Connected people

u-blox

Foreword

Dear Readers,

We are delighted to present to you the fifth edition of our u-blox magazine, with a focus on how the rising tide of wireless connectivity, cloud computing, and big data analytics is redefining the way we work, live, and interact. Welcome to the connected society.

According to a report by We Are Social and by Hootsuite, for the first time, more than half of the global population spends time online. International Data Corporation (IDC) forecasts that annual sales of wearable devices will almost double from 2017 to 2021, reaching 222.3 million units. And revenue generated in the sharing economy, enabled by the rise of the connected society, are predicted to double by 2022, reaching over US$ 40 billion, reports Juniper Research.

This has tremendous potential to increase economic productivity and enhance health and wellbeing, public and individual safety, and environmental sustainability. As a global provider of positioning and wireless communication technologies, u-blox is perfectly positioned to contribute to shaping this societal transformation. Of course, this does not come without responsibility, but we are prepared to assume a leadership role to ensure that, at their core, connected devices are secure.

So, where is this brave new connected society headed? How will wearables, combined with cloud-based data analytics impact our health and our healthcare systems? In what areas will wearable devices and smart clothes, already hugely successful, truly come into their own? How can we keep malevolent hackers out of our devices? And where might the sharing economy go next? This magazine will take you on a tour of the connected society and the many future applications it has the potential to enable.

We wish you informative and smart reading.

Yours sincerely,

Thomas Seiler, CEO

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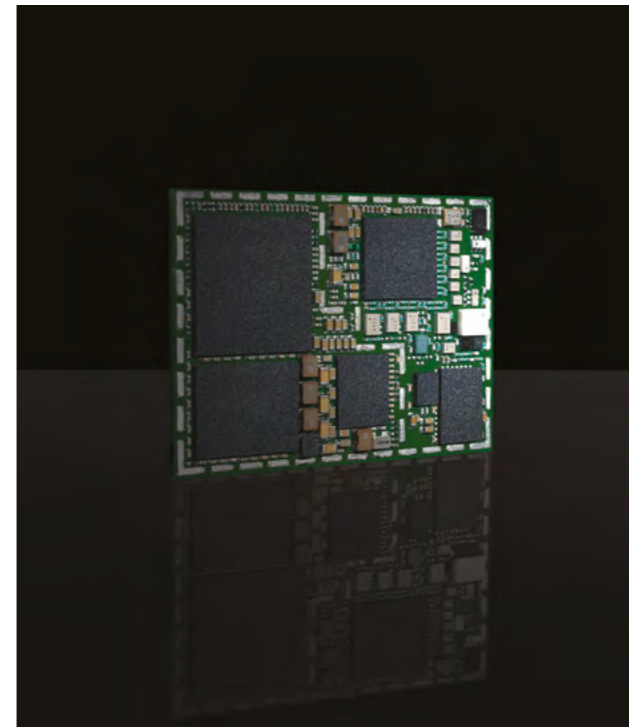

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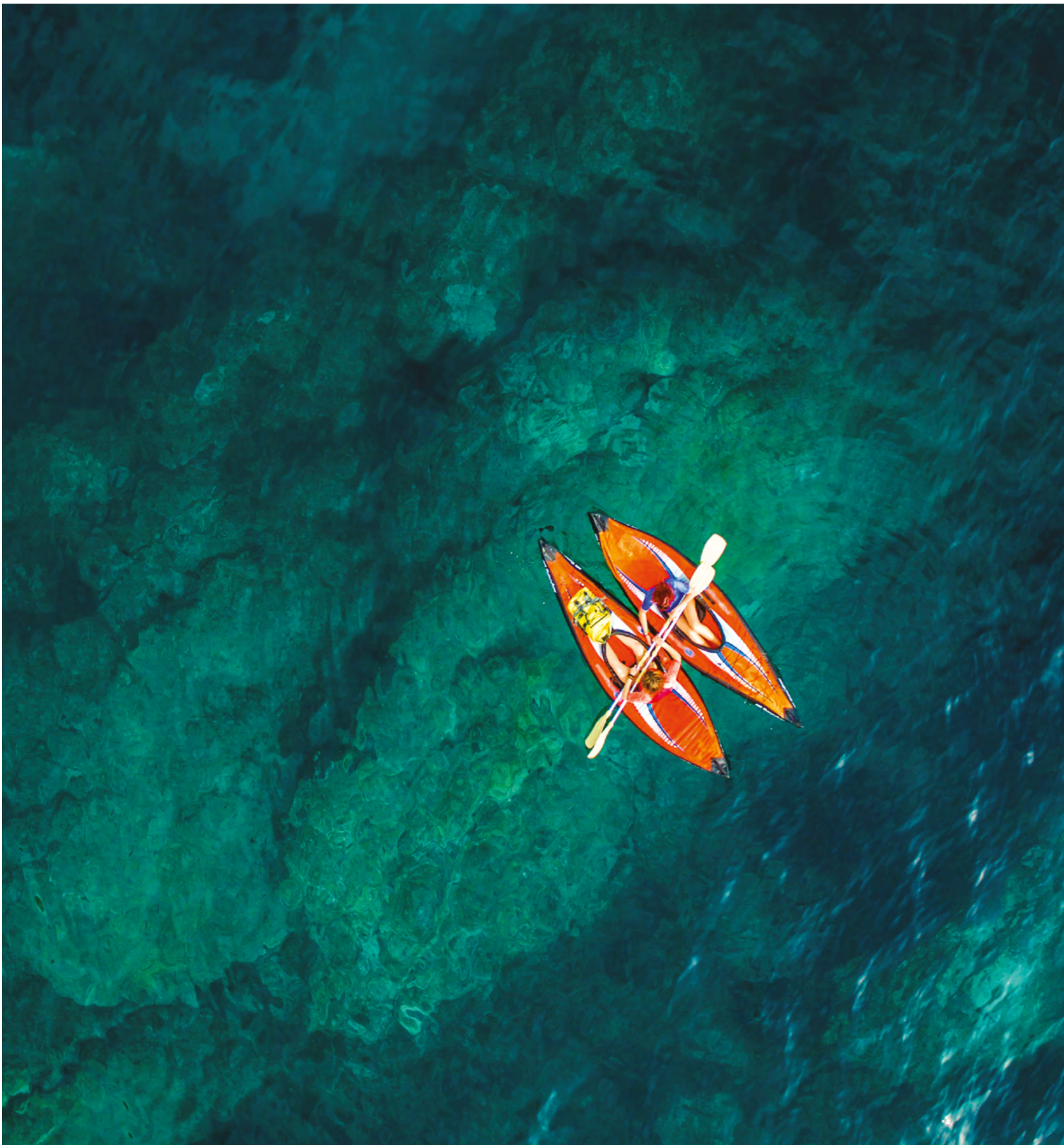
A brave new connected world

We're on the cusp of a digital revolution that will impact every aspect of our lives.

41%

Global wearable shipments for the enterprise to grow with a compound annual growth rate of 41% in the five years following 2022.

Source: ABI Research

Connectivity is a hallmark of life itself. From minute bacteria to majestic redwoods, all living organisms live in a state of constant communication with their surroundings. But no other species does it quite like we do. Using today's technology, we can connect with people on all five continents with a single click. We can track and analyze our movements, our vital statistics, and other personal data and share them with family members, doctors, employers, or just about anyone else in real-time. We can augment ourselves by leveraging the collective knowledge stored on the Internet and the computational power of the cloud. And we can share, trade, and cooperate like never before. Pheromones may be fascinating, but we're onto something much bigger.

Learn more:
www.u-blox.com/we-talk-wearables

It took tens of thousands of years for humans to develop writing, and thousands more to develop the printing press. Hundreds of years later, we began to harness modern telecommunication. A few more decades in and we were developing computers and, eventually, the Internet. And today, just over ten years after the iPhone, smart wearable devices, virtual reality (VR), augmented reality (AR), the Internet of Things (IoT), and artificial intelligence (AI) are emerging at the nexus of wireless connected devices, ubiquitous sensors, and cheap, abundant, and powerful computational power on devices and in the cloud. We've never been as connected.

Lifestyle changers or shiny new toys?
But why do we adopt connected technology? Mostly just because we can. Consider wearables – connected devices like those we wear on our wrists – which, today, along with our smartphones and smart assistants, are our prime gateway to the cloud.

A 2016 PwC survey on wearable technology[1] found that wearables help their users exercise smarter, keep their children safe, relieve stress, and increase productivity, both at home and at work. More often than not, however, the enthusiasm is short-lived. Another survey by Gartner[2] found the abandonment rate for smartwatches and fitness trackers to be 29 and 30 percent respectively. They traced this back to the lack of compelling value propositions. Or, as an earlier PwC report[3] suggested, the devices are often "shiny new toys, rather than lifestyle changers".

Amending this will involve making wearables truly relevant by further increasing their usefulness. If users are promised what they perceive to be an essential benefit from the devices they see in commercials, they'll adopt them not just because they can, but because they feel they should.

There are arenas in which this is already the case, one of them being business. Companies will only integrate wearables into their strategy if they expect them to improve their bottom lines. And the numbers reveal their optimism. ABI Research[4] predicts global wearable shipments for the enterprise to grow with a compound annual growth rate of 41% in the five years leading up

to 2022, outpacing the growth of those devices targeting only end-consumers.

There are many reasons for companies to be bullish: wearables and AR shorten the time it takes for employees to get up to speed on new tasks. They promise to improve health and safety at the workplace by tracking vital signs, monitoring exposure to harmful substances, sounding alarm in case of injury, and nudging workers towards healthier behavior. Wearables provide employers a way to track the productivity of their workforce. And they can streamline day-to-day workplace activities, for example, by automatically authenticating users to their locations and devices.

"Companies will only integrate wearables into their strategy if they expect them to improve their bottom lines."

Data is the new dollar
But merely focusing on immediate user benefits – steps counted, calories burnt, and knowing where your puppy has run off to – still misses half of the equation: data. The devices that connect us to the cloud and the services they run generate a continuous torrent of data, ranging from health-related information, real-time position, geographically and time-tagged audio and video, and work-related information, to name just a few.[5] Unquestionably valuable, but still largely unexploited, this constantly growing ocean of data underpins the new data economy,

in which data can be bought, sold, and exploited. Companies seeking to gain value from the data can easily find themselves trying to drink from a firehouse. Armed with the right kinds of data analytics, however, the data can reveal invaluable descriptive, predictive, and even prescriptive information that can guide their decision-making.

The extent to which the data is leveraged depends on the application. In the healthcare sector, where wearables are already used to monitor patients, the elderly, and their own staff, medical professionals and caretakers can remotely monitor the wellbeing of individuals and receive automatic notifications in the case of emergencies or other incidents. Pharmaceutical researchers can analyze the data sets to monitor clinical trials and quantify the impact of drugs and treatments on larger groups. Hospitals might also track their workforces to streamline their workflows. And the fact that everyone else's devices generate data as well means that, for the first time, there is an abundance of information about healthy people as well.

Data can be a veritable goldmine for retail businesses. Again according to ABI[5], retail companies can purchase wearable data from data brokers such as Emu Analytics and DataStreamX to gain insight into their customers' habits. This lets them push tailored offers and recommendations to their target audience, allowing them to sell more products and better meet the needs of their customers. Service industries can profit as well. Insurances, for example, can better assess risks, offer discounts to physically active individuals, and calculate more advantageous insurance rates. And in the enterprise, at least on paper, data collected from the workforce can deliver actionable business intelligence that companies can use to streamline and optimize their operations.

Whatever the application, players in the data economy will have to tread with care. From our computers to our smartphones to our wearables, all our connected devices leave behind a digital trace, potentially including our whereabouts, our shopping, driving, and dating habits, our cardiovascular health and more intimate

[1] The Wearable Life 2.0, Connected living in a wearable world, Consumer Intelligence Series, PwC, 2016.
[2] User Survey Analysis: Wearables need to be more useful, Gartner, November 2016.
[3] The Wearable Future, Consumer Intelligence Series, PwC, 2014.
[4] Enterprise Mobility Management Services for Wearables, ABI Research, August 2017.
[5] Wearable Data Analytics and Business Models, ABI Research, December 2017.

Medical professionals and caretakers can remotely monitor the wellbeing of individuals and receive automatic notifications in the case of emergencies or other incidents.

All our connected devices leave behind a digital trace, potentially including our whereabouts, our shopping, driving, and dating habits, our cardiovascular health or our search records.

After privacy, security is a second Achilles heel, as wearables and other forms of connected devices gain influence on our behavior.

details, such as our search records and, for women, our menstrual cycles. With the right AI, this data can be crunched to reveal actionable information that companies can use to target products to consumers when they are most likely to make a purchase. If companies are found using this data in reckless ways, they can quickly alienate their customers. Facebook experienced this first-hand when it was recently revealed that Cambridge Analytica, a British political consulting firm, had mined profile data from at least 50 million Facebook users to illegally influence the 2014 and 2016 US election cycles.

"Companies are and will continue to be challenged to protect their customers' data privacy, with the high value of data increasing the allure of data theft."

Companies are and will continue to be challenged to protect their customers' data privacy, with the high value of data increasing the allure of data theft. Consumers have reason to be concerned. Surprisingly, however, despite numerous reports of data breaches, the 2016 PwC study[1] found that consumer opinion improved in the two years from 2014 to 2016, with an eight percent drop in consumers concerned that wearable technology might make them more vulnerable.

After privacy, security is a second Achilles heel, as wearables and other forms of connected devices gain influence on our behavior. Yet, despite the risks posed by malevolent hackers breaking into our devices, security often takes a backseat to other factors, such as functionality and user experience. This is largely a consequence of fierce competitive pressure for consumer brands to be the first to market in their product category – a situation that is improved in professional applications where the stakes are higher.

Connectivity lost and found
The connected society is a journey, not a destination. It's a work in progress. A game of trial and error, where the ultimate test is long-term adoption. This is as true for new forms of wearable technology as it is for new business models and for social networks. Take Google Glass, which, after first generating global euphoria, gave us the expletive "Glasshole" to refer to creepy-looking users of the technology. The technology was shelved, but has since been reborn to target assembly line workers. All it took to make the device acceptable was finding the right context. Lessons learned from the experience are finding their way into new forays into the smart glasses space, such as Intel's Vault glasses, which go to great lengths to simply look like glasses, nothing more.

The same thing is going on in business. Radically transformed marketplaces have emerged that bring together millions of people online to buy and sell goods and services. From Uber's ride sharing to Airbnb's accommodations, from Ofo's shared bikes to Alibaba's e-commerce platform,

these services have disrupted long-established industries at such a speed that they left governments and regulatory authorities playing catch-up. As in the evolution of species, the business models that are best able to adapt and thrive in their niche will come out on top. The others will fall by the wayside.

Despite their positive role in spawning the #MeToo and #BlackLivesMatter movements, social networking platforms – the epitome of the connected people – are facing increased scrutiny for the way they are designed to lure in new users and addict them, robbing them of two of today's most valuable resources: time and attention. As a response, the Time Well Spent movement was founded by Tristan Harris, a former Google employee, to promote a more positive, humane Internet that brings out the better angels of our nature rather the angry Twitter troll that lurks inside each of us. Could the looming battle over the Internet be a forerunner of similar challenges that will play out in other arenas, from wearable to the sharing economy to the IoT? If so, it'll be worth following closely.

"What might it mean for our social, professional, and family lives? And how will it transform our businesses, our economy, and our free time? "

Peering into the future
Some embrace our newfound digital connectivity while others distrust it. But it's difficult to be indifferent to its promise. As the technologies mature, merge, and blend into the objects that we use every day, they promise to augment us beyond recognition. How many problems that challenge us today could be cast aside by augmented societies? What might it mean for our social, professional, and family lives? And how will it transform our businesses, our economy, and our free time? At the same time, how will humanity deal with the increased risk and responsibility that these technologies entail? Despite so many open questions, the industry is

charging ahead at breakneck speed, and some governments are following. Taking Germany's Industry 4.0 initiative to digitalize the industry one step further, Japan last year announced its vision for a Super Smart Society – the Society 5.0. Driven largely by necessity due to an aging population and a dwindling workforce, the government hopes that pervasive digitalization will allow to reap the benefits of the IoT, Big Data, AI, and intelligent robots in a highly connected society. By setting up programs to promote startups in these areas, the government has taken first steps to jumpstart R&D and spur innovation in the field.

With the accelerating pace of technology, it's difficult to spot the next game changer. But there's little doubt that the blockchain, the distributed ledger behind digital currencies such as Bitcoin, will be transformative. By offering a nearly inalterable and trustworthy record of anything from transactions to healthcare and voting data, it does away with the need for digital trust, providing a toolkit to address one of the key challenges: increasing transparency. Blockchain technology further promises to bring digital society closer together by replacing intermediaries such as commercial online platforms with more decentralized public networks.

The rise of the digitally connected society has already left an indelible mark, but this is just the very beginning. Today we already take wireless access to the Internet for granted, as we do the air that we breathe. As more and more technologies are seamlessly taken up into our daily lives, they'll simply become second nature. The potential cultural and societal ramifications are far-reaching. But to paraphrase much-attributed quote, predications are always difficult, especially when they are about the future. ■

Wearables: from hype to monetization

From healthcare to insurances, from public safety to retail, businesses are finding ways for wearables to create real value.

Connected wearables have enjoyed spectacular growth in recent years, leaving behind the hype to become ubiquitous bits of kit. They, in turn, provide a wealth of real-time information for the user and others. Able to collect all kinds of data about us and our surroundings, these devices are doing more than just changing the way individuals live. From a commercial perspective, they're underpinning whole new services and business models that leverage this new data. As a result, monetization opportunities are shifting from the devices themselves to the services they enable.

Making a difference in healthcare

Given that many wearables monitor our bodies, healthcare has been an obvious growth area for new products and services.

An already-common wearable use case is for remote patient health monitoring. This benefits both health services and patients. For the former, it reduces the need for routine check-ups or monitoring appointments, enabling stretched resources to be redirected to where they're most needed. For patients, this always-on monitoring gives them the peace of mind to live their lives as normally as possible, safe in the knowledge

that if something goes amiss, they (and their clinicians) will be alerted.

Elsewhere, data from wearables could enable health insurers to offer new kinds of pricing, based on individuals' lifestyles. Some motor vehicle insurers have smartphone apps that track your driving and offer reduced premiums to safer motorists. Health insurers can do likewise using wearable data.

Keeping safe

Personal trackers are another big growth area. In additino to the consumer market, where they let people keep an eye on their children or pets, these trackers are increasingly being targeted

10m

The number of wearables shipped for use in retail is expected to hit 10 million in 2022 – up from just two million last year.

Source: ABI Research

towards businesses with mobile workforces, to help keep employees safe.

In a similar vein, police-style, connected, body-worn cameras are being rolled out to growing numbers of public-facing, field-based workers in other sectors, including road maintenance and urban landscaping.

Transforming retail experiences – in-store and online
Wearable technology is also appearing in retail. Keen to find ways to stay relevant in the face of online competition, bricks-and-mortar stores are looking to wearables to improve customer experience. For example, giving a shop worker a wearable device that enables them to check stock levels or find which shelf an item is on means they can answer queries more quickly, without leaving the customer.

Others are using in-store wearables to transform the online retail experience by equipping staff with smart eyewear. This gives online shoppers the opportunity to explore the store as if they were physically there.

The plethora of new possibilities means the number of wearables shipped for use in retail is expected to hit 10 million in 2022 – up from just two million last year, according to ABI Research.[1]

Could security concerns jeopardize wearables?
As with most wearable-driven business models, many of these examples rely on the wearer being happy to share the collected data with one or more service providers. This could be their device manufacturer, health service, employer, or another organization.

Given the criticality of data to many of the services, what effect is the growing public awareness of cybersecurity going to have? Will people be less willing to share data in future?

Perhaps surprisingly, research suggests otherwise. A study by Ericsson[2] found that significant numbers of wearable users are happy to share

their data with other organizations if they feel they're getting value in return. Interestingly, device manufacturers were top of the list of organizations users were most willing to share with. Moreover, 70% of wearers believe device manufacturers are "very serious" about protecting data, and 60% feel in control of what they share and who gets to see it.

1

This is a major challenge, particularly when you consider the relentless pressure for consumer device manufacturers to get products to market quickly, and the ever-more-complex nature of the Internet of Things. With its growing number of attack surfaces, this ecosystem demands holistic protection if people's data is to be kept secure and private.

The opportunity is now
The fact that we're talking about real monetization opportunities and are able to study comprehensive research into wearable users' attitudes towards privacy shows just how far these devices have come in a short space of time.

The hype has been well-and-truly replaced by real products and services, underpinned by now-mature technology. And even as public awareness of the security risks grows, users are willing to share the data their devices collect. For those looking to create new services that use this data, now's the perfect time. ■

2

Trust in the companies behind these wearable devices and services appears, for now at least, to be relatively high.

Taking security seriously
This represents an incredible opportunity for wearable makers and others to offer more of the data-driven products and services we've talked about. But if they're to succeed in the medium and longer term, they need to fully protect the data they're being entrusted with.

1 Some motor vehicle insurers have smartphone apps that track your driving and offer reduced premiums to safer motorists.

2 A significant numbers of wearable users are happy to share their data with other organizations if they feel they're getting value in return.

[1] Staff Wearables: Closing the Retail IoT Loop, ABI Research, November 2017.
[2] Wearable technology and the IoT, Ericsson, June 2016.
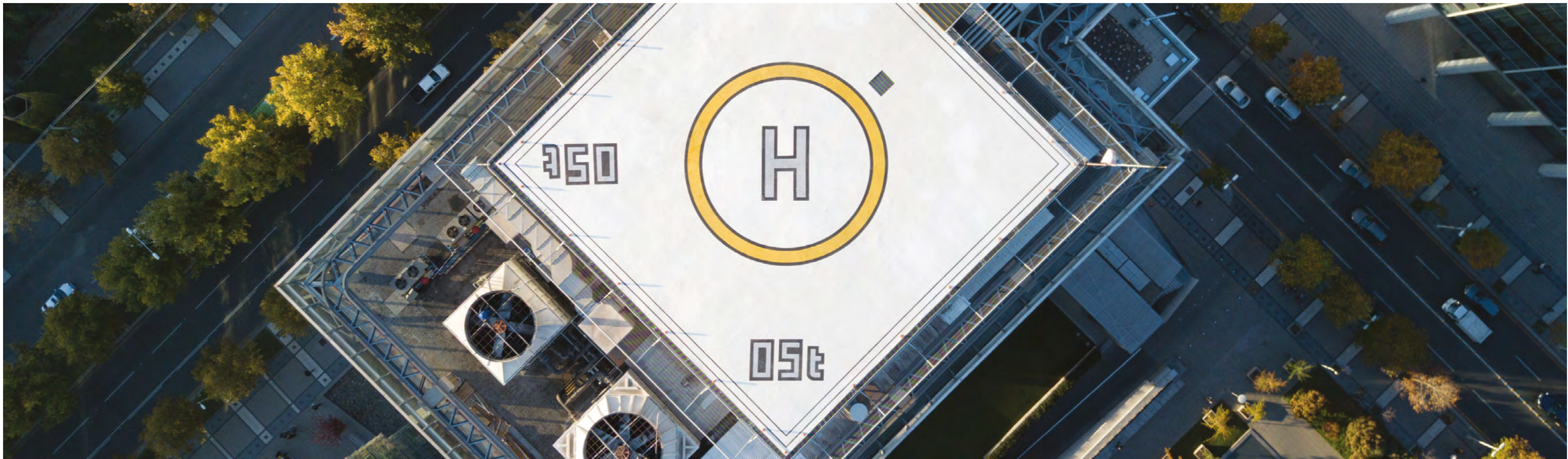
Eh, what's up, eDoc?

Not only will connected technology improve our health, it just might save our ailing healthcare systems.

You're cruising down the highway, engine running smoothly, when a dashboard sign lights up. It's your car's way of telling you it's time to see a mechanic. Vehicles have long been equipped with sensors that look out for disturbances so that problems can be stomped out before they pose a threat. Now, this idea of predictive maintenance or care – already widespread in industry – is entering healthcare as one component of connected healthcare. Enabled by cloud-connected wearable sensors, AI-powered data analytics, and smart devices, connected healthcare has the potential to increase patient autonomy, improve health outcomes, and reduce the pressure on the healthcare system. The price tag? Hundreds of billions, according to Deloitte[1] – in savings!

Wearable sensors are one part of the equation. In the not-too-distant future, you'll be able to turn to your watch to read a litany of statistics: your heart rate, blood pressure, blood oxygen

200 bn USD

Improving chronic care management using remote patient monitoring could save US$ 200 billion over 25 years in the US alone, while also reducing the cost of elder care in rural areas by 25%.

Source: Deloitte, 2015

[1] Accelerating the adoption of connected health, Deloitte Center for Health Solutions, Harry Greespun, MD; Casey Korba, MS; Sunandan Bandyopadhyay, Senior Analyst, 2015.

levels, temperature, stress levels, blood glucose levels. You'll get information on how you've been sleeping, how much you've been moving, and if you're pregnant, how often your baby has kicked. Your wearables will remind you to take your meds, nudge your towards better habits, and send you alerts, much like your car's dashboard.

Big data analytics and cloud connectivity are another. Taken in isolation, your vital statistics and health data are of limited utility. But combining them with everyone else's gives them boundless potential. Big data analytics on the cloud will reveal population-wide patterns, allowing to track the spread of diseases. Physicians and pharmaceutical companies could gain instant feedback on the performance of treatments, speeding up clinical trials and innovation in general. And medical professionals will benefit as artificial intelligence crunches and makes sense of the data amassed.

"Today, the true challenge lies in finding efficient and safe ways to bring these disparate initiatives together."

Tech for the elderly

But initial gains will most likely come from improved doctor-patient communication and the increased autonomy that technology will give patients, the elderly in particular. In a report by Deloitte, three out of four objectives of connected health involve facilitating self-managed care, remote patient monitoring, and providing assistance to sufferers of chronic disease[1]. The report estimates that improving chronic care management using remote patient monitoring could save US$ 200 billion over 25 years in the US alone, while also reducing the cost of elder care in rural areas by 25%. It's a convincing argument in a day and age of ballooning healthcare costs.

The technological ingredients for connected healthcare exist, and initiatives at the crossroads between IoT and health abound.

Connected inhalers track when patients take their medication, allowing doctors to assess their patients' adherence to the treatment they've been prescribed. The same can be achieved using ingestible sensors integrated into pills that send out a blip to a receiver when they are swallowed. IoT solutions let caretakers, relatives, and loved ones remotely watch over elderly people living at home by relaying data gathered on smart medical devices and other connected appliances. And insurance companies are already using digital technology to nudge their customers towards healthier behavior, rewarding them with lower monthly fees.

Today, the true challenge lies in finding efficient and safe ways to bring these disparate initiatives together. Despite myriad startups developing just as many solutions, it will be years until we can all reap the benefits that they will bring. Adoption is also slow, both on the part of providers and beneficiaries of healthcare. Privacy and data ownership are other issues that have yet to be fully resolved. A first step is recognizing healthcare cybersecurity as a key public health concern requiring urgent and utmost attention. But the biggest hurdle is the lack of a global platform – today still a utopian dream – and a regulatory ecosystem to safely share patient medical data while ensuring interoperability among competing service providers.

Tools of the tech titans

This need has not gone unnoticed by multinationals that are staking their claims in the health IT space. IBM has been positioning Watson, its AI supercomputer, as a virtual assistant in variety of areas, from drug discovery and oncology to social program and care management. Apple has been moving into the healthcare space for years, most visibly with its Health app for recording and aggregating data, but also through a variety of other initiatives, such as running clinical trials to test its technology's potential to identify cardiac arrhythmias. Recently, the company announced a solution to give all American's access to their health data via their smartphones. Microsoft has also been involved in the area for a while now, investing in health-related initiatives – most of them involving AI – to analyze DNA, power health chatbots,

and more. Its Hololens is being tested to bring healthcare professionals into patients' living rooms as holograms.

We all stand to benefit from connected health, whether we're patients, tax payers, or in the tech business. But some fear that artificially intelligent eDoctors will make human doctors redundant, and deplete healthcare of its humanity.

If past adoption of AI by the medical community can provide any guidance, it is unlikely that the technology will take final decisions on courses of action out of the doctors' hands. It will, however, certainly augment them. ■

1 Big data analytics on the cloud will reveal population-wide patterns, allowing to track the spread of diseases.

2 Ingestible sensors integrated in pills that send out a blip to a receiver when swallowed.

3 Microsoft's Hololens is being tested to bring healthcare professionals into patients' living rooms as holograms.

Why wristbands are only the beginning

Smaller, more power-efficient components are enabling a new generation of wearables that can link up to the cloud on their own.

When you mention fitness trackers, most people think of wristbands, like those from Fitbit and other early wearable pioneers. These devices were the first real example of connected wearable technology that achieved mass-market penetration. Today, there are so many of these wrist-worn products available that we're spoiled for choice and adoption is widespread – if you don't own one yourself, you'll surely know someone who does.

But arguably more interesting than the sheer pervasiveness of wearable fitness trackers is the significant behavioral change they're driving when it comes to the way we look after our health and wellbeing.

Transforming behaviors
For starters, wearables enable us to understand our bodies and lifestyles better, and consequently take steps (sometimes literally) to live more healthily.

But it's when you combine these health insights with the current social-media-driven notion of sharing things online, that it gets really interesting. Because this intersection is leading to completely new health-related behaviors and interactions.

Imagine you're training for a marathon. Not so long ago, this would have been something you shared with close friends, family, and maybe a handful of other runners in your local area or workplace. Now, however, you can share your training progress online and compare progress, discuss challenges, congratulate one another on successes, and generally benefit from whole new support networks.

It's a fascinating change, and something people are embracing for now – a quick glance down your Facebook or Twitter feed will almost certainly reveal one or more posts based on data from a fitness wearable. Run routes, distances, and times are particular favorites.

Going beyond wrist-worn trackers
These social networks and interactions, centered on health and fitness data, are helping to drive development of other fitness wearables, beyond the wrist-worn tracker.

Apple's Nike+iPod Sports Kit, which tracked your walking and running using a wireless sensor in your shoe, was arguably well ahead of its time when it launched in 2006. While this particular product has been discontinued (though you can still get them from some retailers), recent years have seen, if not a flood, then certainly a notable flow of new non-wrist wearables from established firms and startups alike.

Sensoria, for example, has a range of connected clothing, including t-shirts, ankle bands, and socks. Swim.com and Spire announced their smart connected swimwear at CES 2018. The Welt smart belt, born out of a Samsung Creative Lab project and tracking waist size, activity, and overeating, is now going into production. And L'Oréal recently demoed a wearable UV sensor that connects to your smartphone and tells you when you're getting too much sun, nudging you to put on more sunscreen.

"These social networks and interactions, centered on health and fitness data, are helping to drive development of other fitness wearables, beyond the wrist-worn tracker. "

Enabling the wearable revolution
While these devices are worn on different parts of the body and serve different purposes, they all need to be equipped with sensors to pick up things like temperature, heart rate, impacts, or location. But first and foremost, they require small, lightweight core technology that uses as little energy as possible.

Constantly tracking a person's position demands long battery life. At u-blox, we recently launched our ZOE-M8B, the ultra small, ultra low power GNSS module. To cut power requirements without sacrificing high performance, the ZOE-M8B leverages proprietary u-blox Super E technology, which automatically adjusts the power consumed by the system components based on the external environment.

Connected wearables then need a way of sending this data to other devices or the Internet. Some are designed to work with a nearby smartphone, in which case they'll typically link up using Bluetooth® low energy. If the wearable needs to connect to a network in its own right, it'll need cellular capability, probably using one of the low-power, long-range standards. Bluetooth low energy mesh technology can also contribute to the wearable revolution, for instance when installed in a gym. It would then be used by gym members to send data to the cloud via a mesh network, connected to a gateway.

Getting this part of the product design right is critical – communication can be a power-hungry business and requires the right components, configured in the right way, based on how the device is intended to be used.

An exciting year beckons
Many are getting this balance right, which is why the next 12 months promise to be incredibly exciting for health- and fitness-related wearables. Lots of things are coming together at the right time. Firstly, core technology that's specifically designed for wearables is now readily available, including from u-blox. This is enabling manufacturers to bring exciting new products to market. And as wristbands have shown, consumers are enthusiastically embracing this connected wearable revolution. What will your next smart garment be? ■

Learn more:
www.u-blox.com/product/zoe-m8b-module

1 Sensoria has a range of connected clothing, including t-shirts, socks, and ankle bands.

2 My UV Patch from L'Oréal is a stretchable skin sensor designed to monitor UV radiation in real-time to give wearers a heads-up about their personal sun exposure.

Care to share?

The sharing economy has already disrupted established industries, but the real changes may still lie ahead.

By now you've probably at least once participated in the sharing economy. If not, it's a safe bet that you know someone who has. The sharing economy lets you borrow, rent, or benefit from other people's goods, services, experiences, or knowledge. And it's a force to reckon with. Two of its most prominent representatives, Airbnb and Uber, with a combined value of around US$ 80 billion, famously shook the ground beneath traditional hotel and taxi industries with their flexible and affordable services. But the biggest disruptions have yet to hit us, with truly decentralized and autonomous community-owned services already in the making, courtesy of the blockchain.

But first, what is the sharing economy? The term itself is a bit of a misnomer. In fact, the sharing economy covers a broad swath of business models, only some of which are truly about sharing. In its heyday the Couchsurfing platform connected millions of people looking for a place to sleep with community members offering a couch or a bed, free of charge. Sharing was writ large. But the vast majority of businesses in the sharing economy, in particular the larger, well-known ones, services and goods are monetized. You pay for your Airbnb flat, your Uber ride, or your co-working space. In what is often more accurately referred to as the access

economy, platforms operators connect users to goods and services they would otherwise not have access to.

And this is only the beginning. As the Internet of Things penetrates deeper into every aspect of our daily lives, it is calling into question the very way we think of ownership. Why, for example, own a car if a cloud-based service can route one to you where- and whenever you need one? It's telling that big car companies such as BMW are thinking about innovative models of mobility based on sharing vehicles that better account for our evolving needs.

Big data, the cloud, and IoT
To thrive in societies, humans have always relied on sharing both goods and access to them. What's new is the scale at which this is playing out today. The sharing economy as we know it couldn't exist in a less digitally connected world.

335bn

The sharing economy will grow from US$ 14 billion in 2014 to US$ 335 billion by 2025.
Source: The Brookings Institute

Today's virtual marketplaces bring together millions of strangers online. Smartphones and other smart devices mean that people can access these marketplaces from wherever they are. And many applications rely on big data analytics to calculate the going rate of assets or services on the fly.

The big players in the sharing economy today all build on a variant of this model. Airbnb connects homeowners with prospective tenants, Uber connects drivers with people looking for a ride, and other services provide anything from a loan, clothes for an evening, co-working spaces, freelance jobs, tools, lessons, and countless others. And online reviews, track records, and identity checks help create trust between the service providers and the users.

As a result, the world has become one big marketplace able to connect anyone with an Internet connection with everyone else. Users are promised better, cheaper, on-demand services tailored to their needs. And the glue that holds it all together is a fickle one: trust.

The success of this approach can be read from the numbers. The Brookings Institute predicts[1] that the sharing economy will grow from US$ 14 billion in 2014 to US$ 335 billion by 2025 based on the rapid growth of Uber and Airbnb. But despite this growth, the economic impact of the sharing economy on gross domestic product (GDP) is small. GDP may actually fall when you rent a drill from your neighbor instead of buying one at the local hardware store. While those monetizing their services in the sharing economy are paid, wealth accumulates primarily in the hands of the platform owners.

In blockchain we trust?
If the rise of the sharing economy was an economic tremor, there may be a major economic quake on the horizon. Blockchain, the distributed ledger that powers digital currencies such as Bitcoin, is beginning to prove its potential to power the sharing economy without recourse to a materialized and centralized platform. Additionally, smart contracts, which are enabled using blockchain technology, allow both parties

to agree to terms, with money automatically changing hands when these are met. In a true peer-to-peer economy, middlemen stand on the sidelines, and trust, the key enabler of today's sharing economy, is made redundant.

Examples of blockchain-enabled decentralized services are already being built today, for example for co-investing, bypassing traditional banks entirely. One of them, Switzerland-based TEND, offers a way for people to co-own luxury assets, such as cars, paintings, wine, and watches. By purchasing asset-specific tokens – shares in a given asset in the form of a cryptocurrency similar to bitcoin – participants benefit from increases in the asset's value. And if the asset is a car, they might even get to take it for a spin. MyBit, another one, uses the blockchain and smart contracts to let anyone invest in infrastructure – for example solar panels – and benefit from the revenue it generates.

The forces driving the emergence of the sharing economy, in both its current and future forms, are technological innovation, ubiquitous wireless connectivity, and, crucially, an excess of the assets being "shared." Otherwise idle assets are put to use, from homes to vehicles to just about anything else. Its promise for increased efficiency and broad access to affordable and effective services are, however, balanced by open questions on how they should be regulated and who should be held responsible when something goes wrong. It will likely take some time for the shared economy to work in the best interests of all involved. ∎

1 The Current and Future State of the Sharing Economy, Brookings India IMPACT Series No. 032017, March 2017.

Switzerland-based TEND, offers a way for people to co-own luxury assets, such as cars, paintings, wine, and watches.

The new social fabric

Connected clothes have demonstrated their potential. But to grow out of their niche, they will need to add real value to their users and to the companies that produce them.

2nd

Smart clothing is the second fastest growing category of wearables.

Source: ABI Research

If your clothes could speak, what would they tell you? In direct contact with your skin almost 24/7, they feel your excitement and your cold-sweats, your exertions and your idleness. In many ways, this makes them the perfect habit tracker. Fitted with the right technology, smart clothes could become the user-interface of the future – one without a keyboard or a screen. And they're already finding wide-ranging application, from tracking athletes and workers to supporting the elderly and disabled, from monitoring our health and wellbeing to non-verbally connecting us with the people around us.

We've come a long way since the pioneers of wearable computing started donning their contraptions in the 1990s. In a triumph of engineering over fashion, their wearables consisted of computer components pragmatically attached to their bodies. Today, components have become so small that the hardware has largely disappeared from sight, prompting fashion designers to take wearables more seriously. In the future, more and more of the technology is likely to be stitched right into the fabric.

A report by ABI Research[1] found that smart clothing is the second fastest growing category of wearables. That said, it still has one of the lowest market shares. Despite its tremendous technological potential, wearable tech providers have yet to win over somewhat skeptical consumers – and their own executive boards – by finding a way to make money by meeting a genuine consumer need with an affordable, durable, appealing product that can be worn and washed – again and again. As you read this, countless startups and some of the industry's big players are vying to be the first to square that circle.

Meet homo connectus
To consumers, the appeal of connected clothing includes the Sci-Fi applications they make possible. People with disabilities are among the first to benefit. BrightSign, for example, was designed to give a voice to people with speech disabilities.

It's a smart glove prototype that, fitted with movement sensors and a computer processing unit, translates sign language into speech in real-time. Ducere, an Indian company, invented smart Bluetooth-enabled shoes that use vibrations to guide the blind – and anyone else – along routes defined on a smartphone app. And the CuteCircuit Sound Shirt, another application, lets deaf people enjoy music as vibrations.

Athletes of all stripes benefit from increased comfort and accuracy that garment-mounted sensors provide compared to conventional sports trackers, with smart textiles ideally suited to track heart rate, breathing rate, and muscular activity. Sensor equipped clothing developed by Athos lets athletes and coaches quantify specific aspects of athletic performance, such as the intensity of a goalkeeper's dive, the violence of a tackle in American football, or the strength of a ball bowled in cricket or pitched in baseball. Armed with vast amounts of data on their athletes, coaches can improve how they train them and catch injuries before they occur.

And then there's smart apparel for the rest of us. Levi's and Google have partnered to make a smart jacket that lets urban bikers control their smartphones by swiping their sleeve using customizable gestures. Smart underwear by Myant can track the obvious – heart rate and temperature – and the less obvious – pressure, motion, body fat, and hydration levels – and

Wearable X is demonstrating the potential of real-time sensory feedback to improve performance with its smart yoga pants that track your posture and use vibrations to nudge you into the right position.

send them to your smartphone. And Australian startup Wearable X is demonstrating the potential of real-time sensory feedback to improve performance with its smart yoga pants that track your posture and use vibrations to nudge you into the right position.

A viable business model
With all this potential – and we haven't even mentioned applications in healthcare or targeting the elderly – why isn't the field booming? Today's variety of niche applications typically come with a price tag in the hundreds of dollars – too much to win over the mass market. According to a study carried out by Berkeley University[2], aside from technical and cultural challenges, what is missing is a sufficiently compelling use case. To grow out of today's niches and become truly mainstream, the study suggests that smart clothing will have to ensure that users get their money's worth. At the same time, using big data analytics, smart clothing will have to offer commercial value to the companies, which will help bring down cost of ownership of the technology.

A key challenge that new entrants into this space are confronted with is the diversity of expertise it requires. We set high standards on our clothes, in terms of aesthetics, comfort, and washability. Carrying what used to be a super computer in our pockets has raised the bar on what we expect of our technology. Successful smart clothes will emerge at the intersection between clothing, technology, and big data storage and analytics, as well as with a stakeholder group able to benefit from the insights provided by the data. While entrepreneurs can only marvel at the economic potential connecting clothing already posesses today, it will take brave new alliances to fulfill the full potential of smart clothing for the mass market. ■

[1] Smart Clothing and Textile Manufacturing, ABI research Report, October 12, 2017.

[2] Smart Clothing Market Analysis, Berkeley University of California, Alex Hanuska, Bharath Chandramohan, Laura Bellamy, Pauline Burke, Rajiv Ramanathan, Vijay Balakrishnan, 2017.
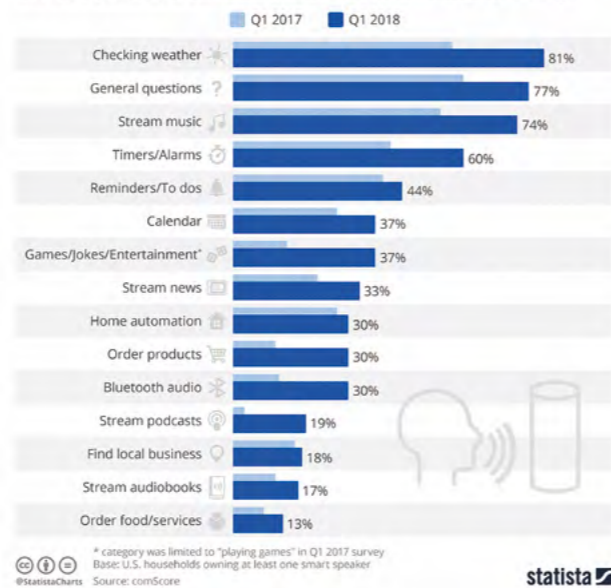
The power of voice

Voice activated smart speakers offer hands-free help around the house – and beyond. Just ask Alexa!

Over the past few years, a new class of devices has popped up in people's homes: voice activated smart speakers – the Amazon Echo, the Google Home, the Sonos One, and Apple's recent HomePod, to name just a few. In the guise of high-end speakers, they are, in fact, much more than that. Speak the magic word – "Alexa," "Ok Google," or "Hey Siri" – and you open a portal to the cloud and everything it enables. Place a call, control your home, shop online, play your favorite song, or do just about anything else, voice-controlled, 100% hands-free.

Americans have pounced at the offering, adopting smart speakers more rapidly than they did smartphones a decade ago. Just six years after Apple introduced Siri, its voice-controlled smart assistant, and just three years after Amazon launched its first Echo, one in six adults owned a smart speaker by the end of 2017[1]. By 2020, three out of four American households will have one[2]. And other countries are catching up, as the artificial intelligence they use becomes increasingly multilingual and AI-mediated services spread across the globe.

Here are some of the ways domestic smart speakers are being used today:

Users Learn to Appreciate Smart Speakers' Many Talents
% of smart speaker owners in the U.S. who have used the device to do the following

	Q1 2017	Q1 2018
Checking weather		81%
General questions		77%
Stream music		74%
Timers/Alarms		60%
Reminders/To dos		44%
Calendar		37%
Games/Jokes/Entertainment*		37%
Stream news		33%
Home automation		30%
Order products		30%
Bluetooth audio		30%
Stream podcasts		19%
Find local business		18%
Stream audiobooks		17%
Order food/services		13%

* category was limited to "playing games" in Q1 2017 survey
Base: U.S. households owning at least one smart speaker
@StatistaCharts Source: comScore

statista

[1] The smart audio report, NPR and Edison Research, January 2018.
[2] Forecast Snapshot: VPA-Enabled Wireless Speakers, Worldwide, 2016, Gartner, September 2016.

75%

By 2020, three out of four American households will own a smart speaker.
Source: Gartner

Getting smarter through context awareness
As voice technology matures, it is becoming increasingly context aware – and, therefore, smarter and more reliable. While in the early days, commands had to be carefully spoken, today, you could be forgiven for forgetting that you are talking to a machine. Tell your smart speakers that you are cold, and they might respond by offering to turn up the heating. Tell them you are hungry, and they might entice you to some take-away or a nearby restaurant.

Voice's conquest of the domestic space foreshadows similar developments in others. Apple CarPlay and Google Android Auto bring you the benefits of Siri and Google's personal assistant when you're behind the wheel. Car brands themselves have also joined the fray. At the 2018 Geneva Auto Show, Mercedes showcased its own context-aware voice activated personal assistant, which responds to "Hey Mercedes." And voice technology is finding its way into the industry as well, with companies like Siemens prototyping voice activated solutions to assist field engineers confronted with challenging situations.

Voice as the user interface of the future is here to stay. So if you feel self-conscious talking to your smart speaker, smart phone, or smart car, you may just need to get used to it. Right, Alexa? ◼

1

2

1 Voice's conquest of the domestic space foreshadows similar developments in others.

2 The HomePod from Apple brings Siri closer to your home.

Getting ready for 5G

The industry's response to the hyper-connected society we are moving towards will transform the way we – and the things around us – communicate.

By 2023, Ericsson predicts that each active smartphone in North America will consume 48 gigabytes of data per month[1]. That's roughly a seven-fold increase compared to 2017. The trend is the same across global markets, driven by improvements in our smartphones, increasingly data-rich content, and better, more affordable data plans. At the same time as smart homes, cities, and industries are linking up to the cloud, it is opening the door to entirely new applications across verticals with demanding requirements on network capacity and capability. As a result of this unprecedented revolution, a new generation of cellular networks will be needed to transform existing 4G networks to cope with the rapidly increased data traffic demand.

The industry's answer to the hyper-connected society we're moving towards is 5G cellular communication technology. 5G addresses future demands and enables new services through three key features: enhanced mobile broadband (eMBB), ultra-low latency and high reliability (uRLLC), and massive machine communications (mMTC). It does so, in part, by expanding the spectrum dedicated to cellular communication to much higher frequencies capable of transporting data at faster speeds, and combining a series of sophisticated technologies to ensure that data is delivered reliably and securely across the network.

[1] Mobile Traffic Outlook, Mobility Report, Ericsson, November 2017.

3GPP, the standardisation body responsible for defining global mobile network communication standards, is releasing 5G in a two-step process. Phase 1, scheduled for Q3 2018, will focus primarily on eMBB applications with high data rates, high mobility and low latency, and use cases include ultra-high-definition video and augmented and virtual reality. Phase 2, which will follow one year later, will focus on critical communications with high reliability and ultra-low latency, as well as on connecting millions of devices, especially in the industrial IoT.

48GB

Each active smartphone in North America will consume 48 gigabytes of data per month.

Source: Ericsson

From virtual reality to the Internet of Skills

It will take longer for 5G to impact you in your everyday life, but when it does, you'll feel the difference. High data rates – up to several gigabytes per second – will transform the way you communicate, and just might let augmented and virtual reality live up to their much-hyped potential. You'll be able to stream high-definition video on all your devices and leverage the computing power of the cloud in ways that are unimaginable today.

Ultra-low latency down to half a millisecond, 99.999% availability, and predictable quality of service will enable critical applications that improve safety and wellbeing. Vehicle-to-pedestrian communication, to name one, will alert drivers when pedestrians cross roads. Another is remote surgery, with which surgeons will be able to operate via a robotic arm on patients that are on the other side of the planet. It's just one fascinating illustration of the Internet of Skills[2] that highly secure and resilient communication over 5G networks will enable.

Just imagine the density of connected devices that mobile communication networks will have to reckon with. Our homes, cities, and industries will all be connected. And so will we, with our wearables and other devices that will serve us and connect us to social networks, day in, day out. Combined, they will lead to an explosion in the number of connected devices per square kilometer and heightened demands on power efficiency and network coverage that 5G networks are fully geared to handle.

Innovation driving technology driving innovation

Industry stakeholders are working together in the 3GPP to define 5G technology specifications, to ensure that the 5G standards meet the needs for emerging use cases and services while leaving ample room for innovation.

5G made its global debut during the Pyeongchang Winter Olympics, where it was used to broadcast live immersive HD images of the sporting events in virtual reality. It's no coincidence that China, Korea, and Japan are leading the transition to 5G, along with the United Kingdom and the United States. But even after the 3GPP releases the 5G standards, it will take a couple of years for networks to roll out worldwide. The wait will test our patience, but on the bright side, it will give everyone involved time to getting fully prepared for 5G. ■

High data rates – up to several gigabytes per second – will transform the way you communicate, and just might let augmented and virtual reality live up to their much-hyped potential.

[2] Internet of Skills, where Robotics meets AI, 5G and the Tactile Internet, IEEE, Centre for Telecommunications Research, Department of Informatics, King's College London, London, UK, 2017.

It's like a tide – it cannot be stopped.

Interview between Greg Williams, Editor-in-Chief, Wired and Paul Gough, Principal, Corporate Strategy, u-blox

How is connectivity disrupting people, business models, and society at large? And what's on TV tonight in Argentina?

Paul Gough
Principal
Corporate Strategy
u-blox

Greg Williams
Editor-in-Chief
Wired

What's new about today's connected society?

PAUL GOUGH – People have always been connected, but modern technology has really expanded these connections. We now can access huge pools of digital information and entertainment and maintain a social network that spans the planet. Today's connectivity is the basis on which we've built whole new personal and societal services.

GREG WILLIAMS – I think the big difference today is scale, and the fact that we have these objects in our hands at all times effectively makes us augmented human beings. We have access to the most powerful computing stack ever created, to all the information the world has ever created, and to pretty much anyone who is on the Internet. We could monitor, right from this table, the air quality in Beijing or discover what is on TV tonight in Argentina. All this information that we don't need, but...

"The fact that we have these objects in our hands at all times effectively makes us augmented human beings. "

P.G. – … can get it, if we want it.

G.W. – The whole notion of "connected people" is a really interesting one, because we are connecting in more ways than ever before. It's much more complex and moving very quickly. We'll probably have another billion people online in the next two or three years. Most of those will come online using voice rather than touch. A connected society, I would say, is an increasingly complex number of data points that we're not quite sure how to make efficient and work with yet. But that's the nature of technology. We always figure things out as we go along.

P.G. – I think that's it. It's never the finished product to start with. You've got to evolve it.

G.W. – It's exciting, because that kind of connectivity now means that small scale entrepreneurs are able to build businesses in ways that they've never been able to before. The other part of this is that all this data that we're creating – if we can make it open and let people share it – would enable us to make the world, frankly, better – and our businesses more efficient.

How does connectivity applied to people differ from connectivity applied to machines?

P.G. – The Internet's based on machine to machine (M2M) communication. M2M is where u-blox plays as a company, as we make many vital components of this connectivity infrastructure. One interesting thing about M2M is that it is not of itself disruptive. It grows incrementally, and for one very good reason: standardization. When you produce a device, it has to fit an evolving standard. It's challenging to innovate in that sort of constrained environment, but it gives developers vast freedom to be creative, because underlying them is a firm connectivity foundation. I like the juxtaposition of non-disruptive, incremental, but enabling the development of disruptive services and applications in the connected space.

G.W. – If you look at the kinds of platforms on which we're building, the most revolutionary is A/C power. Not so long ago, you moved into a house and didn't have A/C power. Now, you wouldn't even imagine a home without it. The world you're describing, with systems communicating with each other, is probably the world we're moving towards, and it is something we'll just take as a given. Right now we're still trying to figure out how best to use it, but five or ten years from now, that layer of connectivity will simply exist in the same way as A/C power exists today. Today, we're scared of robots in the same way that in the 19th century people were scared of elevators, because they didn't trust them. But then, the elevator enabled the construction of modern cities in the 20th century because they let you build up rather than just horizontally. I believe that increasingly we'll see new forms of technology deployed in ways in which we won't notice them.

P.G. – When it's working and its working well, it just disappears into the background. We adapt quite quickly, socially, if it's a benefit.

G.W. – Fundamentally it always comes down to use cases: is this something that removes friction and that offers a better experience?

What sort of technologies are enabling "connected people"?

P.G. – In the recent past, connectivity technology was focused on getting faster, with more ubiquitous access. We went from 2G to 3G to 4G. Now we see companies like u-blox starting to bring in

a new wave of devices that emphasize really low power and are much smaller and more affordable. We can now think about connecting other objects to the Internet, particularly things like sensors. One of the consequences is we're going to see a much more quantified world, in terms of both our immediate environment and our personal spaces. We're starting to see it now with people step counting. In the not too distant future, football games will be recorded and people's performances will be quantified to help players see if they're making progress, or whether they're potentially going to get injured. Today it's at the elite level, but it's going to come down to all of us, because this technology will become ubiquitous.

G.W. – We will get to the point where we can pretty much measure everything through tiny sensors that will tell us about air quality or when the rubbish bin needs emptying. It's a question of determining what's useful. I don't need a kitchen robot to tell me how to make a sandwich. I can figure that out myself. But what would be useful would be a device connected to my dishwasher that tells me when the cheapest time to run the dishwasher is. It's about decision making that is purposeful and meaningful.

How do you see the evolution of wearables, which represent a big share of the "connected people" market?

P.G. – Miniaturization and improvements in power have enabled wellness devices to be worn on the wrist. At u-blox we recognize that there's an opportunity to go a lot further. Today's devices are still pretty clunky, bulky, and power hungry. We need another generation of technology to shrink it down another level, make it more power efficient, and bring in other technologies like flexible electronics. We see some examples of connected clothes, like in the sports arena. Fabric sensors knitted into garments allow to measure respiration, heart rate, and muscle activity. Connectivity is certainly providing a really good foundation on which we can build, but it still needs a little bit more technology to get us to that next step.

G.W. - We're almost at the fourth iteration of the Apple Watch, and I think that it's only just beginning, now, to become something that has a use case. How do we start building this kind of

connectivity into clothing and devices that we wear on our skin? It becomes really interesting when the devices are not just passive, but nudge us into various forms of activity, when they make predictions about health outcomes, or tell us that we need to start behaving in different ways.

P.G. – I have a project with some of my students where we're looking at putting little accelerometers, gyroscopes, and magnetometers in clothes, so that you can measure your movement. Now, all three elements are small enough to fit on one little bit of silicon. The pace for such developments seems to be accelerating.

With the amount of Big Data being generated using, say, health-tracking wearables, what is your take on the security and privacy issues?

P.G. – Security is a prime concern of u-blox as a company, and of our customers. Today customers want to know the specification of your device, but also what you are doing in terms of security. I think it shows how sensitized the industry has become to this issue. It's a difficult

problem because IoT systems have multiple attack points. We have really been trying to make this as easy as possible, with what we call our five pillars of security. They go from making sure that the firmware that goes onto your device is authenticated, to jamming detection in your GPS device. Security has become a quality issue.

G.W. – I completely agree. I think that we're moving into an age where security is such a prime element of any organization's reputation that you have to bake it into everything you make at every part of the process. The IoT means that there's this vast threat landscape where attack points are multiplied by the day. There's two parts to this. One is that manufacturers have to ensure that the protocols they outline are followed. But secondly, it's about educating consumers. A bot made up of millions of compromised IoT devices such as DVRs was created last year. The massive majority of the devices simply had un-secured factory settings. Factories just sent out their products, assuming that consumers would secure them, but consumers don't want to be proactive in that way.

This reflects on a bigger point, which is around privacy, where there is a shift going on. I certainly feel that for the Silicon Valley companies, in the next two to five years, there will be public and regulatory demand for them to be a lot less extractive than they are now and to share more of that data that they do extract. The EU's General Data Protection Regulation (GDPR) is going down that road. I think there is more awareness of privacy now, but not enough of security. It's something that we all need to think about because it's a collective responsibility. Not just manufacturers or consumers or governments – it's everyone.

P.G. – You're right to separate privacy and security. We're really learning about security now and it's incumbent on companies like u-blox to educate our customers. They buy a module from us because it shortens their time to development and they don't need to worry about technical or certification issues. If we can help them with security as well, it gives us an extra opportunity to differentiate ourselves.

The constant data collection can feel quite invasive. How much control do we still have and when does it become too much?

P.G. – I think this new wave of devices and the whole issue of generating data has momentum and will carry on. Like a tide, it cannot be stopped. On the positive side, with this extra data, you can start to see things like early diagnosis, for example, in medical conditions, and perhaps better treatment and follow through. Also, sometimes these things can just make your life easier. But if that's going to happen, it comes with responsibilities. If you're generating more data, then you've got to be able to make sure that your system is secure and can withstand malicious attacks. Today, if you put something out on the Internet unprotected – a little honeypot – within half an hour, somebody's on your IP address scanning your ports. It's an unbelievably hostile environment, and it's part of our responsibility to make it as secure as we can. But I think Big Data is inevitable.

"It's an unbelievably hostile environment, and it's part of our responsibility to make it as secure as we can. But I think Big Data is inevitable. "

G.W. – It is inevitable, by the very nature of what we're doing, attaching sensors to everything. However, I think that there's a shift now with consumers wanting more access to their data and to know exactly how it's being used. And also understanding that their data is the product – they are the product.

If you are using any social network, you're the product. Maybe at some point in the future, people who use Facebook will start to think that if the photos they post of their kids are generating revenue for Facebook through the advertising revenue model, they should be getting a cut. I think that, increasingly, we'll start to see a transactional relationship between people sharing their data and large organizations that are leveraging it.

P.G. – That's a very good point. You could almost see an intermediary, kind of like an Uber, negotiating the payment on your behalf.

G.W. – Something that Jaron Lanier, the futurist, has proposed for a long time, is an Internet that's based on micropayments. Every time you click on anything or look at an advert, you receive a micropayment. There's an interesting movement growing called Time Well Spent that is trying to figure out how to make a more useful and collaborative Internet. Don't get me wrong. I think there's so much about the Internet that's amazing, in terms of information sharing and learning. But I do think that we now have three or four companies that are effectively the gatekeepers of the Internet. Things need to change a little bit in terms of the amount of access and power they have over consumers.

P.G. – Today much of this is largely hidden. We'll probably see better tools for users to be able to control this information and make it more transparent.

G.W. – Yes, and I think that the Blockchain will mean that there will be increased possibilities for people to interact directly and have more ownership, more say, and more ability to transact directly without gatekeepers in the middle extracting value. I think it will be a game changer, and that's why some of the large social networks are pivoting their products to become more like decentralized networks.

How do you see the "connected people" in the next 10 years?

P.G. – In 2002, I had to write an article on the future of wearable electronics and personal technologies. I had a look at what I wrote to see how much I got right. Back then, I predicted that in 2002 we'd have access to multimedia. The next stage I called EAsy RICE, which was Easy Access to the Right Information, Communication, Entertainment. I think we are there now, with today's search tools and recommendation systems for entertainment which are pretty good. Then we predicted something we called the Perfect Partner, where the idea was that you would have a device that knew you so well that it could anticipate your needs, like a digital assistant, to the point that you could delegate activities to it. The final part was mediated reality, with glasses, AI, and AR, in which everyone would have their own personal reality. Aside from the fact that we should have had the Perfect Partner in 2010, I think my prediction probably still holds today.

"AR will definitely become part of our lives, because I can see a use case."

G.W. – We are getting to the point with AI that our machines and systems are beginning to anticipate our needs in ways they weren't able to even five years ago. We've been talking about AI for some time, but now we are genuinely seeing products that will have a significant benefit to us. I think AR will definitely be something that will increasingly become part of our lives, because I can see a use case. I don't know what that interface will be, probably not the HoloLens as it is right now, but something similar, or a Google Glass. I think that it will increasingly offer

all the data from our connected devices – our vital statistics, the weather, our email… I can't see the smartphone going away. I think it's the best thing that we've created. It's given rise to a massive supply chain, which is responsible for a lot of what's going on in the world of IoT and connected devices. We'll probably still be carrying smartphones in 10 years.

P.G. – From a u-blox technology perspective, we'll certainly see devices becoming smarter. The radios themselves will have multiradios, handling multiple frequencies and air standards. And they'll be smarter. When they need to send information, they'll do it in the most efficient, low power, or fastest way depending on the context. I think the same will happen with the microprocessors that we work with today, that are based on standard von Neumann architecture. Eventually we'll get neuromorphic processors. You mentioned AI. One of the places you could use it is at the edge of the Internet of Things, to do object classification and provide context awareness. I think this is something we might see in our devices as well.

" We'll certainly see devices becoming smarter. Radios will handle multiple frequencies and air standards."

G.W. – At the moment, we're mainly using AI for pattern recognition and classification. But people forget that AI is only useful when you have data sets that are clean and labeled. As we begin to have larger clean and labeled data sets, we'll begin to find new ways in which AI will be useful to us. I think autonomous vehicles are going to fundamentally transform the nature of our cities, of mobility, of uses of energy. And that may be more powerful than even the smartphone, because it will essentially change our built environments. Although physically we

might still recognize our built environment in 15-20 years, they will function in a very different way. I could imagine that China could mandate no traffic lights by the year 2050 because autonomous vehicles will move people around.

"I think autonomous vehicles are going to fundamentally transform the nature of our cities, of mobility, of uses of energy. "

P.G. – AI has come out of the winter. There's deep learning, we can make it scale, and suddenly AI can do image recognition as well as we can. You're right. The car will probably be the vehicle that will drive AI, sensors, and sensor fusion. And your car and your personal assistant in your phone will interact seamlessly with each other. There will be some continuity in the services as you go to your car.

G.W. – Automotive manufacturers will just become part of our ecosystems. They'll have to figure out what OS they're going to run and whom they're going to partner with. That's already going on. A lot of automotive manufacturers are just now changing their business model, moving from car manufacturers to seeing themselves as part of a larger mobility solution. They're thinking about partnering with mass transit, with cities, changing their business model from us going and making a purchase, to us buying into a network in the way that we would buy a Netflix or an Apple iTunes subscription. I think that industry in 30 years will be very different from now.

P.G. – It was people like Elon Musk at Tesla who came along and kicked the industry. When somebody like that comes along and is able to show what the possibilities are if you're bold enough. It's interesting that the industry has reacted. That is good. ■
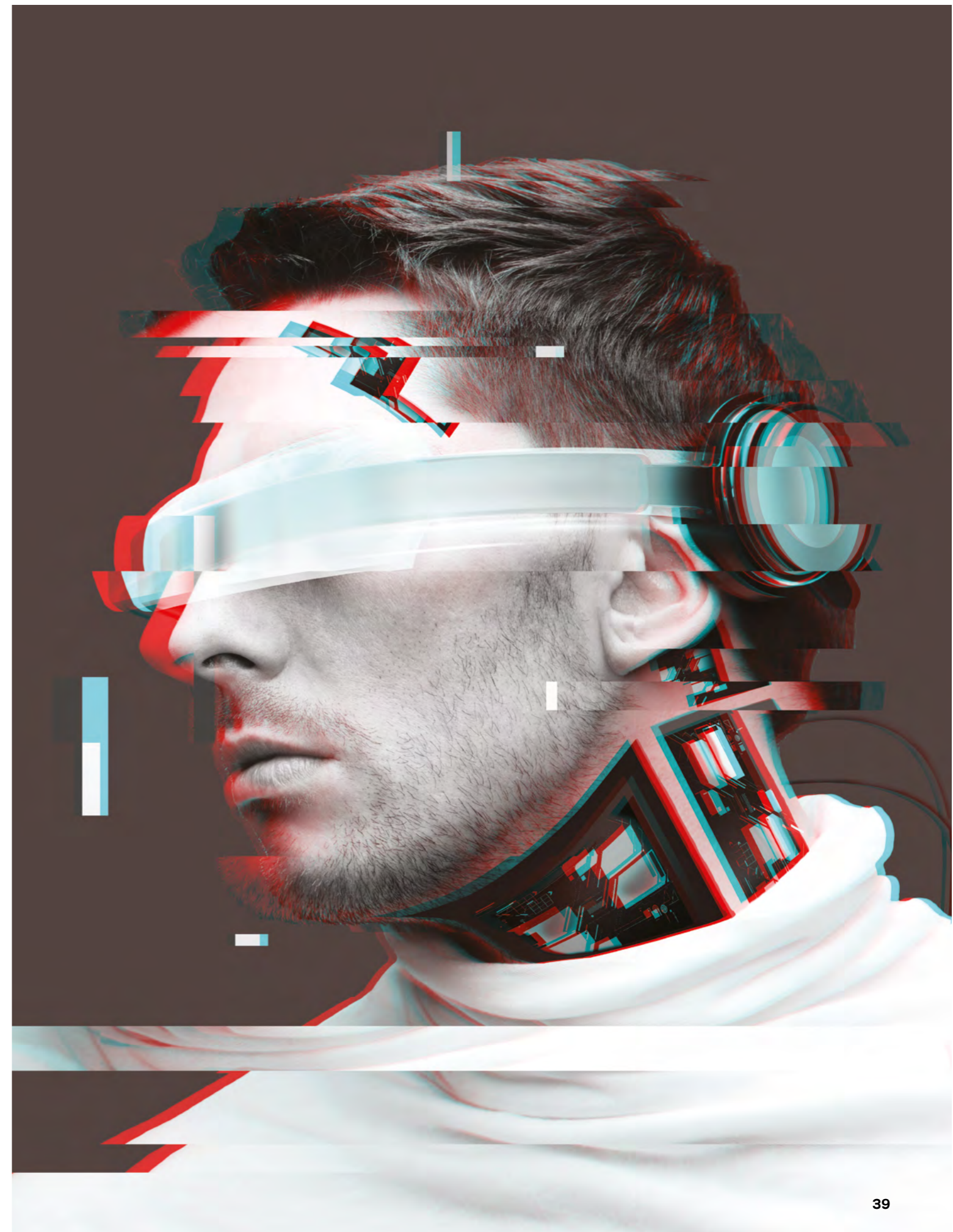
What drives the growth of our connected society?

Here are some facts & figures. Would you have known?

3.8bn

Internet users worldwide

Source: Hootsuite and We Are Social

40bn

US$ of revenue generated in the sharing economy by 2022, double that of 2017

Source: Juniper Research

156m

sports, fitness, and wellness trackers shipped by 2022

Source: ABI Research

35%

CAGR of remote-patient monitoring wearable devices shipped by 2021

Source: ABI Research

48GB

of data per month consumed by each active smartphone by 2023 in North America

Source: Ericsson

40m

healthcare devices shipped by 2022

Source: ABI Research

31m

smart clothes shipped by 2022

Source: ABI Research

17m

personal trackers using GNSS by 2021

Source: ABI Research

Cameras rolling, drone in position, action!

Seattle-based Freefly Systems develops tools for professional cinematographers. Their Alta 8 camera drones rely on a u-blox NEO-M8 GNSS receiver module.

Gone are the days when helicopters and cable mounted cameras were the only way for Hollywood camera crews to shoot fast moving aerial footage for the latest blockbuster. Cheaper than a helicopter, more agile than a cable cam, and as steady as a surgeon's hand, Freefly Systems' Alta 8 drone for aerial cinematography creates video footage you'll never forget. That's why it's being used in more and more movies – including some you've probably seen.

Part of the magic behind shots taken using the Alta 8 comes from its smart SYNAPSE autopilot. Combining inertial sensor and barometer data with location data from a professional grade u-blox NEO-M8N GNSS receiver, and running it all through sophisticated proprietary algorithms, the SYNAPSE flight controller makes it easy

for users to fly complex flight paths, creating stunning and often surreal visual effects.

The smooth images shot by the multi-rotor platform for aerial cinematographers somewhat belie its size and strength. The drone spans over 1.5 meters across and is strong enough to carry a 9 kg payload. (Look online and you'll even find videos of one towing a surfer across the water!)

"Our drones are being used on some of the biggest movies in the world, and our customers need to be able to depend on them," says Tabb Firchau, CEO of Freefly Systems. "We're trusting the positioning of the aircraft to a single sensor, so we want that sensor to be as high quality as possible. We love the reliability that the NEO-M8N provides."

But reliability wasn't the only reason Freefly Systems opted for the NEO-M8N in their design. "We loved the short lead times that working with u-blox enabled as much as the precision of the u-blox parts," he says. "When you're on set with several drones flying around and everyone's devices are communicating wirelessly, there is a lot of interference. We're impressed at how robustly the NEO-M8N rejects the interference, delivering awesome performance in tough environments."

Learn more:
www.freeflysystems.com
www.u-blox.com/product/neo-m8-series

Connecting people
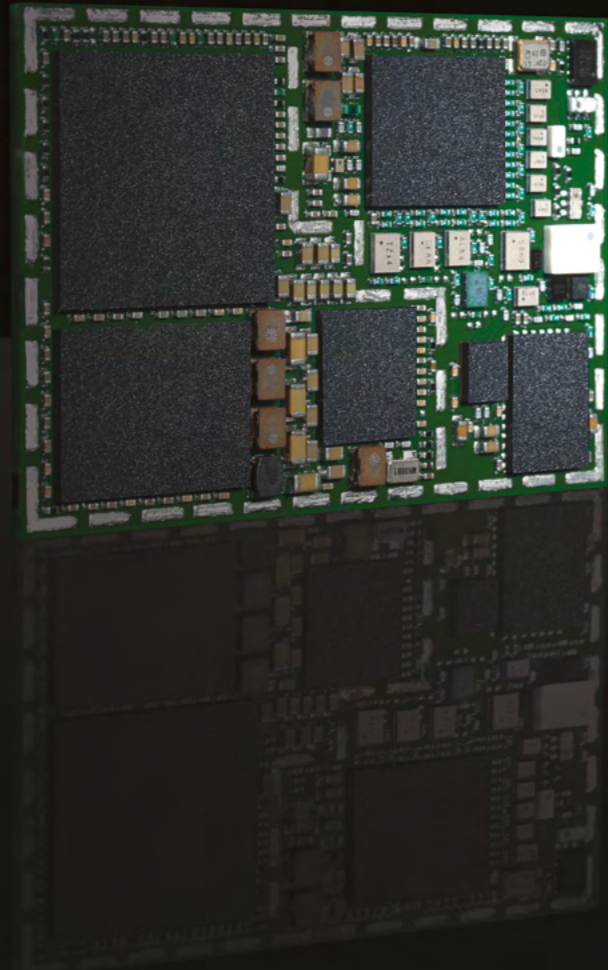
The latest in positioning and wireless communication technologies

Combining leading industry quality, robustness, sensitivity, and performance with innovative features, u-blox contributes components and solutions for your designs. We focus on business critical applications where products need to perform 24/7 with exceptional reliability and handle exceptions in a way that minimizes disruption to the overall system. We offer our customers improved productivity, fast response, and new business opportunities... And the best is yet to come. ■

u-blox F9

The u-blox F9 technology platform enables the next level of GNSS precision for mass market industrial and automotive applications.

This GNSS platform offers integrated Real Time Kinematics (RTK) to deliver centimeter-level accuracy. It uses GNSS signals in multiple frequency bands (L1, L2, L5) and delivers fast Time To First Fix as well as fast convergence. It receives signals from all GNSS constellations (GPS, GLONASS, Galileo, BeiDou) concurrently, enabling the highest number of satellites available, which is particularly important for RTK in obstructed areas such as in dense cities with many tall buildings. It also offers optional dead reckoning for high positioning performance in any condition.

Learn more:
www.u-blox.com/high-precision-positioning

SARA-R412M

As the newest member of u-blox's SARA-R4 product series, SARA-R412M provides multi-mode LTE Cat M1/NB1 connectivity with quad-band 2G (EGPRS) fallback. The ultra-compact 16 x 26 mm form factor is ideal for use in trackers and other space-constrained devices. It is software-configurable to support any global band combination based on a single hardware unit with the ability to define the preferred radio interface modes.

Featuring LPWA power save features that extend battery life up to 10 years, the module also provides extended in-building and underground coverage. Nested design provides easy migration from 2G and 3G modules to the latest generation of cellular technologies.

Learn more:
www.u-blox.com/product/sara-r4n4-series

ANNA-B1

ANNA-B1 is the smallest Bluetooth 5 module for industrial applications. Ultra compact, 6.5 x 6.5 mm, it enables many applications in size constrained designs requiring high speed Bluetooth® connectivity and low power consumption. It includes an Arm® Cortex®-M4 microcontroller, flash and RAM, an antenna and a range of hardware interfaces. Customer applications can run on external host interfaces to ANNA-B1 via UART or integrated in the module.

Typical applications are small devices such as power tools, industrial and medical sensor products, wearables, and point of sale devices.

ANNA-B1 comes certified for select markets off the shelf.

Learn more:
www.u-blox.com/product/anna-b112-module

u-blox revamped: 20 years and a new identity

In 2017, u-blox turned 20. From a spin-off of the Swiss Federal Institute of Technology (ETH) in Zurich to a global company with 1,100 employees, we grew at a dizzying speed, having to constantly reinvent ourselves to become a connectivity technology leader.

Two decades in, the time had come to rethink our brand, align it with a world that has greatly evolved, and be ready for the future.

On February 27, 2018, we unveiled our new website and event booths to the public. Our new corporate identity, which further consists of a new positioning and tone of voice, as well as an original visual identity including a proprietary font, reinforces our commitment to technological innovation and our unique position in the market. We remain a global provider of positioning and wireless communication technologies.

In the words of Thomas Seiler, our CEO: "We had long and extensive exchanges with our customers, partners and employees, and came to the realization that u-blox needed a make-over. The brand no longer reflected the level of technological excellence and business performance that we've achieved over the years. However, despite the new image, we remain the same company, with the innovative, reliable, and restless spirit our customers have come to trust, and the same high quality product and service offering."

It's thrilling to open a new chapter in our company's history. ■