of the world and not just inside the vehicle. It's a big trend as well and will open up new possibilities, new values and new opportunities for companies. We will see a lot of innovation, combining technologies from different verticals to add more value to the end users. u-blox has invested in DSRC (Dedicated Short-Range Communications) technology and is playing in a lot of these segments already.

In terms of wireless technologies, which one of GNSS, Cellular, and Short Range Radio do you think will best answer future needs of the automotive industry?

D.B. – We need all three, but I think cellular will become more important than it is now. Originally designed for mobile phones, broadband communications, video downloads and social networking, we see now how can we optimize cellular connectivity for the IoT. There is a tremendous amount of discussion how we can extend LTE to machine-type applications. LTE Cat 1 enables lower-price modules at lower-speeds and bandwidths, but also lower battery consumption and better coverage, all of which already optimizes IoT requirements. I am not so sure whether this is useful for cars, where there isn't such a need for low power consumption. Of course with electric cars, this might change.

T.S. – You made an important remark at the beginning saying that self-driving cars may make use of both cloud and autonomous driving. I think that's why you say that cellular is so important, because without the cloud in the background many things cannot happen, and because these autonomous cars have so much computing power and so much data, they need a strong data connection. This is why LTE, in particular for high-end data rates, will be required.

D.B. – Yes, I don't see NB-IoT for cars. But of course we need positioning, which will not be just GNSS, but use other parameters as well. And we will need short range wireless technologies like Wi-Fi and Bluetooth for what's happening inside the vehicle, for applications such as connecting a phone and tire pressure monitoring.

T.S. – I would like to say a word about positioning. The autonomous car is contingent on having absolutely precise, reliable, functional, and safe positioning information. This is core technology that u-blox can provide. However, there is still a way to go with the development of the technology, probably two to three years until the positioning information fulfills the requirements. Self-driving vehicles are unthinkable without it, because you need an absolute position, and it must be very precise, so that the car can react to its environment and keep you safe.

What do you think of data security (hacking, etc.): is it a challenge?

D.B. – The security challenge is huge and unfortunately very difficult to address. There is a constantly changing and unknown external threat of cyber attacks into vehicles, whether it is a malicious hacker, or a hobbyist, or a terrorist. If people can break into a connected vehicle, take control of the power train and the steering, they can create accidents or ultimately use these cars as weapons. I think everybody is waking up to this reality and investing heavily across the value chain. You can do security on the chipset level, like secured memory and trusted booting, to ensure that the software launching on hardware is very well protected. You can also protect the connection through encryption and authentication, use virtualization, with hypervisors separating infotainment systems from the critical car functions. You can also monitor vehicles in real time: this is called deep packet inspection. I would say that security is a number-one concern on the road to driverless vehicles. If we cannot solve the security problem, people will not want to travel around in a driverless car.
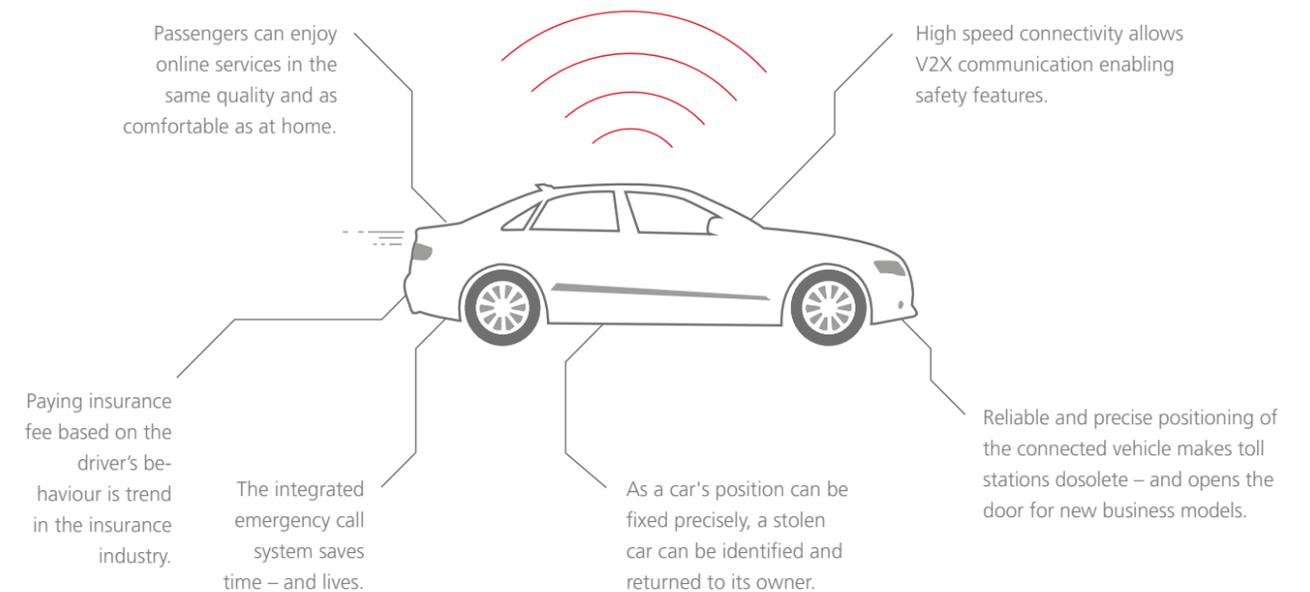
T.S. – Security is also a concern for the connected car. Even if there are just a few additional electronics in the car, but they are connected, it is possible to break into all the car's systems. As long as there is a TCP/IP connection, there is access to the system.

Do you see new applications arise from the Usage Based Insurance (UBI) market trend?

T.S. – Usage paid insurance alone is an incentive for a connected car. One can install a box in the car that links to the data network in the car. You can save money because then your car is connected. However, the box is no longer just for the insurance to find out how many kilometers you drive or at what time in the day you were driving and at what acceleration. It has become an Internet hub, a retrieval piece to check on the health of your car. You are in the midst of the connected car, which is a data hub continuously sending data gathered in the car over to the cloud to be sold again to other users.

D.B. – Regarding Usage Based Insurance, we currently see a situation where there is a separate box for each use case or application, for example different hardware for eCall and UBI. In the long term, we need to consolidate these boxes into one connected car hardware platform. UBI as we now know consists of plugging a device into the OBD (on-board diagnostics) port. This is a temporary phenomenon and will have to move to the embedded platform to make usage easier and cheaper.

T.S. – There is already a huge installed base of old cars on the road with an OBD connector. Everybody can plug a device into it, which creates a large aftermarket for making cars connected.

D.B. – But the numbers are still quite low. The UBI market only represents around 10 million connections globally. More and more manufacturers bring connectivity into every car. Whether the users pay for it or not, OEMs want to have connectivity for their own purposes, for example diagnostics, maintenance, capturing data, and over the air updates, because physical recalls are very expensive. Even if you can only solve 10% of the problems over the air, it's already a huge cost saving, which pays back for the module, connectivity, and so on. It has taken a long time, but the automotive industry is now starting to understand that they need embedded connectivity.

T.S. – In the US, there are 250 million cars on the road and the replacement is very slow, with cars being used for 20 years. So the aftermarket, or refurbishment market is huge. Once we start to propel this consumer asset value, we will quickly make big strides. Large populations of the cars will be connected.

D.B. – It's good that the automotive industry as a whole now recognizes they need embedded connectivity. A lot of the technologies we talked about until recently were seen as nice-to-have, such as connection for infotainment or some safety features, but I think we now very quickly move into connectivity being a must-have and it doesn't matter anymore whether the customer pays for it or not. This is the big shift in thinking from premium nice-to-have, to a critical piece of technology that every car should have. This is a critical transition. ●

WHAT DRIVES THE INDUSTRY

Almost no industry is studied more than the automotive industry. Here are some facts & figures. Would you have known?

10^X

The number of Heads Up Displays shipped worldwide will increase by almost 10-fold by 2024
(source: ABI Research)

80$^%$

Penetration of Intelligent Transport System technologies in smart cities will exceed 80% by 2025
(source: ABI Research)

219110^M

US$ will be the overall value for Advanced Driver Assistance Systems by 2025 worldwide
(source: ABI Research)

400^M

Almost 400 million Adaptive Cruise Control Systems will be shipped comulatively by 2025
(source: ABI Research)

51.54^M

registered platooning vehicles will be on the road worldwide by 2030
(source: ABI Research)

65$^%$

The Bluetooth penetration for automotive entertaiment will reach 65% by 2019
(source: IHS)

23.17^M

new vehicles with Security Technology for Connectivity will be shipped in 2020
(source: ABI Research)

6^X

In the US, the number of Insurance Telematics Subscribers will increase 6-fold by 2020
(source: ABI Research)

56$^%$

Globally, 56% of drivers describe them-selves as being "happy" and 54% feel "free" when they are in the car.
(Source: GfK Connected Car study)

5.2^h

The average time drivers spend in a car each week
(Source: GfK Connected Car study)

PARTNERSHIP OF EXCELLENCE

Customer-led innovation is at the heart of the success of u-blox positioning, cellular and short-range radio technologies, but it would be of little value without world-class manufacturing and logistics.

CUSTOMERS BENEFIT BY SHORT LEAD TIMES AND MOST FLEXIBLE SERVICE.

For u-blox modules, Flex (also known as Flextronics) has been our manufacturing partner for more than 10 years, producing over 80 million units in that time, and our work together is growing year-by-year. Flex has 100 sites in 40 countries and employs 200,000 people. u-blox is Flex's largest customer at its Althofen plant in Austria.

More than ten fully automated, surface mount assembly and test lines guarantee utmost product quality, consistency and reliability, together with cost optimisation. Statistical process control guides a zero defects policy, while ever-improving logistics mean that u-blox customers benefit from an optimized supply chain with short lead times and the most flexible service possible. That's essential in a business environment where fast-changing demand is the norm.

Design and manufacturing facilities are amongst the most advanced in the world. They meet stringent international standards including ISO/TS 16949, ISO 9001, ISO 14001 and ISO/IEC 80079-34.

u-blox and Flex: a design, manufacturing and logistics partnership that's proven its value over 80 million times. ●

LEARN MORE:
www.flextronics.com

1
State-of-the-art pick-and-place equipment
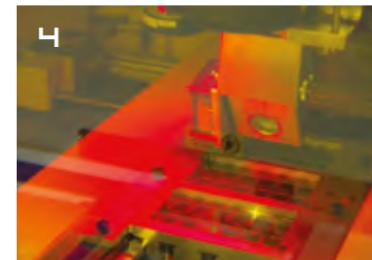
2
Fully integrated test system adaptable to all u-blox modules

3
Barcode labeling allows full traceability

4
Depaneling with a high precision laser cutting machine

5
Final inspection on tape before reeling

1+1=
TOMORROW'S V2X COMMUNICATION

Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) wireless technologies, also known as Vehicle-to-Everything (V2X), are paving the way to the transportation of the future, and ultimately autonomous driving.

By allowing communication between vehicles and their surroundings, V2X improves road safety, reduces traffic congestion and energy consumption, while enhancing passenger experience and safety. Coupled with more conventional Advanced Driver Assistance Systems (ADAS) technologies, such as radar sensors and cameras, V2X enables a 360° situational awareness with information such as the position, speed and direction of surrounding vehicles.

To meet the needs of this trend, u-blox partnered with Australia-based Cohda Wireless, a global leader in connected vehicle technology and also the world's number one equipment vendor in the Cooperative Intelligent Transport Systems (C-ITS) market. The company manufactures hardware products with acknowledged best-in-world performance and has Cisco and NXP Semiconductors as strategic investors. Its hardware and software products are used in V2V and V2I field trials worldwide today. Being well aware of this, u-blox decided to collaborate with Cohda Wireless and combine both companies' expertise.

Combining forces

Cohda's DSRC-based (Dedicated Short-Range Communications) V2X system utilizes highly accurate satellite positioning with embedded dead reckoning technology provided by u-blox to deliver the performance that is crucial to the requirements of next generation cars. To meet rapidly increasing demand for V2X modules for trials, early deployments and infrastructure rollout, Cohda Wireless and u-blox have agreed on an exclusive license for the use of the latest MK5 module design, leveraging u-blox strengths in quality manufacturing and global supply of automotive components for positioning and communications.

"While Cohda Wireless developed the MK5, a state-of-the-art V2X radio module, we have decided to license its design in order to focus on software intellectual property (IP). V2X communication is a growing, exciting market and, by taking this step, we are looking forward to closer cooperation with u-blox," explained Paul Gray, CEO of Cohda Wireless.

Eliminating driver error

How the Cohda vehicle-to-vehicle communication system could save lives and reduce congestion

1 Like sat nav devices, the Cohda system uses an antenna to communicate with global positioning satellites to establish the vehicle's location

2 GPS location and speed information are then transferred to a radio frequency (RF) chip in the car

3 The RF chip broadcasts this information 10 times a second to all vehicles equipped with similar chips within a 500ft radius
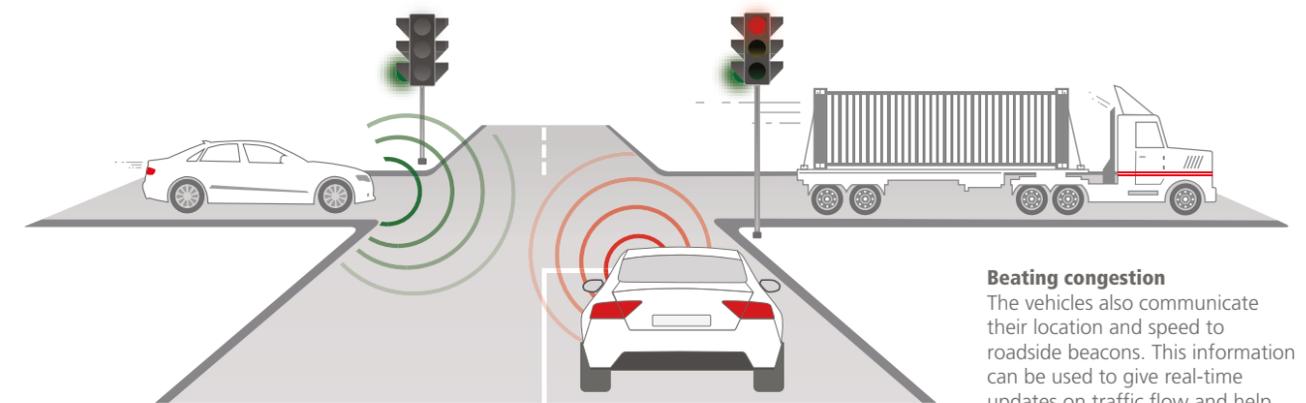
Beating congestion
The vehicles also communicate their location and speed to roadside beacons. This information can be used to give real-time updates on traffic flow and help drivers to avoid congested areas

4 In the scenario illustrated here, the vehicle is travelling at 40 mph and is about to run a red light, heading into the path of the car on the left

5 The system will respond iinitially by sounding a warning alerting the driver to the danger ahead

6 It then increases breaking pressure if the driver reacts too slowly, and could also take over the steering to automatically manoeuvre the vehicle out of harm's way

Source: Cohda Wireless

THEO-P1 is a compact, automotive-grade transceiver module facilitating development of V2X communication systems and products. Already with a strong market penetration, it addresses both equipment within vehicles (OBU-On Board Units) and road infrastructure (RSU-Road Side Units). THEO-P1 delivers proven superior performance – it is based on 5.9 GHz radio link, single-channel 802.11p diversity, and a two-way, short range wireless communications technology compliant with IEEE-related standards. It is designed to work with vehicle speeds well above 200 km/h and unprecedented range. Cohda Wireless will continue to offer MK5 OBU and MK5 RSU products in V2X trials and low-mid volume V2X deployments, but in future these will be based on the THEO-P1. ●

LEARN MORE:
www.cohdawireless.com

Centimeter-level
performances
when collecting
data with UAVs
saves costs, time
and effort.

CENTIMETER-LEVEL ACCURACY AT ITS BEST

u-blox answers the growing demand of affordable high precision technology

In the past 15 years, standard precision GNSS technology has been adopted in various applications that are a part of everyday technology, such as car navigation or sports wearables. In these applications meter-level accuracies have sufficed. Until now, high precision GNSS positioning has been constrained to professional applications, such as for construction, due to the high cost of achieving centimeter-level performance.

One way of obtaining high precision positioning is by combining GNSS (global navigation satellite systems) with Real Time Kinematics (RTK). RTK relies on the use of a local base station that provides corrections to a moving device, which typically is referred to as the rover. The rover feeds the base measurements into the

RTK algorithms to produce the rover's position relative to the base station at centimeter-level accuracy.

In recent years, the demand for accessible high precision technology has become increasingly urgent. In areas such as unmanned aerial vehicles (UAV), there is a strong need for increased control in the centimeter ranges. The use of UAVs is increasing steadily in both consumer and commercial applications. Examples of consumer uses are action sports and cinematography, while the commercial applications include surveying, inspection, and agriculture. Typically, the UAVs are manually piloted, however an increasing number feature pre-programmed scheduling and automated flight. This allows the safe and efficient use of UAVs in many

different areas. Thanks to centimeter-level performance, UAVs can collect detailed data for the creation of accurate 2D/3D models from the collected and geo-tagged images.

Precision agriculture has advanced with the increase of automated tractors. Through the use of GNSS-RTK equipped tractors, farmers can reduce waste and costs by using high precision GNSS technology to create equally spaced rows to control the placement of water, fertilizer, and herbicides. When combined with special geo-referenced maps (e.g. Normalized Difference Vegetation Indexes and hyperspectral imaging) the distribution of key inputs can be limited to specific areas as required, while avoiding areas where these inputs could negatively affect crop yield. As a result, the implementation of

Errors in satelite clocks, satellite orbits, and atmospheric disturbances on signals are mitigated, because the error sources are common to both receivers. Thus, enabling the RTK algorithmus to produce centimeter-level positioning.

GNSS
satellite
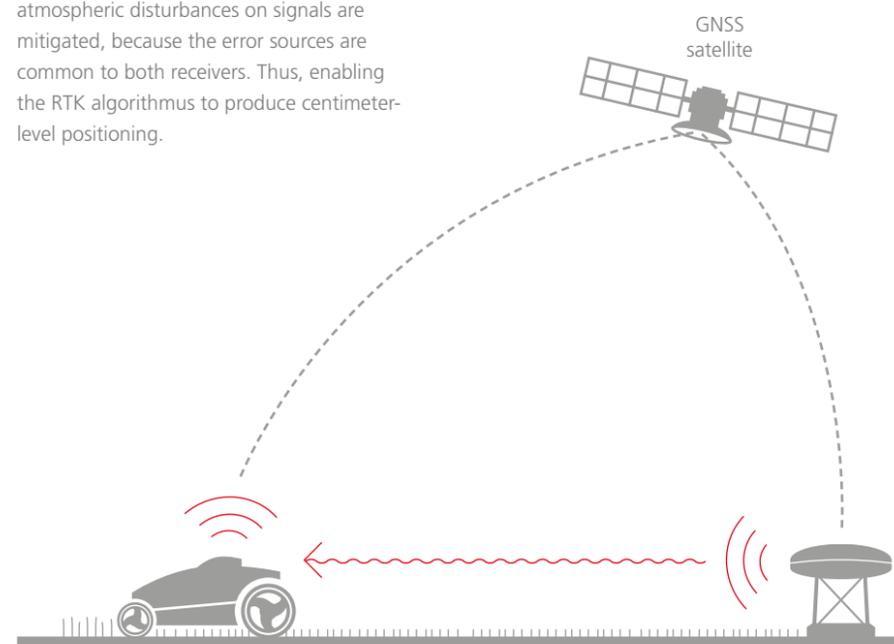
The rover receiver feeds the base masurements into RTK algorithms to produce rover's position relative to the base station at centimeter-level accuracy.

The base receiver, with known position, provides corrections to the moving device, which is typically called the rover.

this technology helps increase overall crop growth and productivity. However, the benefits of high precision GNSS-RTK equipment have been limited to large-sized farms so far, where initial high expenses are typically accepted, considering the positive return of investment. Additional applications in the mass market are robotic lawnmowers, where centimeter-level accuracy is required.

The demand for lower priced high precision technology is growing rapidly, as evident in the areas of precision agriculture, UAVs, and robotic lawnmowers. However, due to size, power, and cost restrictions, existing high precision solutions have been unable to meet the demands of these markets. u-blox has developed the recently launched NEO-M8P to meet these growing demands.

The NEO-M8P: proven high-precision GNSS solution for the mass market

The NEO-M8P makes centimeter-level positioning technology more accessible, due to unmatched cost-efficiency and performance levels, for applications such as commercial UAVs and robotic guidance systems. Measuring merely 12.2 x 16.0 x 2.4 mm, NEO-M8P is today the smallest high-precision GNSS module with RTK technology (real time kinematic).

The u-blox rover (NEO-M8P-0) receives corrections from the u-blox base receiver (NEO-M8P-2) via a communication link that uses the RTCM (Radio Technical Commission for Maritime Services) protocol, enabling centimeter-level positioning accuracy. The RTK algorithms are pre-integrated

into the module. As a result, the size and weight are significantly reduced compared to existing solutions, and power consumption is five times lower, thus cutting costs and improving usability dramatically. Customers can further reduce their R&D efforts, as they do not have to spend significant resources and time to develop an in-house host-based RTK solution. ●

LEARN MORE:
www.u-blox.com/neo-m8p

READY FOR THE NEXT GENERATION?

u-blox is constantly working on new products to make the lives of engineers and designers easier. We are aiming for easy-to-integrate and cost-efficient developments for your application in the industry, the consumer and the automotive market.

WIRELESS CONNECTIVITY VIA WI-FI, BLUETOOTH SMART AND 2G/3G

u-blox connects the Internet of Things
Combining leading industry-quality, robustness, sensitivity and performance with innovative features, u-blox offers components and solutions for your designs. We focus on business critical applications for which our customers need our products to perform 24/7 with exceptional reliability and to handle exceptions in a way that minimizes disruption to the overall system. As a result we can offer our customers improved productivity, fast response, and new business opportunities… to locate, communicate, accelerate. ●

LILY-W1
This ultra-compact, host-based 802.11n 2.4 GHz Wi-Fi transceiver module is designed for industrial and commercial applications. Its internal antenna and support for two host interfaces – SDIO and USB – mean it's easily integrated. What's more, it can concurrently act as an access point for up to eight clients while itself being a client in another network. In combination with Wi-Fi direct support and an integrated LTE filter, LILY-W1 is the perfect Wi-Fi-to-cloud data link for IoT applications. ●

NINA-B1
This Bluetooth Low Energy (BLE) – or Bluetooth Smart – wireless module complies with the latest Bluetooth 4.2 specification and is certified to global radio type approvals. It helps bring BLE-based Internet of Things (IoT) designs to market in the shortest possible time.

Comprising an antenna, radio transceiver, an embedded ARM Cortex M4F microcontroller and a Bluetooth low energy stack, it is ready for design-in to a wide range of IoT applications including connected sensors, building automation, medical devices, telematics, and monitoring and control units. ●

SARA-U201
The world's smallest 2G/3G wireless cellular module comes in an ultra compact, 96-pin LGA package. Pin-compatible with the u-blox SARA-G350 GSM/GPRS module, SARA-U201 supports 5-band UMTS and quad-band GSM, making it the ideal solution for applications requiring a single module able to operate on any 2G and 3G network in the world. ●

1

2

GETTING READY FOR REAL-WORLD PERFORMANCE

It's not enough to test u-blox automotive products in a laboratory or manufacturing plant. That's not where they'll be used.
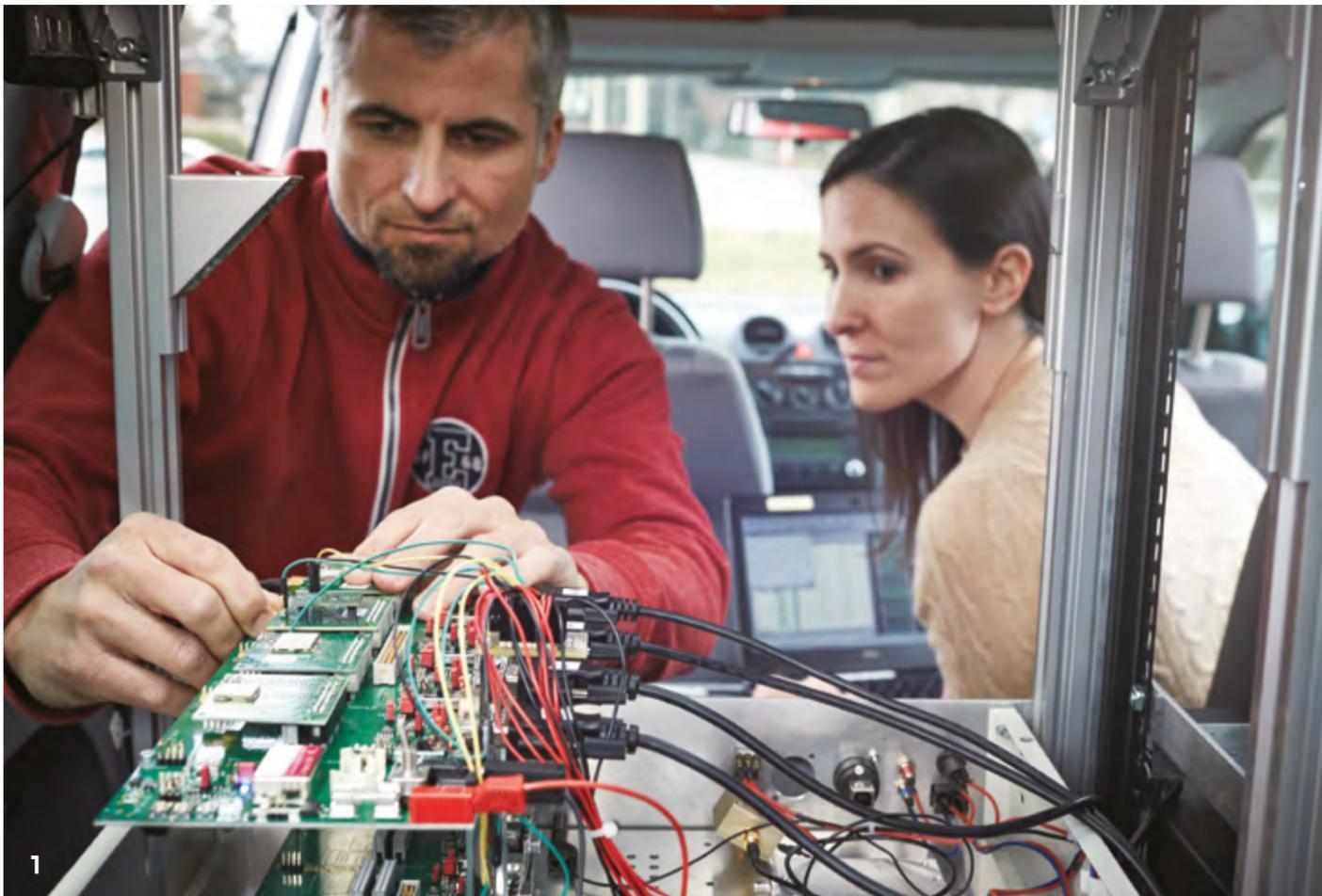
25000

km the GPS Testing Vehicle was on the road since its commisioning

16

receivers can be tested in parallel

5

antennas are mounted on the roof of the car for the reference system and the test receivers

The u-blox test car provides more meaningful results than what can be achieved in a lab. It enables testing of all automotive-grade chips and modules in a wide variety of environments in which they'll be used, from multi-story car parks and urban canyons to highways in wide open spaces.

The car is equipped with a high precision Inertial Navigation System (INS), two geodetic GNSS receivers and a Distance Measurement Indicator (DMI). Routes are tracked with great accuracy to enable error measurement and statistical analysis. Everything that's learned from these tests is then used to optimise the performance of u-blox products. ●

1
Getting ready for a test drive

2
The u-blox GPS Testing Vehicle helps to validate the accuracy of chips and modules.

TOP-NOTCH QUALITY GRADES

The cornerstone of all u-blox product design and manufacturing philosophy is quality. However, through a policy of customer-led innovation, the company understands that each application has its own special environmental requirements.

Standard grade products are designed for price-sensitive consumer applications, where they'll usually be used in benign environments. More rugged products are used in professional and industrial applications. These have environmental conditions such as a wider operating temperature range, stronger vibrations and a longer product life.

However, automotive applications, including those for the connected car, demand more. That's why u-blox makes a range of modules and integrated circuits that are subject to extended ISO 167050 (AEC-Q100) evaluation and qualification. These are designed for long-term, reliable operation in the potentially harsh environmental conditions experienced in and around our cars: high levels of EMI, bump, shock and vibration, and extremes of temperature. They operate over a minimum ambient temperature range of −40 °C to +85 °C and for some types even beyond that. These products are characterized by lowest possible field failure rates. They have long-term availability to support the automotive industry's product life cycles and are subject to automotive quality processes (PPAP, 8D, Failure Analysis, PCN).

For every connected car there's a reliable and cost-effective u-blox solution: easily integrated GNSS, short range wireless and cellular radio chips and modules. ●

LEARN MORE:
www.u-blox.com/pg
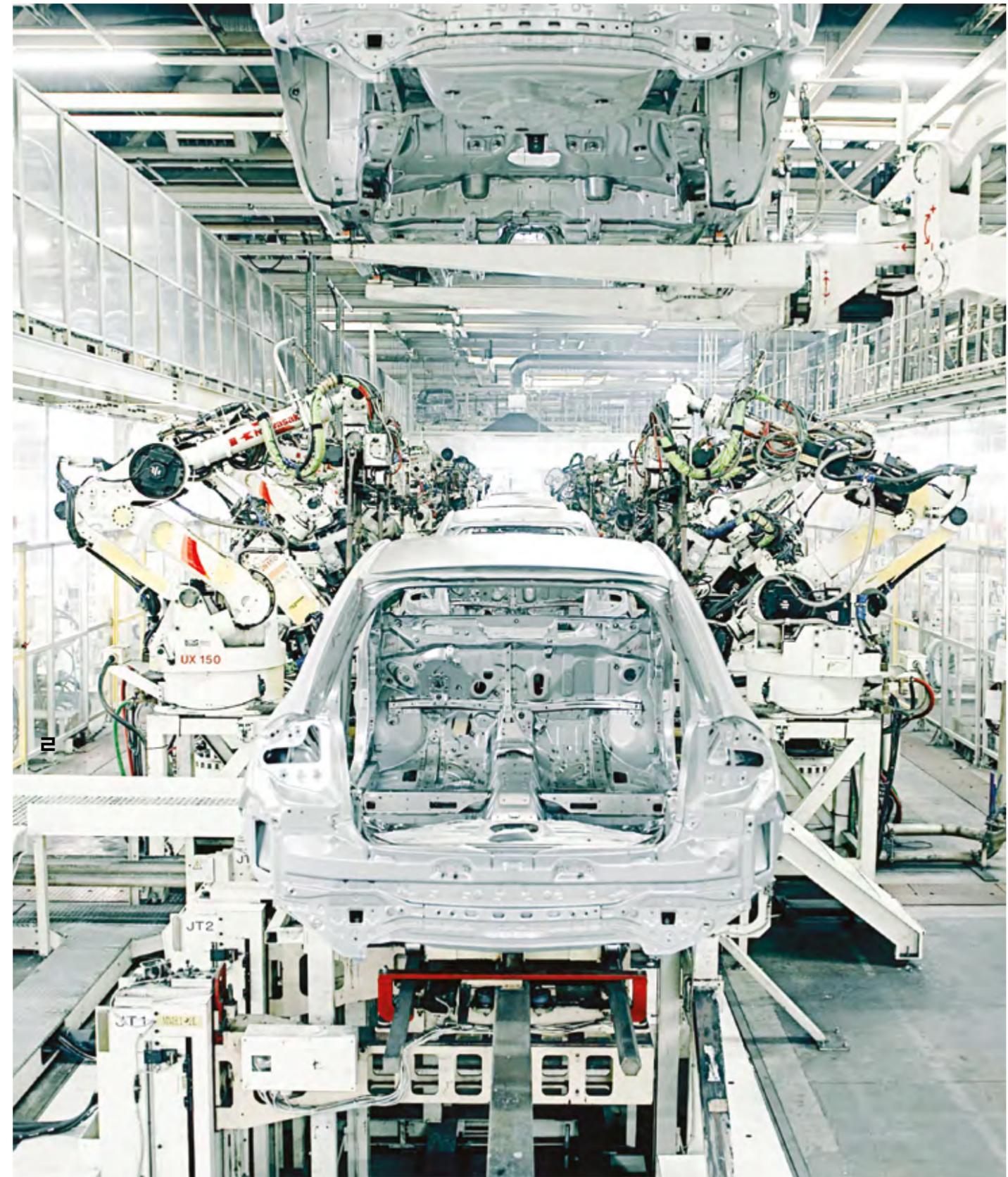
Fit for the automotive industry:
Automotive grade products from u-blox.

u-blox.com