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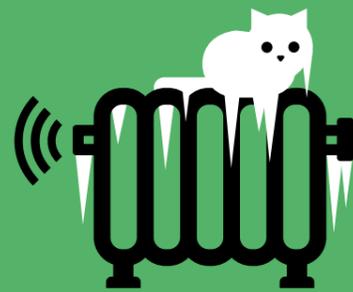
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# CAN PUTIN STOP THE INTERNET?



**Tim Cole**

is the editor of *Smart Industry – the IoT Business Magazine*. His latest book, *Wild Wild West – What the History of the American Wild West Teaches Us About the Future of the Digital Society* is available on Amazon.

A couple of years ago, I wrote a book entitled *Management Challenge Internet* which was well-received by the press. In a review, the German daily *Süddeutsche Zeitung* went so far as to call me the “itinerant preacher of the German Internet.” While I enjoyed the compliment, I also thought it ridiculous. Is there any such thing as a German Internet, I asked myself – a network only for Germans? Of course not.

It turns out I was wrong. A country really can cut itself off from the Internet. China has been trying for years to stop its citizens from accessing Western content on the web – but the “Great Firewall of China” is nothing to what Russia is contemplating. The State Duma, Russia’s tightly controlled parliament, is considering proposed legislation, supported by President Vladimir Putin, that would disconnect the Russian Internet, officially called *RUNET*, from the rest of the world. The official reason is state security because the Duma is worried about America’s cybersecurity strategy, which it perceives as threatening. The bill being discussed, it says, is just about strengthening the nation’s online infrastructure and making it safe from sabotage by the US military.

Russia has been slowly severing its ties to the Internet for quite some time now. Following the Arab Spring uprising and waves of domestic protests in the winter of 2011/12, Russian authorities began intensifying online censorship and surveillance. Facebook and Twitter are under scrutiny by Russian media watchdogs and it is believed that it will only be a matter of time before they are forced to leave the country. It looks increasingly as though Russia may succeed in seceding from the global network.

The only problem is the technology. The Duma contains relatively few computer scientists and network specialists, so the wording of the bill was left vague. The only thing that is certain is that cutting loose will be expensive, which worries Russia’s state auditors. Domestic providers say that simply shutting down international connections would cause Russian networks to go down. A brief shutdown in April was meant as a stress test to see just how resilient those local networks are and how much Internet traffic could slip through the cracks.

Nation states, especially those with an autocratic form of government, are increasingly showing willingness to exert greater authority over their own portions of the Internet, which can lead to shutdowns. In January, for instance, the government of the Democratic Republic of the Congo turned off its Internet during a highly contested presidential election.

Nobody knows what the long-term effects of Russia’s Big Disconnect will be. Today, the Russian Internet is truly global, notes the Russian IT security specialist Andrei Soldatov in a blog post. Not only is the country connected by many dozens of cross-border fiber optic cables, with over 30 operators owning them, but Russian Internet companies built and own huge data centers in Europe, for instance in Amsterdam.

Will banks, hospitals, or airports be cut off? How many websites will stop working? After all, most web pages rely on multiple servers, many of them in other parts of the world. A news site, for example, may run on an Amazon Web Services cloud server and include links to Google tracking software and a Facebook commenting plug-in located outside of Russia. “Every page is made of 1,000 different things. If you’re running a website in Russia, you’d have to figure out where everything is coming from,” says Andrew Blum, the American author of *Tubes: A Journey to the Center of the Internet*.

Users outside of Russia should be worried, too. What about web traffic from other countries being routed through Russia? What will it mean for the Internet of Things, which is based, after all, on the concept of total connectivity? In fact, IoT presents a formidable challenge to Russian efforts to totally control their own Internet. As users start connecting to fridges, TV sets, or garage doors, the harder it will become to monitor or cut off the connection. If a user can start a Skype phone call on a smartphone and continue talking on their TV set, how many lines and operators are involved?

The Russian authorities are seriously underestimating the size of the challenge they face in trying to pull the plug on the Internet. Technology will, hopefully, prove more powerful than even Putin in the end.

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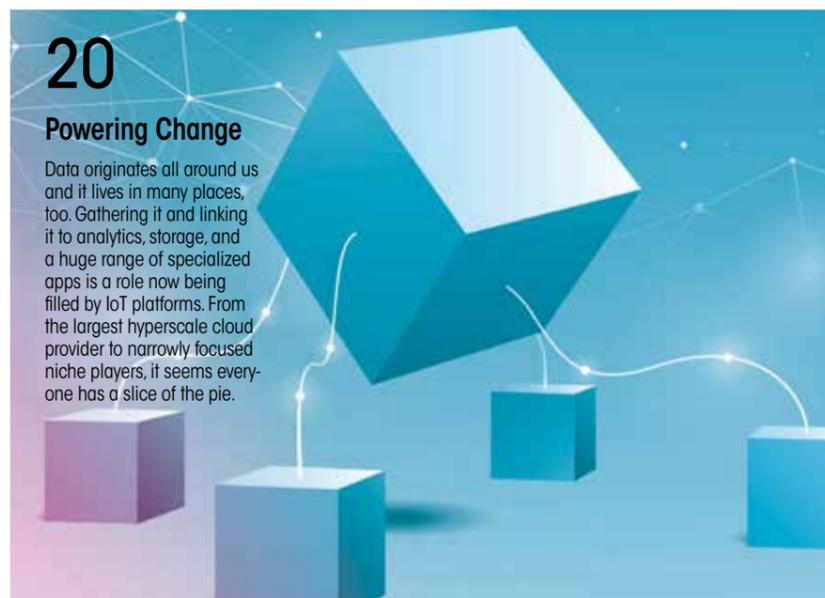
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China is betting big on IoT with huge investments in cutting-edge technologies. Does this mean it will come to dominate the industry? And should the West be worried?



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Data originates all around us and it lives in many places, too. Gathering it and linking it to analytics, storage, and a huge range of specialized apps is a role now being filled by IoT platforms. From the largest hyperscale cloud provider to narrowly focused niche players, it seems everyone has a slice of the pie.



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As IoT hits commercial insurers, it is expected to be at the heart of many new strategies, with insurers able to use IoT data to assess customers, reduce insurance premiums, and provide real-time warnings.



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Like the industrial revolution, when new manufacturing processes marked a historic turning point, so-called "low-earth orbit satellites" are poised to transform our relationship to outer space.

## IMPRINT

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# Behind the Scenes SMART PEOPLE

All over the world, brilliant individuals are hard at work creating the technologies and solutions that will one day **make the Internet of Things come alive**. We visited a few of them and listened to their fascinating stories.

**Niall Murphy, founder and CEO of Evrything**  
**Winning the Counterfeit Wars**

Niall Murphy is a man on a mission. “Machine learning is changing how consumer product brands fight back against the \$1.2-plus trillion in revenues lost to counterfeit and supply chain integrity issues each year,” he explains – and he wants to be in the thick of the fray. Born in South Africa, Murphy founded Evrything to provide a digital identity for billions of consumer products on the web. This wasn’t his first start-up venture: he cofounded a pan-European Wi-Fi network, called The Cloud, with technology entrepreneur George Polk, ultimately selling it to BSkyB in 2010. He also founded one of the first ISPs in South Africa in a joint venture with Sprint and three digital media businesses. Long before that, in 1994, he teamed with Daniel Erasmus, a leading futurist, to establish the Digital Thinking Net-

“  
”  
Digital identity systems generate real-time data and capture everything that happens to every product throughout its entire life cycle.

Niall Murphy



work, billed as a “scenario thinking consultancy.” In 2018, the first app from Evrything was launched at Carrefour supermarkets in Spain. Called Reciclaya, it allows customers to determine how to recycle individual products by simply scanning the barcodes on supermarket receipts. The app separates the products into virtual recycling bins so that customers can deposit them in the closest corresponding contain-

ers. Consumers can earn rewards by registering where they are recycling by scanning or tapping identity tags on recycling units. “For the first time, consumers can receive detailed information on how to recycle all products and packaging using a single app – and be rewarded for their participation,” Murphy says. “It’s convenient and simple and, through a gamified experience, it drives a new style of behavior.” Murphy has his sights set on bigger game: counterfeiters. “Counterfeit products and gray-market imports prey on the quality, goodwill, and trust that brands have spent years and billions of dollars building, sucking profits and impacting consumer trust,” he maintains. The problem is not a new one: “A running battle has been fought for decades between brands and fraudsters,” Murphy says, moving on to describe an ongoing “arms race” where brands invest in special labelling designs, invisible inks, and complex packaging materials in an

attempt to outwit the fraudsters. “The good news is that software intelligence and the mass-scale digitization of the world’s consumer products is coming to the rescue.” Counterfeit products and gray-market imports thrive because of a lack of visibility into the supply chain, Murphy believes. If brands knew where every single product item was as it



moves through the supply chain – where it was made, how it got there, when it reached the retailer and, ultimately, when it was purchased by the customer – brands would know if the final product is genuine and if it is in the right market. “Achieving this kind of visibility hasn’t been possible until now,” he says.

His answer is the application of digital identity technology in the cloud:

- Every product can have a web address through a global upgrade to barcodes enabled by the advent of the GS1 Digital Link standard.
- Brands have the capability to gather logistics data through billions of smartphones already equipped to scan barcodes.
- Mass-scale, crowd-sourced data from consumers allows brands to continually redefine and grow revenue, based upon real-time intelligence.
- Cost-effective, real-time data collection throughout each product’s supply-chain journey can be achieved.

“Digital identity systems generate real-time data and capture everything that happens to each individual product throughout its entire life cycle, from manufacturing to recycling,” Murphy explains. By creating a dynamic digital ecosystem around the world’s physical products, brands have an opportunity to change the integrity-management game. The challenge, until now, has been

**Complete Transparency**

Software intelligence and the mass-scale digitization of the world’s consumer products tells manufacturers exactly where every product was made, how it got there, when it reached the retailer and, ultimately, when it was purchased by the customer.

the cost of detection. Previously, the only way brands could track products and protect brand integrity through the supply chain required cost-prohibitive hardware and a lot of people – teams of brand protection experts – to identify problems in the market. The arrival of software algorithms with predictive intelligence can help brands not only to protect against but also to stay a step ahead of counterfeiters at scale. Data gathered from products as they’re manufactured, distributed, retailed, and consumed is aggregated in the cloud, while machine learning algorithms, trained to look for patterns, can apply this data to identify suspect events. With this intelligence, companies can take a proactive stance against brand integrity issues.

Real-time gathering of data and giving each product a unique digital identity dramatically increases the amount of data that needs to be processed. The best way to do this, Murphy feels, is through machine learning, where a machine programs itself by learning from data, finds answers in the data collected, learns patterns of what is normal and what is not, and learns to identify when things happen outside of these norms.

Cheap and abundant processing power, big data, and improved algorithms have all contributed to the practical application of machine learning and now it can be applied with product data at massive scale, he says. Unlike traditional software programming, which is limited to the rules and vision of the software coders, machine learning reduces the programming time for problems involving a complex network of rules and offers the ability to attack seemingly “unprogrammable” tasks that go far beyond the human brain’s capacity.

“If a brand inspector were to be present at the manufacture of each product item and then accompany it throughout its life cycle from distribution to recycling, problems of illegitimate production, diversion in the channel, and counterfeits at the →

point of retail would be eliminated," Murphy claims. Clearly that would be delivered at absurd cost, not to mention the additional carbon footprint of the airlines involved.

That said, product digitization coupled with machine learning can do the same job as a human brand inspector – but much faster and better. Each unique digital identity in the cloud accompanies every product on its journey and a machine-intelligence brain scrutinizes each step along the way. This provides unprecedented data analytics and real-time traceability.

If a product is headed toward the wrong channel of distribution, it is detected. If a product identity appears in the wrong market, or the pattern of events surrounding a product is wrong, it is detected. Every consumer engagement becomes a data point to support integrity enforcement in the supply chain and, because every product item is uniquely digitally identified, the source of any suspected problem is rapidly identified.

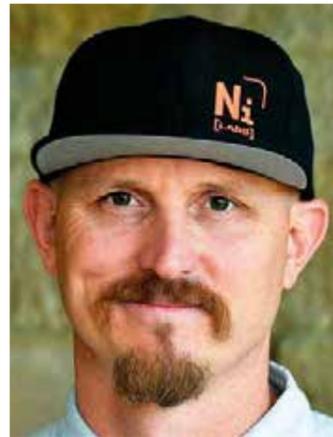
According to the Organisation for Economic Co-operation and Development (OECD), 2.5 percent of global imports are counterfeit – with US, Italian, French, and Swiss brands being most affected. According to Murphy, protection is now available to any brand, consumer, or retailer by using a regular smartphone and industry-standard product codes. "For companies losing tens of millions of dollars every year, software is changing everything," he concludes.

**Mick Ebeling, founder and CEO of Not Impossible Labs Vibrations for Good**

American film producer Mick Ebeling's life changed when he met Tempt. If you aren't a graffiti buff, you won't immediately recognize that this is the tag, a stylized signature, of artist Tony Quan. At the time of the meeting, in 2003, the famous graffiti artist was lying in a hospital bed motionless, kept alive with a breathing apparatus and a network of tubes.

**We are an innovation lab that's focused on creating things around social good.**

**Mick Ebeling**



Tempt was suffering from amyotrophic lateral sclerosis (ALS), a degenerative nerve disorder which causes the body's muscles to shrink. Nobody knows what causes ALS and there is no known cure. Right off the bat, Ebeling felt compelled to help Quan communicate and create art again. Since he would never be able to wield a brush again, there had to be another way to make it possible. Ebeling is president and CEO of the Ebeling Group, which produces commercial and studio work and serves as a hub of creative and technical innovation for film, television, and advertising projects. At that time, he was deeply focused on animation

and production design, including the coveted role of creating a James Bond title sequence.

Sitting down with his team, they came up with the idea for a device which "we had no business of making," he admitted in an interview for Forbes magazine. The invention was called the Eyewriter and it allowed Tempt to literally draw with his eyes. Ebeling recalls that many weeks later he got an e-mail from Tempt saying, "That's the first time that I've drawn anything for seven years. I feel like I had been held underwater and someone finally reached out and pulled my head up so I could take a breath."

Word leaked out and the world went wild. The Eyewriter made it to the front page of *Time* magazine as one of its "50 Top Innovations of the Year." That was the beginning of Not Impossible Labs. "Not Impossible is a brand-new business model and it's a mash-up. We are a technology innovation lab that's focused on creating things around social good," Ebeling said.

It seemed absurd to him that a gifted artist like Tempt should not be able to create. It seemed absurd that a young boy named Daniel, whose arms were blown off by a

landmine in South Sudan, couldn't feed himself. So Ebeling and his team flew to sub-Saharan Africa and set up a 3D printer, in effect creating the world's first mobile 3D printing lab for prosthetics. When they departed in November 2013, the boy was able to feed and take care of himself. When Ebeling visited him again in 2016, Daniel had been enrolled in a private school in Kenya and had just learned to swim.

One of Ebeling's latest dreams is to revolutionize live music by bringing it to an audience that has traditionally found it inaccessible: the deaf community. With help from product development engineers at Avnet, Music: Not Impossible (M:NI) premiered in September 2018 at the Life is Beautiful music festival in Las Vegas. M:NI is an innovative wearable technology that translates the sound of music into full-body vibration, allowing both deaf and hearing-impaired concertgoers to literally feel live music technology and experience it together for the first time.

It's really Mick's mantra of "help one, help many" that forms the basis of the Avnet and Not Impossible Labs partnership – the notion of finding a single instance of human need on which to base a new technology that can ultimately help the world.

"This partnership allows us to focus on Not Impossible Labs' highest and best purpose: inventing solutions to the world's 'absurdities,' with confidence that our creations won't languish on a back-office shelf," says Ebeling. "It really helps us bring our dream to 'Help Many' to life."

**Gabrielle La Rue, founder and CEO of Locketgo I Can Do it Better**

Gabrielle La Rue is more at home holding a guitar than sitting behind a desk, but that hasn't stopped her from founding Locketgo, one of the shooting stars of Canada's IoT start-up scene.

Locketgo is a young company based in Montreal providing on-demand temporary storage for event at-



tendees. Its turnkey solution allows an event-goer to reserve a locker for their personal possessions before setting out and to access it without standing in line to use their festival wristband, smartphone, or PIN number to claim a storage space.

Live concerts often take place at remote locations or in the open air where storage facilities are usually nonexistent. Mobile rental lockers aren't a new idea but they are rarely found at events and most of them are low-tech solutions using traditional mechanical locks and keys. As an accomplished, gigging musician La Rue has encountered these units and was impressed. Hauling in a bank of lockers for the duration seemed to her to be a pretty good idea: "That's when I thought to myself, 'I can do it, too – and I can do it better!'"

At that time, La Rue was working for Eventgo, a company that offers web-based software for show managers, venue organizers, and service providers in the entertainment industry. Her boss encouraged her to branch out on her own and develop the idea,

**Locketgo lets event-goers enjoy their festival experience more by giving them a chill-out space and a comfort zone, a place to rest and maybe put on their makeup.**

which took two years to get up and running. "In fact, we still work closely together – and Eventgo gave me my first contract for three big events which helped me get on my feet," she says.

Even more important was a stint at Montreal's Centech. Founded in 1996 by the École de Technologie Supérieure (ÉTS), the accelerator helps tech entrepreneurs to acquire the business skills they need to succeed. "We were far from knowing what we were doing, and weren't even close to understanding the technology we needed to build our systems properly. I talked to Centech on a Friday and joined their acceleration program on the Monday," she recalls.

One advantage of her time at Centech, La Rue believes, is that she could tap into a wide range of engineering talent. "Everyone there has their strengths. That helps a young company like ours shape where we want to go." A start-up, she discovered, is much like a good rock band – tightly focused, but with room for everyone to riff.

The Locketgo solution, which incorporates secure RFID-controlled locks and phone chargers, fully integrates with the festival ticketing and access control system. The area around the prebooked lockers enables event-goers to enjoy their festival experience more by giving them a chill-out space. "It gives them a comfort zone, a place to rest and maybe put on their makeup," La Rue explains. Now firmly established in the Canadian festival scene, Locketgo plans to take its show south to the US soon. And after that? "There are concerts all over the world," La Rue says. →

**Everyone has their strengths. That helps a young company like ours shape where we want to go.**

**Gabrielle La Rue**



# Interview



## Not Many Companies Can Do That

Q-loud was formed in 2016 as a spin-off from QSC, the large German broadband and data center operator, but you remain part of the QSC family – why?

Because QSC has seen that IoT is the future – not just for the industry but for the company. QSC has three verticals: cloud computing and data centers, ERP consulting, and Q-loud as the industrial Internet of Things provider. Together these are perfect to support and enable the new business models of the German *mittelstand* – the medium-sized companies in engineering and manufacturing that are the backbone of the German economy.

Germans, of course, see things differently to the rest of the world. While many people talk about the third industrial revolution, why do Germans like to talk about Industry 4.0?

The companies in Germany engaged in operational technology (OT) –



Hooking sensors up to IT shouldn't be that hard, but the deeper you go, the harder it gets.

**Dr. Myriam Jahn,**  
CEO of Q-loud, an IoT provider based in Cologne

electrical engineering and automation, for instance – are the ones already driving Industry 3.0, the third industrial revolution. For them, this is really a new industrial revolution, namely the bringing together of IT and OT as the fourth one.

**Your mission statement at Q-loud is We Connect Things. Please explain.**

Connecting things doesn't look all that difficult. Hooking sensors up to IT shouldn't be that hard, don't you think? But the deeper you go, the harder it gets. Wireless or cable? How much data do we have to handle? A typical machine tool nowadays produces up to 70 terabytes of data per year – and that's just a single machine. Besides all this, there aren't just physical connections, there are also software connections and very real physical constraints for them. That makes stuff really tricky.

**What are the biggest obstacles today to making IoT happen in enterprises around the world?**

Communication. There are companies that understand the IT world, but they know nothing about the OT world, and vice versa. IoT is about bringing the two together. There aren't very many companies that can speak both languages and provide solutions for both sides.

**There don't seem to be many female CEOs in IoT companies. Why is that?**

I can only speak for Germany and, here, less than 10 percent of students enrolling in engineering or technology are women. If understanding both the IT and the OT world is crucial for being a CEO, you need a good scientific background and there aren't many women around who fit the bill.

**Do women have a different approach to IoT than their male colleagues?**

Definitely! In order to understand the strange but exciting world we are entering into right now, you have to be able to listen a lot. Listening –

pardon the cliché – is not exactly the biggest strength of most of my male colleagues.

**Your bosses at QSC are men. Is that a problem?**

No, not at all because they think in terms of business administration. That's pretty neutral. They have the strategic perspective and they leave the technical details to me.

**Where will IoT be in, say, 2030?**

That's a good one. Will there even be anything called IoT anymore? I think there will be a new layer within industrial IoT which will be Edge Computing. Both IT and OT are coming together right now out there on the edge, and this will replace the way we think about IoT.

**Most managers, especially at medium-sized companies, worry that IoT introduces new threats and risks. What do you say to them?**

We will solve that problem – because we have to. IoT needs end-to-end security; security on the shop floor and security all the way to the cloud. This is completely different to securing a data center. Blockchain will play a big role here, for example, in linking both edge and cloud in a secure fashion.

**Would you agree that establishing trust in IoT should be the first priority?**

That's the most important challenge we face. It's also the reason the IT and the OT worlds still speak different languages. You know, according to the very strict German data protection laws, machine-generated data belong to the operator of the cloud where they're being stored. That's unbelievable because, with AI and self-learning algorithms, the USP [unique selling point] of every machine will rest in the cloud. That makes it absolutely essential that there is trust between the cloud operator on the one hand and the machine builder on the other. Only this way will new business models for the Industrial IoT thrive.



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## IoT Made in China

# THE RACE IS ON

China is betting big on IoT with huge investments in cutting-edge technologies. **Does this mean it will come to dominate the industry?** And should the West be worried?

■ By Greg Langley

**W**hen a blinding dust storm rolled across Saudi Arabia and engulfed its capital Riyadh in April last year, 61,000 street lights automatically responded to the low visibility and turned on. The solution was installed by a firm based in the Chinese province of Zhejiang, Fonda Technology, a specialist in intelligent lighting. Fonda uses the Narrowband Internet of Things (NB-IoT) to control street, tunnel, and facade lighting brightness, immediately identifying system malfunctions. Founded in 2010 in Hangzhou, a coastal city near Shanghai, Fonda lists many large Chinese cities among its clients and a growing number of international ones, including some in Cambodia, Indonesia and, of course,

Saudi Arabia. Western companies can expect to increasingly butt heads with Chinese IoT firms in international competition. The “Middle Kingdom” has been investing heavily over the past decade in a bid to become a major player in IT, with a schedule that could see Chinese firms appear on the international stage in increasing numbers after 2025. IoT applications are well integrated into China’s daily life. They are found in solutions that reduce pollution, prevent bicycle theft, and monitor agricultural crops in remote regions. In cities, buses and trains are on the go with embedded IoT technology, while fleets of smart bikes whisk people through congested traffic. Face-scanning solutions are used everywhere, from retail to banks and

police stations. In Shenzhen, China’s answer to Silicon Valley, jaywalkers are recognized by street surveillance cameras and a fine is sent automatically to their WeChat social media / mobile payment account. The norm for paying such fines, or for purchased goods, is via smartphones using Tencent’s WeChat Wallet or the country’s other leading digital platform, Alibaba Group’s Alipay. Does the rapid rise of China’s IoT abilities mean the country will dominate the sector? Not necessarily, according to Rui Ma, an early stage investor active in China and the United States. The proliferation of consumer and commercial solutions, she says, can give the wrong impression that China is more advanced in IoT than the West. “In terms of simple every-



China has many IoT solutions due to its large manufacturing base.

Rui Ma, Investor

day consumer IoT, China is selling a lot because of its massive population. In terms of manufacturing, China has many IoT solutions based on robotics due to its large manufacturing base. But, as for cutting-edge, deep-tech IoT, it is unclear that China will ever dominate."

### The Western Edge

Today, China is the largest market in the world for IoT with a 22 percent market share, according to data portal GSMA Intelligence. The *Annual IoT Industry Development Report of China*, published by the China Economic Information Service, says the IoT market in the country was worth more than 1.19 trillion yuan (\$176 bn) in 2017. The Industrial Internet of Things (IIoT), still in its infancy compared to consumer markets, is projected to link 14 billion objects by 2025. GSMA believes that Greater China (China and Taiwan), with around four billion connections, will account for nearly a third of the total global IIoT market by then. Such numbers may draw a picture of China surging to global IoT dominance but it is misleading, says Saman Farid, a partner at Baidu Ventures.

Farid has worked in China for 20 years, including founding and selling two start-ups there. He now leads the US artificial intelligence early-stage investment team for the capital arm of Chinese technology company Baidu. He argues that both China and the United States have advantages that

make them the principal competitors in IIoT but feels the West has the edge through technical superiority, which is the result of close interaction with leading research universities.

Farid points to the example of CubeWorks, a Michigan-based company that develops millimeter-scale, ultra-low-power, autonomous wireless systems (mmWave) capable of imaging, motion and pressure detection, and temperature sensing. The CubeWorks microsensors can be embedded into everyday objects, from smart home systems to wind farms, and links them wirelessly to form IoT networks. The sensors can even be injected into human tissue to monitor intraocular pressure in glaucoma patients and intracranial pressure in trauma victims. They could also be used to measure pressure inside tumors and thus the effectiveness of cancer treatments. In comparison, China's leading companies have tended to excel at applications of existing technologies, whereas CubeWorks is a spin-off from Michigan Micro Mote (M3), an initiative of the University of Michigan. "You can do a lot of things with off-the-shelf technology," says Farid, "but such solutions as the microsensors of

CubeWorks are the result of years of research that come from an academic tradition built up over decades. You can't buy that type of knowledge."

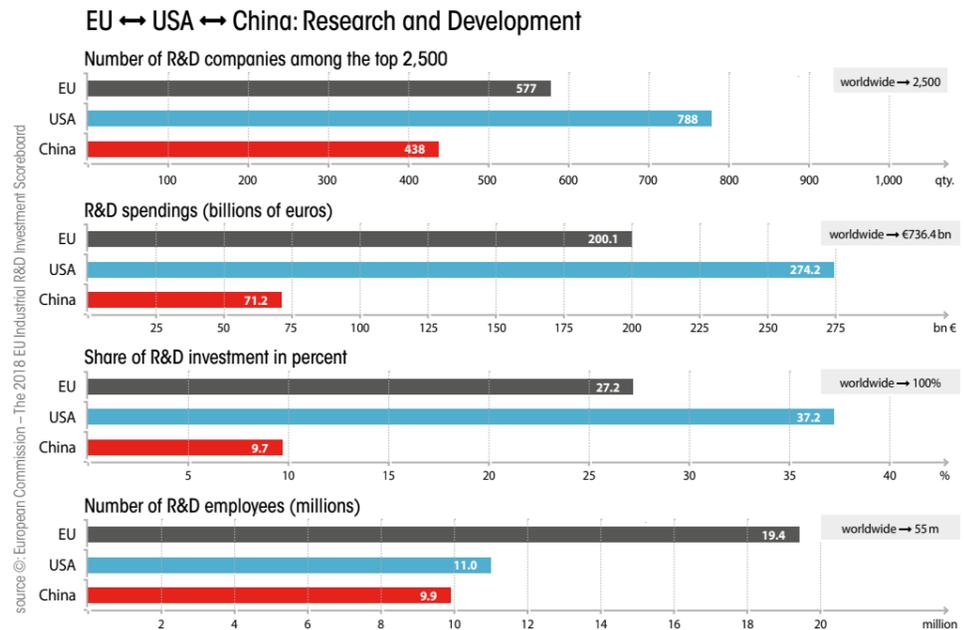
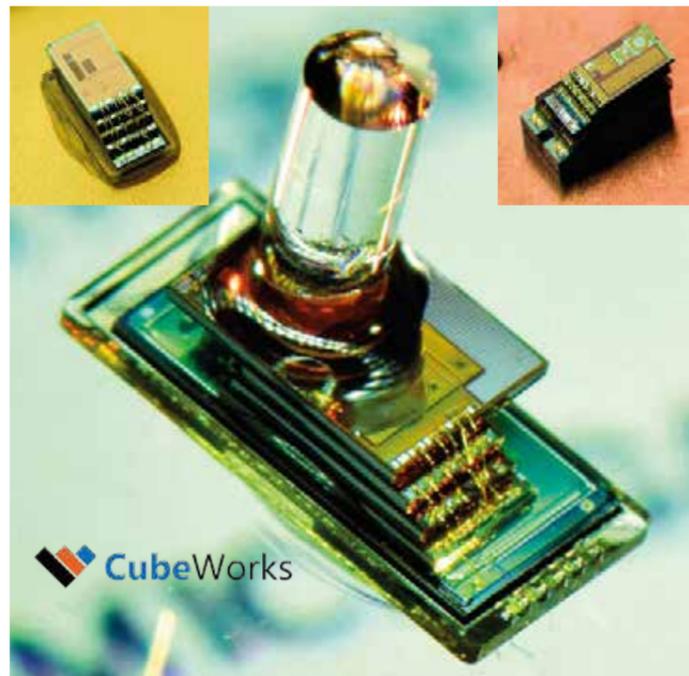
### Shenzhen Speed

This has not stopped China from throwing money at the problem. The year 2006 was important for IoT in China because it was then the government decided the country should be known for more than copycat technology. In its Medium- to Long-Term Plan for the Development of Science and Technology, Beijing outlined how China would transform from "the world's factory" into "an innovative society" by 2020 and become a leader in science and technology by 2050. China intends to increase R&D funding to beat rivals in "strategic emerging sectors" such as advanced materials, biotechnology, and IT. Goods are no longer simply to be "Made in China" but "Designed in China."

In 2014, Premier Li Keqiang enhanced this strategy by introducing a blueprint for "mass entrepreneurship and innovation," which included subsidies and generous government contracts. China immediately became a hotbed of millions of start-ups chasing innovations in aerospace, artificial intelli-

#### Getting Under the Skin

Companies like Michigan-based microsensor maker CubeWorks still enjoy a lead over Chinese competitors because of their decades-long academic tradition.



gence, and robotics. IoT companies have been a grateful beneficiary. The sector was earmarked as far back as 2010 for special treatment as part of a five-year economic plan that targeted reaching a market volume of \$163 bn by 2020. That volume was actually passed in 2017 and the China Economic Information Service now thinks the Chinese IoT market will surpass \$230 bn by 2020. Archer Zhu, vice president for strategy at Yunding Network Technology, downplays the importance of subsidies in developing China's IoT. His company, he says, has managed to capture 60 percent of its market without a cent of government funding. "For some companies it may be helpful, but at the end of the day, what counts is having a good product at a reasonable price. That is what appeals to customers and if you don't have that, no number of subsidies will help," he explains.

### Amazing Speed

Founded in 2014, the Beijing-based company specializes in smart locks and cameras for homes and offices. One of the advantages Chinese companies have is being able to iterate quickly and this is evident at Yunding, which has experienced 300 percent year-on-year growth and, in 2016, shipped 200,000 products. The company has managed to produce a new product line every year. In comparison, US company August, founded

two years earlier, is only on its third generation. Even so, Zhu describes Yunding as being comparatively slow: "Other [Chinese] companies are much faster than us. The speed at which they can reiterate is amazing." Kai-Fu Lee, a leading AI venture capitalist, touched upon speed as a Chinese advantage in his 2018 book *AI Superpowers*, which described how China is rapidly moving toward becoming a global leader in AI. "A week spent working in Shenzhen," he wrote, "is equivalent to a month in the US, as a prototype can be created overnight in Shenzhen and then repeated the next day at little cost." Rapid prototyping shortens the time for new product introductions. Considering that the Dyson vacuum cleaner, for example, required over 5,000 prototypes, such a manufacturing ecosystem offers significant advantage in moving from the lab to the market. Farid agrees with Lee: "Proximity to the supply chain is important. In China, you can pop into the factory every few days, which adds to the speed of iteration, plus it is easier to find skilled people there." Tim Cook, Apple CEO, has made the same point. In 2017, he said that "China has a wealth of skilled labor unseen elsewhere." He added that a meeting of tooling engineers in the US would not fill the room but "in China you could fill multiple football fields." From this perspective, it is harder for a US company to reiterate on technol-

**Catching Up**  
China still lags far behind the West in terms of overall R&D spending, but the lead is shrinking, especially in the top-priority fields of IoT and IIoT. The stakes couldn't be higher.

ogy than a Chinese company, says Farid. He adds that having the cell-phone supply chain in China is also a huge advantage: "Lots of the components that go into IoT devices, such as cameras and sensors, are produced in China for mobile phones, so this makes it easier to adapt components for IoT devices."

While the technological progress made by China in a little over a decade is impressive, an incident in April 2018 made it brutally clear how vast the gap is before China can compete on technological competence. Chinese telecommunications giant ZTE, which makes smartphones, telecommunications equipment, and other mobile gadgets, was banned from accessing crucial American technology after violating sanctions on Iran. ZTE, one of China's star tech companies, was pushed to the brink of financial collapse before the US relented. ZTE uses Snapdragon processors from Qualcomm in San Diego for its smartphones and sources 53 percent of its chips from the US. Without them the company was crippled. Most major Chinese tech firms are in a similar position, with around 90 percent of the integrated circuits used being imported or made domestically by foreign chipmakers.

"ZTE was a shock," says Rui. "While industry insiders knew the situation, the public was used to thinking that Chinese technology - the fast trains, the smartphones, the e-com- →

Proximity to the supply chain is vital. Here you can pop into the factory every few days.

Kai-Fu Lee, AI venture capitalist and author



merce giants – was world-leading. To see ZTE humbled due to a lack of local semiconductors was a wake-up call.”

The ZTE incident exposed the technological weakness underlying China’s ambitions. Much of the recent progress has been based on parts and equipment designed abroad. China’s world-leading smartphones cannot function without cutting-edge foreign microchips. The Android operating system powering them, almost exclusively, comes from Google. And the rapid strides being made in manufacturing depend on German and Japanese industrial robots.

Zhang Jun, Dean of the School of Economics at Fudan University, says China is not the fierce competitor for global technological supremacy that many Western observers imagine. Writing for *Project Syndicate* in July 2018, he commented, “China is really nowhere near the cutting edge of IoT technology. In fact, the distance separating it from that frontier is far greater than most people recognize.” Zhang argues that digital technologies may be transforming China’s economy, but it reflects the implementation of “mobile Internet-enabled” business models rather than the development of cutting-edge technologies, and it affects consumers more than manufacturing. This transformation is not unique to China and there is little evidence that the changes have anything to



**No Chips in the Game**

To see a giant like ZTE humbled due to a lack of local semiconductors was a wake-up call for China.

do with the government’s industrial policies. “On the contrary, the growth of China’s Internet economy has been driven largely by the entrepreneurship of privately owned companies like Alibaba and Tencent,” Zhang says. The ZTE incident and the ongoing trade war with the United States have underlined to Beijing the importance of reducing dependence on foreign companies for core technologies. China’s leaders now see chip dependency as a national security threat, especially in a time of heightened tensions with America.

**Made in China**

Given the strategic importance of the semiconductor industry, they may be right to worry. “You need semiconductors for everything,” Roger Sheng, an industry analyst for Gartner, told *CKGSB Knowledge* magazine last year. “On every digital, connected device, all information is transmitted on IC-based infrastructure.” Weaning the country off foreign technology is a central aim of the Made in China 2025 strategy, the latest take on its plan to become a leading player in virtually all high-tech sectors. Besides tax breaks, the strategy calls on public institutions to pursue IoT projects as a path to becoming a global player. However, the government reportedly scrapped the contentious economic plan last December, after it drew the ire of US President Donald Trump and other officials and became a central focus of the ongoing trade war. The strategy was controversial abroad be-

cause it set specific goals for raising the market share of domestic companies in many industries.

Zhang argued in his *Project Syndicate* article that the industries targeted by Made in China 2025 are precisely the ones in which China lags furthest behind the West. “There is a big difference between applying digital technologies to consumer-oriented business models and becoming a world leader in developing and producing hard technology.”

His conclusion was: “China probably remains 15–20 years away from matching the R&D input of, say, Japan or South Korea, and when it comes to output – the more important factor – it is much further behind.”

Rui is not so sure as the Chinese have shown themselves to be quick studies. Since China began opening to the West, its manufacturers have proved adept at seizing opportunities to emulate and adapt technology. “ZTE is a catalyst for China to develop its own chip industry,” she says. “But developing R&D capacity is not like copying, especially for products like semiconductors. Still, they are determined and if there is one lesson the West should have learned it is not to underestimate the Chinese.”

In May, while ZTE’s future still hung in the balance, President Xi Jinping called for self-reliance in IC. “The initiatives of innovation and development must be securely kept in our own hands,” he said. Officials and CEOs scrambled to answer his call and more than 11 local governments

aim to set up IC production facilities and major companies, including Alibaba, Baidu, Gree Electric, and Tencent, have pledged to invest more in chip research and development. Yet, for all this energy, China will be forced to take the slow road as the country does not have manufacturers of chip-making equipment and the US has begun to crack down on the export of this vital technology.

At the end of last year, Chinese DRAM maker JHICC (Fujian Jinhua Integrated Circuit Company) was indicted on charges of economic espionage for stealing manufacturing secrets. Before that, Washington had slapped the company with an export ban preventing it from obtaining US-made equipment, a move seen as impeding its efforts to enter mass production.

China’s homegrown chipmakers also face a talent crunch. A report last August in the state-run *Global Times* noted there are presently only about 300,000 of the 700,000 engineers needed for the growing sector.

These obstacles will not deter China from its technological ambitions. Spurring innovation is a central policy

focus for Beijing as the drivers that propelled the economic miracle – cheap labor and surging fixed-asset investment – gradually lose steam.

In a 2015 report, McKinsey found that China would need to generate at least two percentage points of growth through innovation to maintain its fast gross domestic product (GDP) growth rate. The industry needs to generate economic innovation to propel itself to the next stage of development. To avoid the middle-income trap, which has claimed places such as Brazil and Mexico, a country needs to shift from imported to indigenous innovation.

This is the complex political and social background against which China’s IoT is seeking to compete with the West. Zhu’s company plans to enter international markets this year, starting with Southeast Asia and the United States, but he scoffs at the notion that China will ever dominate IoT.

“How can any one country ever dominate IoT? You may have products manufactured in China, but they are designed in the United States and built on German machines. However, if you ask about Chinese brands

“  
China is really nowhere near the cutting edge of IoT technology.”

Zhang Jun,  
Fudan University



dominating, that is different. I believe Chinese companies will be able to compete on the world stage in terms of quality and value,” he says.

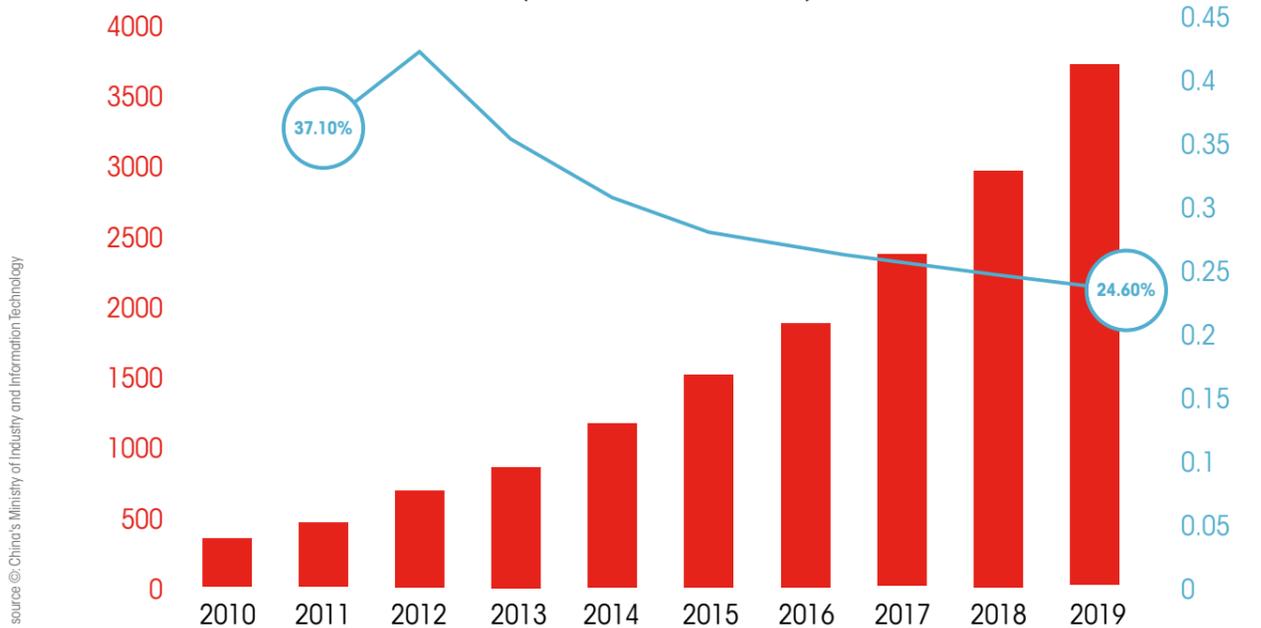
Farid also rejects the notion that China will dominate. “We are really only at the beginning of IoT. Previously it was about getting sensor networks deployed, now it is about getting AI to understand the data coming out of the sensors,” he explains. “In this area, both China and the United States have their own advantages, I don’t think one country will dominate.”



“  
China and the U.S. are the principal competitors in IIoT but the West still has the edge.”

Saman Farid,  
Baidu Ventures

**The Overall scale and growth forecast of China’s IIoT in year 2010 to 2019 (100 million RMB)**



## Social Scoring in China

# BIG BROTHER SQUARED

IoT technology offers many opportunities for massive surveillance – and China is using them all

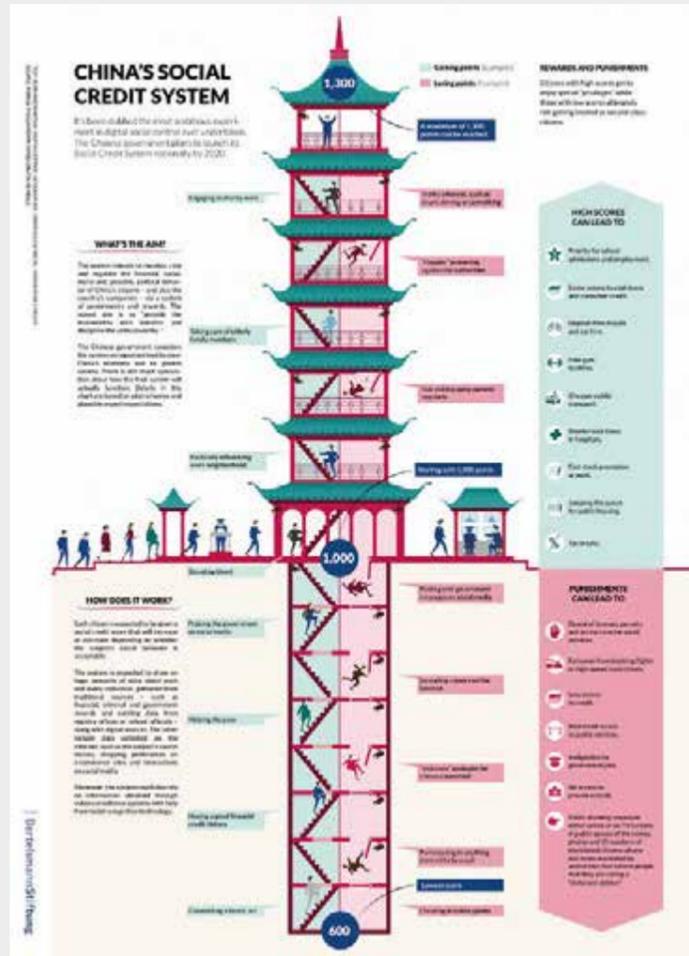
By Rainer Claassen

If you regularly drive a car, you probably know one social scoring system: most countries have central ledgers in which serious violations of traffic laws are stored. When a person's penalty-point score goes too high (or below zero in some countries) they may lose their driver's license.

In 2020, the Chinese government announced a social scoring system that will cover violations even by pedestrians – as well as misdemeanors in many other walks of life. The system was first envisioned in the mid-1990s with the aim of evaluating anything that might indicate the trustworthiness of each of the 1.4 billion Chinese people. In 2014, the Chinese government specified its plan in a document sent to all provincial, regional, and municipal People's Governments.

In an interview with the Mercator Institute for China Studies (MerciS), Rogier Creemers, China law and governance lecturer at Oxford and Leiden universities, said, "The central leadership seems to believe that technology will allow it to overcome the old problems of 'the mountains being high and the emperor being far away' that have plagued Chinese administrations for 3,000 years. So, I think the use of social credit systems for government oversight is something we're very much going to see."

**Chinese Tower**  
China is broadening its data gathering and has given licenses to eight private companies to develop systems and algorithms for determining social credit scores.



The Chinese government (and local authorities) will be able to see a lot: estimates say that there are 170 million CCTV cameras installed in the country – and they don't just use face recognition to identify people. Artificial intelligence firm Watrix has developed a gait-recognition technology which can identify individuals from the way they move and the shape of their silhouette from up to 50 meters away – even if their face is hidden. It is currently being used by police in Beijing and Shanghai.

Using the same technology in IoT applications, China plans to rank all its citizens based on their "social credit" by 2020. Like private financial credit scores, a person's social scores can move up and down according to their behavior. At the moment the system is piecemeal – some are run by city councils, while others are scored by private tech platforms that hold personal data. The program is due to be fully operational nationwide by 2020 but is being piloted for millions of people across the country already.

The Western media are already publishing stories about social scoring penalties that could have been taken straight out of George Orwell's novel 1984. Reports abound that people are being punished for behaving badly and rewarded for good behavior. In February, China's National Public Credit Information Centre released its annual report which stated that 17.46 million "discredited members of society" had been blocked from buying flight tickets and that 5.47 million were denied high-speed rail travel. The program is eventually expected to be used to punish individuals for bad behavior such as traveling without a ticket, loitering in front of boarding gates, smoking in no-smoking areas, spending too much time playing video games, wasting money on frivolous purchases, and spreading "fake news" or making unwise posts on social media. Trust-breaking individuals could also be banned from doing management jobs in state-owned firms and big banks, while children may be denied places in the best schools and universities because of their parents' antisocial behavior. In July 2018, a Chinese university was said to have re-

fused admission to a student because his father had a bad social credit score. The city of Jinan started enforcing a social credit system for dog owners in 2017, according to local reports. Pet owners are awarded a score and get points deducted if the dog is walked without a leash or causes public disturbances. Anyone losing all their points will have their dogs confiscated and be required to take a test on pet ownership regulations. It is not clear by which means the government will raise the cost of breaking trust and misbehaving, but it is broadening its means of data gathering and has given licenses to eight private companies to develop algorithms for determining social credit scores. Among the chosen developers are China Rapid Finance, partner of the giant social network Tencent, and Sesame Credit, a scheme run by the Ant Financial Services Group (AFSG) – an affiliate of the Alibaba Group, the world's largest retailer and e-commerce company. AFSG's core business is selling insurance products and providing loans and its Alipay service is used to pay online and offline and to transfer money privately.



**The Eyes Have It**  
China has been quietly building what it calls the "world's biggest camera surveillance system." The 170 million CCTV cameras use artificial intelligence and facial recognition technologies to get an inside look at everything about its citizens. Currently, the U.S. has about 30 million surveillance cameras installed across the country. According to a report in 2014, the UK operates six million cameras in public places.



The use of social credit systems for government oversight is something we are very much going to see.

Rogier Creemers  
Mercator Institute



Human rights activists worry that people will be judged according to their score and that there will be no way to appeal a sentence imposed by technology. Human Rights Watch called it "chilling," while Rachel Botsman, a trust expert who lectures at Oxford University's Saïd Business School, called it "a futuristic vision of Big Brother out of control." Proponents of the scoring system note that people can also be rewarded for behaving socially. For instance, they will potentially be able to get discounts on energy bills, rent things without deposits, and get better interest rates at banks. According to a recent article in MIT Technology Review, "... many scholars argue that social credit scores won't have the wide-scale controlling effect presumed. The data the scheme collects doesn't actually align with the data that, say, a bank needs to determine whether to grant you a loan. Regulations have also been revised in instances of intense pushback. Suining County allegedly got rid of its point deductions for unauthorized petitions, for example, because of widespread unpopularity. Therefore, these scholars say, the system acts more as a tool of propaganda than a tool of enforcement. Others point out that it is simply an extension of Chinese culture's long tradition of promoting good moral behavior and that Chinese citizens have a completely different perspective on privacy and freedom."

## IoT Platforms

# POWERING CHANGE

Data originates all around us and it lives in many places, too. Gathering it and linking it to analytics, storage, and a huge range of specialized apps is a role now being filled by IoT platforms. **From the largest hyperscale cloud provider to narrowly focused niche players,** it seems everyone has a slice of the pie.

■ By Gordon and Eamon McCarthy Earls



## SIZE MATTERS: THE BIG FOUR

For enterprise IoT projects, cloud-based IoT platforms from the leading public cloud providers are increasingly central to new initiatives. Recent results from the 451 Research survey Voice of the Enterprise – Internet of Things, Vendor Evaluations 2018 found that 59 percent of enterprise respondents were using a commercial IoT platform. Not surprisingly, in terms of survey respondents reporting a platform in use, Microsoft Azure and IBM Cloud were neck and neck with 35 percent and 34 percent adoption respectively. Meanwhile, Google Cloud and Amazon Web Services (AWS) were similarly paired for third and fourth ranking, with 27 percent and 26 percent of respondents using their IoT platform.



“The Big Four are starting to differentiate by adding more AI and edge capabilities.”

Frank Antonysamy, Cognizant

Indeed, 451 Research found that customers seem to be deciding on hyperscale IoT platform providers primarily based on factors such as technical expertise, long-term viability, and total

cost of ownership – but other factors like strategic vision, partner networks, or customer-service capabilities were also influential.

“All of these platforms provide hyper-scale for enterprise-grade IoT solutions and IoT/PaaS services,” says Frank Antonysamy, global markets head for connected products at consulting firm Cognizant. He adds that all of the so-called Big Four platform vendors continue to enrich their core IoT services but are gradually starting to achieve differentiation through artificial intelligence and edge capabilities. Antonysamy explains that most of the IoT offerings provided by the Big Four are essentially platform as a service (PaaS) solutions specific to data ingestion, device management, streaming analytics, and the data pipeline. ➔

## SMALL(ER) MAY BE BEAUTIFUL

Let's start with an analogy. According to Olivier Frank, global director for converged servers, edge, and IoT systems at Hewlett Packard Enterprise (HPE) in France, the smartphone has become a pervasive tool in our private and business lives for two key reasons: first, the smartphone converged previously separate functions like music player, camera, computer, and phone into one device; secondly, it's connected to an app platform that provides countless opportunities to benefit from these converged functions.

“The same thing is happening in the Internet of Things,” Frank says. “[With IoT], edge systems converge previously separate operational technology (OT) functions like data acquisition,

industrial networks, and control with standard enterprise IT.” They, in turn, are connected to a rich ecosystem of IoT, analytics, and AI applications to capitalize on the OT data generated in factories, oil rigs, or energy grids, he adds.

Frank, whose company offers its own IoT platform, says these converged edge systems, combined with a platform, are ultimately crucial to achieve the central goal of all industrial IoT initiatives – namely “turning OT data at the edge into intelligence and action to increase efficiency and differentiation.”

Although the public cloud giants have advantages, in the large and growing universe of IoT platforms there is an enormous variety of smaller, or niche, players that provide offerings which

“Edge systems are converging with operational technology, analytics, and data that used to be separate.”

Olivier Frank, HPE



are compelling for their competitive pricing or particular capabilities. Frank Antonysamy at Cognizant divides these players into five main categories. For starters, there is ➔

They all typically function satisfactorily with the rest of each vendors' PaaS and infrastructure as a service (IaaS) cloud platforms that provide product-related compute, storage, analytics, AI, integration services, and such. "All of these services are needed to realize an enterprise IoT solution, and IoT service offerings are just another set of their PaaS services," says Antonysamy. However, integration of IoT offerings with some vendor-specific cloud offerings vary – Azure integrated with Dynamics 365, for example, is at a relatively nascent stage.

**Microsoft Azure** – In contrast to some of its competitors, Azure has focused sharply on enterprise use cases for IoT, highlighting major customers such as ThyssenKrupp, Johnson Controls, and Rolls-Royce. Its IoT Central monitoring and management solution lets users, which it calls "builders," create device templates with web-based tools to define what kind of telemetry is sent

by a device and specifying its behavior and thresholds.

"Microsoft Azure has actively built partnerships with smaller platforms that they compete with – examples of this include PTC ThingWorx, and SAP Leonardo," says Antonysamy. In addition, he notes that Azure also has the most industry-specific approach, with customizations built for different industries. "Google and AWS seem to focus more on the platform providing the scale and reliability, leaving their partners to build any industry-specific applications," he says.

Following its acquisition of GitHub in 2018, Microsoft hosts all of its IoT software development kits on the site, with support for Java, .NET, Node.js, Python, and C (written in ANSI C for portability). If problems crop up, users are invited to create help desk tickets for Microsoft Support through the Azure portal.

**IBM Cloud** – Of the Big Four cloud providers, IBM may have the smallest

cloud market share but it is an important player in IoT and should not be underestimated. In parallel with AWS, IBM Cloud uses the lightweight message queuing telemetry transport (MQTT) protocol or HTTP and a mix of representational state transfer (Rest) APIs and real-time APIs.

"IBM is leveraging its deep analytics capabilities around Watson to provide pre-built applications like Condition Monitoring and Predictive Maintenance in the industrial manufacturing space," Antonysamy says. A modified version known as the Watson IoT Platform is targeted at companies looking to deploy IoT devices. In November 2016, the Watson platform was extended for IoT security goals, with the addition of Risk and Security Overview Dashboard, geared toward whitelisting and blacklisting traffic, connection security maintenance, and certificate management.

**Google Cloud** – When it comes to

IoT and generic PaaS services, Google Cloud is gaining interest and momentum, according to Antonysamy. He says its strategies are bringing in cloud data flow innovations with AI, machine learning (ML), and cloud-native platforms, and scores after telemetry ingestion.

With platforms maturing, the trend is to offer more IoT-specific services such as platform managed services, including third-party offerings. "They also offer services and tools in the adjacent areas like AI by integrating AI-based data analytics tool sets into their platform as well as IoT edge," he says. "This is a result of providing edge runtime frameworks that even support ML and serverless computing on the edge."

At the center of Google's approach to IoT is its Cloud IoT Core, which draws in data from devices and pushes out commands, doing management with Edge Connect, Edge ML, and TensorFlow Lite for analytics and machine



learning. Google integrates MQTT notifications with its own Cloud Pub/Sub system, which it describes as a "globally durable message ingestion service." Pub/Sub is intended to be a "shock absorber and rate leveler" for inbound data streams as well as app architecture changes, setting topics for different streams and allowing different parts of an app to subscribe to specific streams.

From the perspective of storage and analysis, Google offers both raw and processed data storage in Cloud Datastore and Firebase Realtime Database, with the option to run "ex-

**Who Will Win the IoT Platform Race?**

Among the Big Four platform operators, Microsoft and IBM Cloud are leading neck in neck, but Windows Azure and Amazon Web Services seem to be catching up fast.

tract, transform, and load," streaming computation, and batch operations with its Apache Beam-powered Cloud Dataflow. The TensorFlow open-source machine learning framework present in IoT Core can be run in a managed training or distributed approach through Cloud Machine Learning Engine.

**Amazon Web Services**

From the time AWS launched in 2006, Amazon entered the market as a technology upstart and quickly became a leader in the field, in part by winning over many developers ➔

a plethora of pure-play IoT platform providers, such as ThingWorx, Xively, and Ayla, powering various use cases. ThingWorx, which was acquired by PTC in 2013, integrates well with the company's range of other products that offer a full suite of capabilities for product and service life cycle management (PLM and SLM), and augmented and virtual reality (AR/VR). He also notes that C3.ai offers what it calls a full-stack platform that is, it claims, gaining traction in the market by enabling an analytics platform, rather than leading as a pure-play IoT platform that provides device connectivity and device management.

Next, although not at the scale of the Big Four, HPE and the powerful enterprise application providers – Oracle, SAP, and Salesforce – have also introduced IoT platforms that are typically based on their own cloud platform. Antonysamy says, "They have seen a fair amount of success tapping into their customer base who already have



**Compelling Offers**

An enormous variety of smaller players provide competitive pricing or particular capabilities.

deployed enterprise apps and have IoT use cases that extend and integrate with these apps."

In the telecom sector, IoT platforms from providers such as AT&T, Verizon, Telefonica, and Vodafone have modest market shares but they are in a

good position to use their infrastructure and business experience to carve out their own IoT platform territory. Antonysamy notes that their strategies differ from most of the other platform providers because they focus mainly on promoting cellular connec-

tivity and a data pipeline. For example, he notes, one provider has a solution that offers a container-tracking application with the capability to leverage partner devices and their own cellular network and IoT platform.

Industrial IoT (IIoT) platforms represent a fourth sector with services like Schneider Electric EcoStruxure, ABB Ability, and Bosch IoT Suite. "In our experience, the industrial sector tends to compete directly with enterprise IoT platforms," says Antonysamy. "What we're seeing is the industrial solution providers reengineering their own solutions leveraging these platforms and using the platforms as a brand."

According to Sabina Kentsch, the marketing and communication spokesperson at Bosch Connected Industry, IoT Suite fulfills this promise by being a PaaS offering based on open standards and open source. She explains that it is intended for IoT software developers, for example, the software

portfolio Nexeed, for management of procurement, production, process and logistic data, and is intended specifically for IIoT users. "Nexeed uses services of the Bosch IoT Suite and services of other cloud providers for device management or authentication functionality," she says. She adds that Nexeed solutions run in the cloud but can also run on-premises as well. Finally, in Antonysamy's schema, there are the IoT edge providers. These vendors mainly provide edge and fog (a mini-cloud of edge devices) computing capabilities, complementing cloud-based IoT platforms by integrating well with them. For example, FogHorn and Cisco are prominent fog providers, while Intel and Digi are leading edge gateway providers.

Christian Renaud, a research vice president at 451 Research's Internet of Things practice, and a former advisor on G20 and European Commission projects, cites recent studies from his firm that underscore the vitality of the

platform sector and the strong interest in platforms that are not from the Big Four hyperscale cloud providers. According to the 451 Research report, Voice of the Enterprise – Internet of Things, Vendor Evaluations 2018, of those surveyed, 62 percent use at least two platforms to support their IoT initiatives, while 24 percent use three platform vendors. What is driving this trend toward multiple platform vendors? According to 451, it is the availability of specialist IoT and OT platforms running on cloud infrastructure and able to deliver best of breed capabilities specific to different industries. Some of the multivendor adoption was also attributed to the comparatively early stage of IoT platform adoption with many customers simply experimenting.

**Selecting and Implementing**

While there are many uses cases drawing organizations toward ➔

and small and medium businesses to the AWS platform. While the IoT platform market has become increasingly dominated by Microsoft Azure, AWS has managed to claim the most cloud usage overall.

AWS offers a broad portfolio to organizations trying to connect devices and services. AWS IoT Core is the central offering for IoT deployments, offering a messaging and connectivity system for devices, with a device-side software developers' kit (SDK).

Amazon FreeRTOS uses the popular real-time operating system (RTOS) for microcontrollers, common across industry, teaching, and the hobbyist community to deploy diverse sets of microcontrollers. Amazon's derivative version is updated regularly with SDKs and connectivity libraries, in a bid to maintain compatibility for extensions and connections to AWS.

"Using these SDKs in combination with our IoT Core service, you can

**We support TLS authentication, authorized and secured by encryption in certificate-based services.**

Ian Massingham, AWS



securely send information with the managed MQTT message service. We support mutual certificate-based TLS [transport layer security] authentication. [Data is] authenticated, authorized, and secured by encryption features in the certificate-based services," says Ian Massingham, director of AWS evangelism.

To date, AWS has been applied to wide-ranging IoT scenarios like BMW's smart service and automotive maintenance deployment for its 7 Series cars, or Italian energy company Enel's smart metering. Data processing and analytics is a key element of Amazon's strategy for IoT, ranging from its S3 simple storage system to its Redshift data warehouse and Kinesis high-volume data streaming, all integrated for IoT. Because IoT devices vary in their output, AWS Lambda aims to be a nearly serverless software creator that responds programmatically to actions taken by IoT devices. US manufacturer iRobot has used Lambda with many of its house cleaning robots.

Massingham gave an example of smart agriculture using AWS in which a polytunnel sensor breaches a temperature threshold. "You can receive messages from IoT devices with IoT Core Service and a rules →

IoT and toward platform adoptions, it is important to make sure that the IoT data is enriched with customer-relationship management (CRM) context for organizations supporting equipment in the field, says Taksina Eammano, VP of Salesforce IoT Go-to-Market. That capability can then help field workers to respond to issues in a timely fashion.



**It's important to make sure that IoT data is enriched with CRM context.**

Taksina Eammano, Salesforce

"IoT data must be able to connect with customer data so dispatchers can understand which signals coming from connected devices affect what customers and then dispatch the right technician with the right skill set to handle any support issues in the field," Eammano says.

She notes that organizations need to consider what gaps they currently have in understanding the status of their connected devices. Understanding issues like that can help inform platform choices.

Most platforms provide broad "horizontal" capabilities for IoT and can be utilized to deploy a variety of use cases, according to Antonyamy. He stressed that, at this time, his organization has not seen a strong alignment between specific platforms and use cases. Still, he suggests there are some rules of thumb to consider when choosing a platform:

• Suitability: Does the customer need a point solution to addresses a spe-

cific business unit requirement, or do they want to create a platform that can be leveraged to build multiple solutions?

• Evaluation of core platform features: This includes device connectivity/management, hot/cold path analytics, along with other capabilities for IoT edge and AI.

• Total cost of ownership: Including accounting for licenses, subscription, solution development, managed services, etc.

• Existing cloud platforms in use: This applies to applications as well as data lakes (repositories) and analytics.

• Greenfield vs brownfield: Drawing a comparison between undeveloped land and property that has been developed in the past. Antonyamy suggests considering whether there is an existing solution that must be reengineered with the new platform. Any existing code-base may have to be incorporated. →

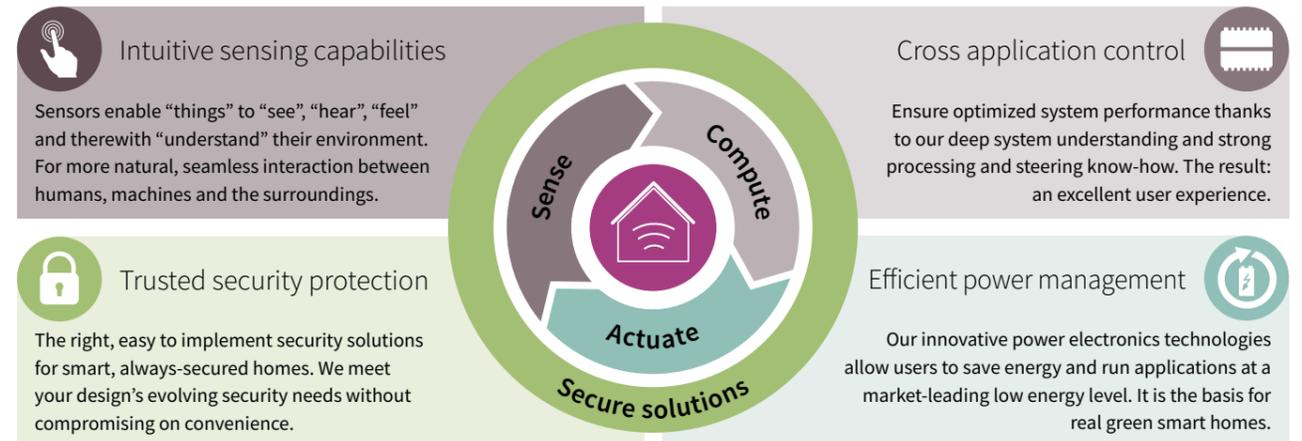


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engine can evaluate the content to make a routing decision ... and publish [commands] to a vent, heater, or chiller, correcting a temperature by opening a window in the polytunnel or adding humidity with a sprayer." He adds that to make sense of the alert, data can be routed into long-term storage with Redshift and S3 and used to create visualizations in a dashboard app.

### Bigger Is Better – for Many

According to Antonyamy, all four platforms have their roots in their underlying cloud/PaaS platforms and they have evolved into IoT platforms by introducing core IoT services such as device connectivity and management, and streaming analytics, along with other "product-as-a-service" offerings for storage, compute, analytics, and enterprise

integration. That heady combination of size and broad capability seems destined to convey an important, long-term advantage, he thinks. In fact, according to the 451 Research survey, those companies that have adopted IoT platforms from the Big Four are farther along in their digital transformations. Potentially, this indicates that the die has been cast and that these major providers are very much baked into long-term planning.

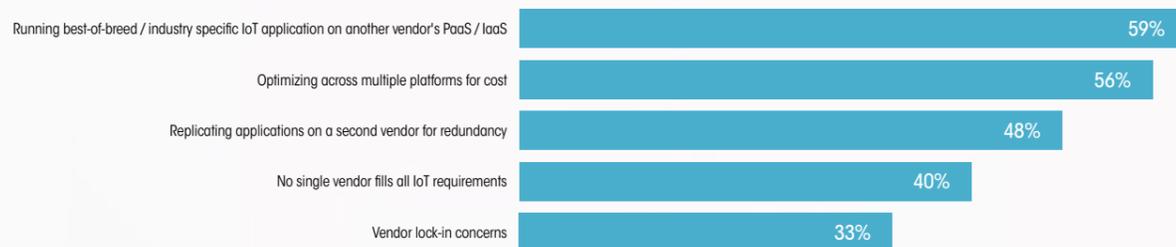
## Enterprises Turn to Multiple IoT Platforms

Top reason: IoT specialty / vertical platforms running on cloud IoT PaaS / IaaS

IoT platform vendor in use	Total [n=301]	Incidence of joint usage			
		Low	Moderate	High	
Microsoft Azure IoT [n=106]	35%	100%	29%	35%	
IBM Cloud / Watson IoT [n=101]	34%	27%	100%	28%	
Google Cloud IoT [n=80]	27%	26%	22%	100%	
Amazon AWS IoT [n=79]	26%	27%	27%	44%	
Other	64%	58%	54%	68%	

### Most important reasons for using multiple IoT platform vendor

% of respondents [n=180]



- Deployment options: Can the solution be deployed in the cloud or does it have to be on premises?
- Integration: Do other enterprise applications (either on-premises or in the cloud) have to be taken into account?
- Non-functional requirements: Scalability, performance, security, and other technical considerations also need to be weighed up.

- Availability of development accelerators: Time to value can be reduced if solution templates, device agents/ plug-and-play devices, and other preconfigured kit can be used.
  - Relationship with the vendor: Ability to influence the roadmap, price negotiation, etc.
- The list of rules grows every day and is already far more extensive than the key considerations listed here. The

#### Making Sense of It All

The IoT platform space is important, but crowded and confusing. There are platforms for many specific industries and even for various devices, and hardly any one size will really fit all.

same is true of the number and varieties of platforms and 451 Research says it is already tracking hundreds of IoT platforms. It is clear that Antonyamy's examples form a generalized list of the full complement of commercial IoT platforms available and choosing the best option requires planning and a deep understanding of business requirements.



## Enhanced security and intelligence at the IoT edge



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## IoT and Commercial Insurance

# DISRUPTION INSURED

Digital disruption is about to hit commercial insurers full force as the industry prepares to undergo major transformation. IoT will be at the heart of many of the new initiatives as **insurance firms find new ways of using IoT data to assess customers, reduce premiums, and provide real-time warnings.**

■ By Stian Overdahl

**C**ollecting data is critical for the insurance industry because it enables underwriters and actuaries to estimate the likelihood and cost of future misfortunes. Consequently, data harvested from connected devices embedded in the Internet of Things could have a major impact on the industry, giving insurers new insights into customer behavior and real-time risks which, in turn, could reduce premiums for fastidious customers while raising them for the risk-takers.

Already there are some trailblazers. Corvus Insurance, based in Boston, Massachusetts, uses IoT data collected from sensors that are transported along with climate-controlled goods in the food and life sciences sectors to assess each company's performance, using algorithms to customize premiums (Corvus doesn't sell policies to end users, but relies on brokers for distribution). Businesses with a better track record can also receive broader spoiler coverage, while access to on-board sensors allows Corvus to provide real-time warnings to customers of potential threats to their cargoes, says Phil Edmundson, the company's CEO and founder.

In bringing its IoT insurance product to market, Corvus investigated where IoT could be used to predict loss, including unusual threats like measuring pressure from the weight of snow on a roof, or detecting water leaks. Despite this, a stumbling block was the fragmented nature of the market – while historical data to build predictive algorithms could be obtained from sensor manufacturers, Corvus couldn't easily identify who its future customers might be.

The company subsequently narrowed its focus to temperature-controlled goods, partnering with supply chain visibility specialist Sensitech, →

which had a sufficient share of the thermal sensor business to allow Corvus to offer its insurance product to a wide segment of the market. Edmundson says that one key feature of the insurance policies is that they draw on several years of historical data from each customer to produce accurate profiles.

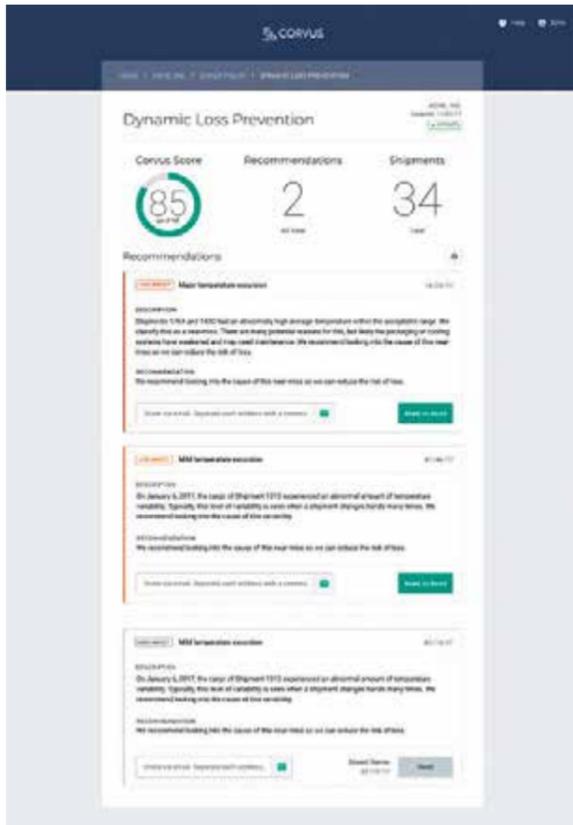
In other ways the product is still traditional, with policies being sold for a full year rather than being micro-adjusted every week or month in response to new data. Edmundson argues that, while it may be “tempting” to implement this, most companies don’t want a high level of granularity. “The customer doesn’t want to be getting an e-mail from their ocean marine insurer every day or every week, saying your Corvus score changed from 86 to 85, so we’re going to adjust your premium for next month by \$7,” he explains.

### On Further Inspection

Another company using technology to give insurers more accurate data is Virtual i Technologies, which sends inspection engineers equipped with recording hardware, including video streaming glasses and thermal cameras, to warehouses and other commercial sites. This provides the office-based underwriters with a rich data set at a much lower cost than sending in a senior loss prevention engineer. Instead, the senior engineer, or even an insurance underwriter, can watch the feed remotely and give instructions to the on-site inspector, says Mark Pollard, president of Virtual i’s European operations.

The company is targeting small to medium enterprises where the expense of sending a senior engineer to make a thorough site inspection is often prohibitive, says Pollard. At the moment, lower-level surveyors are sent to visit no more than three percent of risks that are insured but the company’s goal is to expand that into double digits over time, he says.

The value of enhanced data feeds from customers will be borne out by future directions for the insurance industry. If insurers could receive data



#### Scoring Big on IoT

Corvus is able to collect information from business-critical management, monitoring, and logistics systems to provide brokers and policyholders visibility into the insured operations for troubleshooting, predicting, and preventing claims.

**Philip Edmundson**  
Founder/CEO of Corvus Insurance



from sensors within buildings – such as sensors within sprinkler valves, or cameras measuring the position of goods within a warehouse – insurers could use these to assess risks constantly. This could also feed into automated underwriting processes and even “continuous and dynamic underwriting” without human intervention, Pollard suggests. “Underwriting has been informed by data since underwriting started. What’s changed

has been the quality and the quantity of the available data and the ability to interpret the data,” he says.

### Industry in Its Infancy

Despite green shoots like Corvus and Virtual i, experts agree that the development of IoT in commercial insurance is still in its infancy. While millions of IoT-informed policies have been sold in the personal insurance world, that number is likely to be just in the tens of thousands for commercial lines, suggests Matteo Carbone, founder and director of the IoT Insurance Observatory think tank.

One of the main reasons for the low penetration is complexity, says Carbone. While personal insurance policies are standardized off-the-shelf products, commercial insurance policies normally have to be tailored to an individual company and its unique risks.

This complexity means there are also relatively few potentially disruptive Insurtech start-ups, since most of them focus on simpler retail products that have larger markets, says Maximilian Straub, an associate partner at consultancy McKinsey & Company. “Commercial lines insurance is very difficult to do – you need the top people for underwriting, very good actuaries, and for good profits you need a significant amount of capital for longer-scale risk. Start-ups in this space are very few,” he observes.

While the number of IoT devices in businesses has grown sharply in recent years, it’s not clear how readily data from these can yield actionable insights for insurers, says Gary Barnett, chief analyst for thematic research at GlobalData.

Much of the data within organizations is hyper-specific and siloed and an insurer of airplane engines doesn’t want to receive gigabytes of data every second from each engine, says Barnett – as it is, insurers are still grappling with using big data sets.

“At the moment, the techniques, tools, standards, and simply the volume of data aren’t there to create a realistic prospect. In the next couple of years, insurers will be able

to suck in lots of data and perform either complex post-event analysis or even true real-time analysis,” Barnett maintains.

Longer term, greater use of data would likely allow insurers to sort between good and bad customers better, which could lead to lower premium prices for the former, and higher prices for the latter, believes Barnett. While that could be great news for many good companies, for insurers it would likely mean a reduction in their core income from policies and force a shift to earning revenues through ser-



**Greater use of data will allow insurers to sort between good and bad customers.**

**Gary Barnett**,  
managing director of Trak Global

vices, such as preventive consulting or real-time warnings.

One area where the service model already predominates is cyber insurance, notes Dietmar Kottmann, a partner at consultancy Oliver Wyman. Specialist cyber insurers provide customers with diagnostic tools to reduce the risk of cyber intrusion; experts to provide urgent advice if a company is hacked, which is especially important in the case of ransomware; and public relations services to contain the reputational fallout following a data breach. Since both →

## Insuring IoT against Cyberattacks



### Sins of Omission

Cyber risk insurance is one of the fastest-growing areas of commercial insurance as more and more companies suffer devastating attacks that disrupt business operations, destroy hardware, reveal private data, and damage reputations. According to Munich Re, a reinsurer, the market volume for cyber insurance may grow to \$9 bn by 2020 – more than twice the level in 2017.

Some of the costs of a cyberattack may be covered under a company’s existing general cover but nobody will be fully covered, says Sjaak Schouteren, a partner in the cyber team at Jardine Lloyd Thompson (JLT) Group, a specialist insurer. Cyber insurance is designed to return a company to the same operational level it was at before an incident occurred, he says.

Writing a policy requires an holistic approach and the 14 people in JLT’s Eu-

ropean cyber team conduct workshops to help companies to identify and assess their IT risks and mitigate them. The sessions also consider issues such as technology errors and omissions (Tech E&O) insurance, which covers losses as a result of an error or omission in a service or product they have supplied to an outside company.

When it comes to IoT, Tech E&O blended with cyber insurance is the most important form of cover for most companies, maintains Schouteren. Having these policies in place is key, especially when acting as a supplier to companies in the US, where there is the greatest awareness of cyber risk management and therefore insurance.

The thorny questions of who is liable if an IoT device is used as the point of entry for a cyber intrusion – such as the case in 2017 when a newly fitted smart thermometer / feeding device in a

### Technology Takes the Risk Out of IoT

Tech E&O and cyber insurance is the most important form of cover for many companies.



**Cybercriminals, like burglars, will always look for the weakest spot.**

**Sjaak Schouteren**,  
Cyber team partner at Jardine Lloyd Thompson (JLT) Group

fish tank was used as a gateway into a North American casino’s database – will usually come down to the fine print in an individual contract between supplier and client, says Schouteren.

The good news is that IoT is not a main focus for hackers, who currently find it easier to make money through methods such as ransomware or phishing e-mails, says Schouteren. Levels of security within Industrial IoT systems are normally much higher than in consumer IoT devices, like a coffee machine, he says. “Cybercriminals, like burglars, will always look for the weakest spot where they can get in as easily as possible. At this point there are far more easy access points for criminals than Industrial IoT. But every organization should always look at where the impact of a possible incident is the highest.”





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5G networks will boost the effectiveness of sensors on board cargo containers.”

**Bob Skerret,**  
managing director  
of Trak Global

“Our outlook is that the IoT will eventually be adopted by everyone in the market and across all lines of business. In a few years there will be insurance companies that use data and those that used to exist. Traction in the market is starting to increase and it will be the early adopters who will benefit the most.”

### Not Just Premiums

Other impacts of IoT in commercial insurance can be seen around behavior modification and transaction cost reductions, such as streamlining claims processes.

For commercial vehicle fleet insurance, telematics information expedites claims processes and even protects insured companies against false claims, says Bob Skerret, managing director of Trak Global. He cites the case of a personal lines motor book that was able to save £564,000 (€652,500)

from an annual spend of £10 m on premiums through using its telemetry data when making claims, including using that data in court to defend against a fraudulent claims case.

Despite this, progress in the sector as a whole has been slow, says Skerret. Most companies use telematics primarily to improve logistics and fuel efficiency, not for the insurance link-up. He believes that technology providers are somewhat to blame – many focus more on the technology itself rather than on expanding its uses.

Fleet managers can identify risky behavior, such as tailgating or drivers who become distracted, by installing video cameras on vehicles to provide additional data, says Simon Marsh, managing director of VisionTrack. He believes the on-vehicle camera products his company sells can lower insurance premium costs for fleet owners by up to 30 percent. The mere presence of the system is seen by insurers as a sign that the client is being proactive about safety and it allows the fleet manager to work on curbing risky behavior by identifying the worst drivers. Some insurers have even started recommending VisionTrack to problematic customers because they are facing a time of increasing claim costs, says Marsh.

### 5G Heralds Cheaper IoT

Beyond insurance, industry innovation, improved technology, and lower costs should also accelerate the attraction of IoT insurance products. GlobalData's Barnett says the falling

cost of track-and-trace devices has the potential to be a major catalyst for innovation. Battery-powered sensors on board cargo containers, for instance, will help the industry home in on the precise time and cause of loss events, and will also help to monitor logistics chains. Developing enhanced supply-chain interruption insurance by monitoring upstream logistics flows, for example, is a major prize for any commercial insurer. The advent of 5G networks will also boost the effectiveness of these sensors, says Skerret at Trak Global. “Marine cargo, and areas like that, are



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On-vehicle cameras can lower insurance premiums by 30 percent or more.”

**Simon Marsh,**  
managing director  
of VisionTrack

begging for better, low-cost, real-time tracking. With the coming 5G networks and lower latency, you'll get much longer battery life, so we expect battery-powered IoT location devices to be a big growth area. Micro tracking and low-cost telemetry is going to be incredibly useful,” he predicts. While there's a wide expectation in the industry that IoT will have a major impact on insurance, there's much less clarity about how near-term developments will play out. “Everyone can see the future, but the steps from here to there need careful navigation,” Skerret concludes.

parties want to avoid cyberattacks and contain any impact of an intrusion, “the interests of the insurer and the customer are perfectly aligned,” points out Kottmann.

For many insurers, a dramatic shift in their revenue models is not something they want to happen overnight. Large companies are preparing for this disruption but not rushing to usher in the changes: “Insurers want to be ready to go that path if an industry, or a country or region, switches to do it at scale. Nobody wants to be the first – because being the first means losing money,” says McKinsey's Straub.

Still, some early adopters are bullish. Matthew Madahar, a data analyst at Concurus, which works with insurers to leverage IoT data to improve their premium writing and “write more risks with less risk,” including in fleet and maritime, believes companies which act now will have an edge.



“  
The interests of the insurer and the customer are perfectly aligned.”

**Dietmar Kottmann,**  
partner at consultancy  
Oliver Wyman



### Write More Risks with Less Risk

Companies which act now to leverage IoT to improve their premium writing will have an edge, especially in the fleet and maritime businesses.

**Matthew Madahar**  
data analyst at  
Concurus



## On the Seas with Blockchain and IoT

### ■ Riding the Insurwave

Marine hull insurance for shipping dates back to the sixteenth century when merchants at Lloyd's Coffee House in London began sharing the risks of disastrous voyages, reducing the financial damage of a single ill-fated sailing.

Recently, this sector has struggled with cumbersome and inefficient processes involving multiple paper trails between agents, brokers, shipping companies, and underwriters. High overheads eat into profits.

One initiative seeking to overhaul this process is Insurwave, a collaboration between professional services firm Ernst & Young, security specialist Guardtime, the Danish shipping giant Maersk, and a number of insurers. Built on the Corda blockchain, Insurwave uses smart

contracts that comprise codified insurance agreements, automated processes that include quote generation and purchasing, and making the data available to all parties instantly, says Jamie Steiner, financial services manager at Guardtime.

“Insurers today don't have an up-to-the-minute view of what their risks are, where the ships are, what the profile is – they really don't know about the value of the cargo that is being transported. As a result, they have to price their policies defensively, which takes up more capital than it would otherwise,” says Steiner.

Real-time data has been available from GPS transponders since they were made mandatory in 2012 for all marine vessels above 300 tons. This



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Insurers don't really know about the value of the cargo being transported.”

**Jamie Steiner,**  
general manager  
for financial services  
at Guardtime



information is publicly available but few marine insurers make use of it, even though knowing a vessel's position can be crucial. Through Insurwave, brokers have access to all this real-time data, allowing them to account for spikes in policy prices when, for example, vessels enter and leave war zones. These additional premiums can be immediately encoded into the insurance contract – automating a process that once relied on shipping companies sending faxes to insurers.

Beyond marine hull insurance, the Insurwave investors plan to address new business areas to cover all sectors of commercial insurance. “Marine insurance has lagged in digitization and automation but now there is an opportunity to leapfrog over technologies that have been around for ten to 15 years,” making it a prime target for Insurwave, Steiner believes.

### On Course to the Future

Marine insurance hasn't changed much since the days of Lloyd's Coffee House in London, but IoT and modern blockchain technology are making important inroads.



**B**orn in the UK and having earned a first-class honors degree in chemistry and computer science at King's College London in 1990, Thomas Weldon moved to the US to study for a PhD in chemistry at Harvard University before joining Bell Labs' physical sciences research laboratory in 1995. He won multiple awards for his work there before becoming a member of technical staff in the materials research laboratory.

After the spin-out of AT&T Technologies, which included Bell Labs, as Lucent Technologies in 1996, Weldon focused on early Fiber to the Home technologies and architectures. This led to his subsequent appointment as chief technology officer of the broadband solutions business unit of Lucent in 2004. After the merger with Alcatel in 2006, he became the CTO of the broadband access business unit of Alcatel-Lucent and progressed to become its corporate CTO in 2009. In 2013, after the departure of Jeong Kim, he added president of Bell Labs to his corporate role and was appointed CTO for Nokia when it acquired Alcatel-Lucent in 2016. His brief was to restore Bell Labs' status as an innovative leader in information and communications technologies by focusing on solving the key industry challenges.

In recent years, Weldon has inaugurated the Bell Labs Prize to encourage external innovators to collaborate with the company's researchers. He has also engaged in numerous industry leadership activities such as the FCC's Open Internet Advisory Committee and the launch of the European Union's Partnership for 5G Wireless Research. His focus on rejuvenating Bell Labs has led to the invention of foundational networking technologies and systems for the cloud networking era. In July 2014, Bell Labs announced it had broken "the broadband Internet speed record" with its 10Gbps XG-Fast technology, which has led to the Future X Network initiative. Bell Labs describes Future X as a digital ecosystem, driven by machines and sensors connecting to augmented intelligence,



**Marcus Weldon,**  
president of Nokia  
Bell Labs since 2013  
and CTO of Nokia.

Interview with Marcus Weldon

# THE GAME-CHANGER

**Marcus Weldon was appointed as the 13th president of Bell Labs,** the research arm of Alcatel-Lucent, in 2013 and became the corporate chief technology officer of Nokia when Bell Labs was acquired as part of the Alcatel-Lucent takeover in 2016.

■ By Gerhard Kafka

running over an ultra-high-capacity, ultra-low-latency, hyperscalable, dynamic network infrastructure.

Outside the purely technical field, Nokia Bell Labs works closely with musicians to investigate the interplay between music and technology. In April 2016, Weldon relaunched a series of collaborations with artists, known as Experiments in Art and Technology (EAT), which uses the concept of a Human Digital Orchestra that allows the audience to interact with, and modify, artistic performances and installations.

*Smart Industry* took the opportunity to talk to Marcus Weldon about his views on the future of communications.

**Please share with our readers the Nokia Bell Labs mission and its research focus.**

Nokia Bell Labs is the world-renowned industrial research arm of Nokia. For more than 90 years now, we have been solving the communications and connectivity challenges that confront humankind. We do this by looking forward to the future and considering "what should be" in terms of human enhancement and then understanding the limits and boundaries that exist to prevent this vision from becoming a reality. We then work from the "future back" to solve the critical problems identified. This approach often leads to groundbreaking discoveries as well as commercial innovations – reflected in the eight Nobel Prizes, Turing Medals, Japan Prizes, many national medals of science and engineering, and even an Oscar, two Grammys, and an Emmy.

We are currently working on a set of disruptive innovations that are enabled by 5G networking technologies, ranging from new sensing technologies, through novel networking systems and platforms, to new computing and distributed cloud systems and new artificial intelligence and machine learning tools and techniques. You'll start seeing end-to-end 5G solutions appearing soon, starting in the US this year, followed by large-scale commercial deployments elsewhere beginning the middle of 2019. We will

also see 5G become one of the foundational wireless technologies for the automation of factories, warehouses, mines, and other industrial settings.

**Now, as part of Nokia, is there any change in the company's strategy?**

In addition to serving as president of Bell Labs, I'm also CTO of Nokia so I help set the strategic technology direction for the company. The company's strategy has always been to be the leader in communications and connectivity solutions and that continues today. Recently, the focus has moved beyond human and web services communications to include machine communications, which brings a new set of challenges in terms of very low latency and very high reliability. The focus of Bell Labs is, as ever, to conduct disruptive research and invent game-changing solutions to critical problems in communications and connectivity to improve lives and enable new economic paradigms.

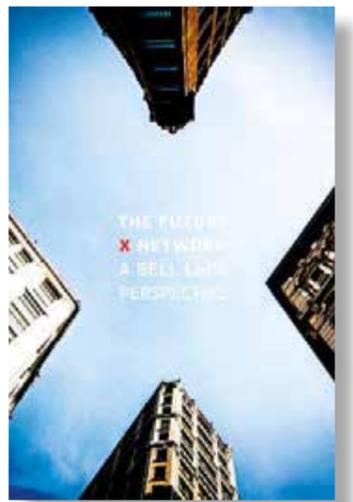
**Could you give us a short overview of recent research initiatives leading to significant changes in information technology and communications?**

In the last few years alone, Bell Labs innovations have led to a radical evolution in traditional wired networks by creating ways to achieve the ultimate limit of communications (the so-called "Shannon limit") over copper wires by advanced interference cancellation called "vectoring." So it is now possible to transmit data at 10Gbps over 100-year-old copper wires, with a path to 10Gbps.

In the optical domain, we invented a completely new way to transmit data at 100Gbps and beyond over optical fiber, using advanced signal processing and coherent detection. We also pioneered massive MIMO [multiple input, multiple output] radio transmission that will form the basis of all 5G radio networks, and we have also created novel IP plus optical routing algorithms for optimized packet transport, as well as leading augmented and artificial intelligence tools and techniques – building from the invention of convolutional neural networks (CNNs) at

**90 years in the making,**

*The Future X Network* provides a Bell Labs perspective of the world at the nexus of a technological revolution.



Bell Labs in the late 1990s. And that's just a sampling of our recent innovations.



**Please share with us some of Bell Labs' current research projects.**

We are working to augment every aspect of human existence, so that humans can be continuously assisted and optimized using a combination of new noninvasive, connected physical, physiological, and even neurological sensing technologies, as well as machine and robotic assistants. We're working on new quantum computing technologies and new operating systems for distributed cloud systems, new device technologies for ultra-high-performance signal and packet processing, as well as new "augmented intelligence" tools and platforms. And, of course, we continue to innovate in all aspects of communications and networking, as we always have, but with a new focus on ultra-low [1 ms] latency, ultra-high reliability [99.999 percent and beyond], and ultra-high capacity. We're even working on "virtual teleportation" and new mixed reality applications – and we're building a network on the moon next year.

**The focus of Bell Labs has always been to conduct disruptive research and come up with revolutionary solutions.**

**Why did it take more than 90 years before Bell Labs published its first book, *The Future X Network: A Bell Labs Perspective*?**

Bell Labs researchers have written or edited thousands of books, and many more have been written about us and our unique history of innovation, but we decided to write a book as an organization as a whole because we saw that we're at the nexus of a human technological revolution that will be very different than any prior era. We thought it was important to share that vision with all. We will be publish- ➔

ing an extension of this Future X vision to cover different industrial transformations later this year.

**What are the drivers transforming human existence in the near future?**

We are entering an era of being connected where augmenting human and machine intelligence will be used to sense, control, and automate everything. We believe we are on the verge of the fourth industrial revolution – a revolution that will be driven by the need to automate everything to save and “create” time. At its heart, this is a technological revolution driven by machines and sensors connecting to augmented intelligence over a massively scalable, ultra-high-capacity, ultra-low-latency, dynamic new network infrastructure, which we call “The Future X Network.” The net effect will be a massive increase in productivity with machines assisting and augmenting humans in both repetitive physical tasks and complex intellectual tasks.

**Can you envision some revolutionary technologies, or even disruptive innovations, influencing our lives?**

I believe that the current consumer-driven digital platforms will be superseded by two sets of new value platforms, focused on augmenting how people perceive and understand their world and how to control and automate it. These platforms will redefine human existence in the next decades. Over the past 20 years, web services have redefined how people shop, read, consume media, find information, and interact. But, in reality, these

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The next revolution will be driven by the need to automate everything to save and “create” time.

services have just created digital replacements for existing capabilities, increasing convenience but not manifestly changing human existence. Moreover, service and experience quality and user privacy have been sacrificed for the sake of convenience and the offer of “free” services. This has resulted in no net increase in quality of life or productivity and the initial utility has eroded over time. The next phase of existence will be driven by the digitization of all physical systems (including humans) and the creation of new machine automations to assist humans in every “scale” task. This will result in two new platform types – platforms that assist humans with perception of the physical world, and platforms that assist humans to control the physical world. These platforms will couple to existing digital web platforms created during Industry 3.0 to create the fundamental new value set for Industry 4.0. The critical characteristics of these new cyber-physical platforms are the ability to support and connect a massive scale of low-latency, real-time data streams from a multitude of sensors, with augmented cognition systems that assist humans in creating new understanding and optimized outcomes.

**What is your perspective of the future of communications and its key technology elements?**

The next industrial revolution will be driven by the digitization of all physical systems to create unprecedented levels of awareness and knowledge. This will allow the augmentation of every process and system, increasing

efficiency and productivity – and ultimately creating time. The existing network architecture must radically transform to meet these needs, due to the massive increase in capacity and reliability, and massive decrease in latency, required. This new Future X network will have a number of profound architectural changes, such as moving from a highly centralized to a massively distributed network architecture, and moving from billions of smart devices to trillions of simple sensors, as well as new intelligent control algorithms and systems.

**Which development do you see for the fixed wide area network?**

We are at the beginning of a new era of access networks, as industrial automation and new infrastructure and information systems will require capacities of 1Gbps to 10Gbps and latencies of one microsecond to 10 microseconds, with ultra-high reliability and adaptability. We have exhausted the use of the traditional low band [ $<1\text{GHz}$ ] spectrum, so radical changes are required in multiple dimensions, such as utilizing massive antenna arrays to form wireless beams to increase spectral efficiency by a factor of five. In addition, we will use new very-high-frequency spectrum bands (so-called mmWave bands) which can support a massive amount of new capacity over short distances (up to 100 m). The result will be a new highly converged, massively scalable wide area network that connects a multitude of dedicated [local] industrial networks, supporting mission-critical application flows that are dynamically managed by new augmented cognition systems.

**Will 5G replace most of the current mobile networks?**

No, it will augment and massively extend current [LTE] wireless networks. 5G will deliver extreme broadband, ultra-robust low-latency connectivity, and massive networking to support many different use cases and business models. For mobile operators, 5G will enable a new level of network econ-

omy and a leap forward in network efficiency – building on the currently deployed LTE macro network infrastructure that provides global coverage and capacity for consumers and businesses, and an increasing number of simple machines and sensors today.

**Are there still challenges in the development of the fifth mobile network generation?**

While we have the first 5G products for enhanced mobile broadband available today, continued innovations are needed to achieve lower costs, higher throughput, and new levels of dynamism and automation. There are also important challenges to realize new 5G wireless solutions that have the same high reliability and the same low latency as the cables that connect robots and control servers in factories today. At Bell Labs, we are working with manufacturing industry partners to pioneer novel solutions in all these dimensions. As one example, we have recently demonstrated, for the first time, the control of a robot with a millisecond response time over a 5G-type wireless connection.

**And can you imagine a sixth generation – again with new features never seen before?**

We have seen a new generation of a mobile network about every decade and this will be no different after 5G. In the course of the next ten years there will be so many innovations in technology, architecture, and applications that it is hard to predict what 6G will look like. But there are many new technologies like terahertz transmission for hyper-local, hypercapacity, dynamic, self-coding mesh networks that are self-deploying and self-optimizing; and new “body area,” or in vivo, networks, as well as, of course, extra-terrestrial networks.

**What are the challenges in the field of Internet of Things (IoT) and what further research and development is required to interconnect billions of devices?**

As already mentioned, wireless connections with millisecond latency and



**Marcus Weldon awards the 2017 Bell Labs Prize**

to Kaushik Sengupta, assistant professor in electrical engineering at Princeton University.

ultra-reliability will be key for critical IoT applications, like control of vehicles or robots. Such applications also require very accurate localization methods. We need highly energy-efficient wireless solutions for sensors and other devices that need to operate for ten years on a single battery charge or solar power – drop and forget. We expect a 100 times increase in the number of devices and, hence, need new systems that can handle the massive scale of connections with dynamic scaling, adaptation, and automation.

**Do you believe in the realization of fully autonomous vehicles on the road, rail, and in the air?**

I believe that this will happen, first in places where well-organized “platoons” can form, for example on highways (trucks and cars), in rail systems and in shipping, and aerial systems (drones). For such systems, the number of variables and scenarios that need to be assessed, predicted, and managed are fewer, and the interworking with legacy [current] vehicles minimized. Although a great deal of progress has been made in autonomous systems, a lot more innovation is required until these systems are truly autonomous, as human tolerance for machine errors and accidents will be far lower than for the equivalent human control. We believe that private industrial networks will be one of the first areas to adopt

many autonomous technologies, given the well-defined environments in which they operate. For example, we are currently working on innovative solutions to enable autonomous operation of trucks in mines and cranes in harbors, as well as robotic systems inside warehouses and factories.

**Bell Labs created eight Nobel Prize winners in the past. Why did you found the new Bell Labs Prize for Innovation in Information and Communications Networking?**

We originated the Bell Labs Prize to attract researchers across the world and to allow them to collaborate with Bell Labs on new disruptive innovations. The goal was not only to connect with the largest possible pool of innovators but also to give them the benefit of the unique capabilities in Bell Labs to help realize their ideas. In the five years since we launched the prize, we have seen over a thousand proposals which have led to collaborations with more than a hundred leading researchers, which, in turn, has led to many new game-changing innovations that are currently in the works, or have recently been incorporated into our products or research projects.

**Are you planning another Bell Labs Innovation Day here in Germany?**

Yes, absolutely. We are very much looking forward to hosting our annual Innovation Day in Stuttgart in November.



# AUTOMATED SAFETY



While improved safety is the main benefit of anti-collision systems in mining, construction, and ports, many operations also see productivity and efficiency gains as a result of the technology investments. At the same time, **anti-collision technology can be a stepping stone to remote control and even full automation** of machines, vehicles, and equipment.

■ By Stian Overdahl

**T**ower cranes play a crucial role on many construction sites, both for logistics and construction, and their productivity can make or break a project's timeline. "Hook time" is highly sought after and allocated sparingly to a project's many subcontractors. Cranes are also safety-critical: a tower crane's height means any accident, especially collisions with other cranes or buildings, can result in serious injuries or death, whether for the crane operators, the workers below, or even members of the public. Beyond loss of

lives and lost work time, tower crane accidents also bring negative publicity to a work site, affecting the reputation of the contractors and even their client, the developer. The emphasis on safety has led to anti-collision technologies that are among the most advanced available and they are often essential elements in construction tenders. In some cases, this has been driven by regulation – in France, for example, mandatory regulation was introduced in 1987 and today it has led to its companies dominating the supplier space.

Now based in Dubai, SK Solutions started up in France and its Navigator software is distinguished by inclusion in the Key French Technology list. Though tower crane positioning was the initial focus, CEO Severin Kezeu now describes his invention as a universal anti-collision system to manage "everything that is moving." Navigator now covers site equipment such as mobile cranes, placing booms for concrete, excavators, trucks – even people. Beyond construction sites, the solution is now used in mining, oil and gas, utilities, and ports.

For tower cranes, the anti-collision system relies on precise sensor data, including the placement of the crane jib, its height, and the load on, and position of, the lifting hook. Wind speed and direction must also be measured – if the wind is coming in at a right angle to the boom the crane will need to increase its braking distance. "The load is critical, and the moment of the load," explains Kezeu. "If the load is close to the center of the crane, or at the end of the jib or boom, the impact is completely different." The cranes are connected in a mesh network, with the safety calculations taking place at the edge. The system has a safety integrity level (SIL) of 2, says Kezeu (where 4 would be the highest dependability factor), and a cloud-based enterprise version is also available to help optimize and prioritize operations. Apart from increasing safety, there are also distinct operational advantages, says Kezeu. Tower cranes are normally

positioned with overlapping work spaces and special care has to be taken in "no-go zones," areas where potential collisions can occur. Normally, only a single crane can operate in this zone, coordinated by a "banksman" on the ground, but cranes can be operated more freely when an anti-collision system is in place, he explains. Kezeu estimates that inefficiencies created by no-go zones can add as much as 10 percent to a tower building's overall project cost, meaning that the anti-collision system will help pay for itself. There are also indirect savings: crane operators feel more relaxed and experience less stress when working with the system, meaning they can work more efficiently over a long shift. Kezeu compares it with an autopilot system on an airplane, which takes away the need for highly skilled pilots to concentrate continually throughout a flight. "Using autopilot reduces stress, so the pilot can focus on more

**Watch Our Dust**

Compared with normal construction, mining equipment is usually bigger and working conditions more harsh. Dust, steam, or other obstructions pose additional problems. Increasingly, industrial radar systems are being used to ensure safety.

strategic tasks. It's the same with a crane operator: there's less stress, so they can focus more on productivity," he says.

**Beyond Building**

Pushes from regulations and worker unions in sectors such as ports, mining, and bulk material handling has led to anti-collision systems being →



used increasingly to reduce the dangers associated with the use of large and heavy equipment. From the contractor's viewpoint, it satisfies their desire to improve productivity and to protect their reputations.

Christian Augustin is the cofounder of Indurad, a mining safety specialist, and the managing director of Yardey, which offers anti-collision technology for container terminals. He explains that ports, bulk material handling, and mining are sectors where "machines are relatively expensive. Compared with smaller construction equipment, they are huge and they operate usually in harsh conditions." Both companies ensure safety through the use of industrial radars because the harsh conditions of dust, fog, steam, or other obstructions preclude the use of lasers or cheaper radars.

Beyond improved safety, the high-precision radar systems have also enabled the development of other productivity solutions, such as facilitating volumetric load measurements and carrying out 3D volumetric inventory controls, which all help to make work-site processes safer and more efficient by reducing the



**Looking at the Future**

Port automation has been slow to take off because of cost and scale. A single gantry crane can require up to ten cameras. With as many as 30-40 cranes, networking capability is essential.

exposure of workers to hazardous conditions and decreasing energy consumption.

Collision avoidance and remote operation or automation often go together, given that an automatic solution normally requires collision avoidance. Augustin says, "Once you have collision avoidance, you're already one step into automation because it helps to 'see' the environment." He adds that he's noted a clear trend, which is particularly strong in container shipping companies using large shiploaders, where customers start with a small collision-avoidance system and develop from there. "They then expand it to operator assistance on the machine, to remote operation, and then

to full automation. This is a good approach as it reduces the project risk," he explains.

Remote operation is becoming increasingly popular. In some cases, there are simply benefits of having an operator work out of the control room rather than sitting on the equipment. For example, in port applications, it's seldom that all rubber-tired gantry cranes will be used simultaneously. Rather than having a driver in each crane, where they may sit idle for part of the day, having the operation carried out remotely means fewer "drivers," or controllers, are needed. It's a similar story in mining, where full automation of equipment, especially dump trucks, means that a single con-

troller can manage a large fleet of up to 30 vehicles.

Augustin sees this trend across both ports and mining operations. At a port in Vancouver, by removing the two-ton operator cabin from a ship-loader and rebuilding its boom, the remotely run machine had greater throughput capacity. In Chile, a copper mine is currently equipping its stockpiling machines with Indurad technology because it wants to operate the entire stockpiling system from Santiago, roughly 1,500 km away. "We see a general trend to have people running equipment from far, far away – and the vision is zero-entry mines," observes Augustin.

**Towards Automation**

Despite advances in automation technology, there tend to be pronounced differences between countries, influenced by factors such as the underlying cost base – including labor costs – as well as regulation.

In the ports sector, while the technology for automation is available, overall adoption has been slow, according to Jarno Kuipers, senior manager for terminal development at Kalmar: "There are huge variations between continents. For example in Australia, terminals are not able to stay competitive without automating their operations. On the other hand, in many other locations automation has not yet gained the critical mass that would force every single terminal to automate their operations to stay competitive.

"Typical factors that play a role in the adoption speed, outside the automation technology readiness, are investment horizons, labor relations, organizational focus on processes and overall organizational skills, and attitude toward modern technologies. The changes take time but, overall, the readiness to adopt automation technology is improving every year," says Kuipers.

Automating a work site can be a massive undertaking, depending on the existing infrastructure. In the case of a port, alignment can be needed across elements as disparate as the foundations, pavement, fencing, gates, elec-



tricity network, servers, and wireless and wired data communication network, says Kuipers.

**Converging Technology**

Rajant is a kinetic mesh network manufacturer whose systems are widely used in mining, ports, and other industrial applications. They are also a major supplier to the US military, which uses its applications to link military convoy vehicles.

Chris Mason, Rajant's EMEA director of sales, describes the situation found in a typical automated port where a single gantry crane can have up to ten cameras transmitting back to the operations room. With as many as 30-40 gantry cranes, networking capability is essential. "Because you are controlling and directing industrial pieces of equipment, the combination of low latency and high bandwidth, and multifrequency resilience, is a massive consideration when you deploy those networks," he says.

The applications that can be run over a mesh network are extensive, such as Industrial IoT solutions monitoring aspects such as engine temperature, tire pressure, fuel levels, and driver alertness while providing highly accurate location information. Many of these third-party solutions are plug and play – for example, AeroScout from Extronics can run over a Rajant mesh network to provide a real-time location system (RTLS) to track workers and equipment.

When it comes to anti-collision, a Rajant network can support latencies of around a millisecond per wireless network hop. Mason says, "The critical aspect of collision-avoidance systems is that they have to work extraordinarily rapidly, and they have to work in environments that are largely isolated from other production-type networks."

Mason says that the emerging direction for safer anti-collision solutions

**Plug and Play**  
Mesh networks enable companies to gather real-time information and track both workers and equipment.

is to have them hard-wired into the equipment. "Most collision-avoidance systems are based around processing being on the vehicle itself, rather than needing to go back to a central switch, which is a point of vulnerability," he says.

**Invest Before an Accident**



**Interest in safety often comes after an accident – but then it's too late.**

**Severin Kezeu,**  
CEO of SK Solutions

**Anti-collision Comes in Two Main Flavors**

**Action Needed**

A major and fundamental distinction in the world of anti-collision is between avoidance systems, which automatically prevent collisions, and alerts that use sensors that notify the driver when evasive action needs to be taken.

Nanotron Technologies, a Berlin-based company owned by sensor manufacturer Sensera, produces a chirp spread spectrum (CSS) radio chip that can be used for anti-collision detection as well as tracking. The main applications are in the mining sector, says Thomas Förste of Nanotron, a systems integrator whose customers include Schauenburg Systems in South Africa, Becker Mining Systems in Germany, and Meglab in Canada.

Nanotron released its first CSS radio chip unit in 2008 and it now takes less than a millisecond to get a fix on a single location. To calculate the distance between two points only takes two milliseconds, claims Förste. Units can be installed on mobile mining equipment or stationary objects – it can even be worn by workers. In mining applications underground, the chip needs to work in the presence of dust and moisture, and has to resist other signals and high magnetic fields. "It's a hostile environment and it needs to work under very severe conditions," he says. Applications commonly provide alerts rather than avoiding collisions in the first place, says Förste. Nanotron's system offers a number of advantages: it allows the drivers of the huge machines used in mining to have full control over their



**Most applications just provide alerts instead of helping to avoid collisions in the first place.**

**Thomas Förste,**  
vice president of marketing and products at Nanotron



equipment and avoids the need for sharp braking, which can damage machines or injure their occupants.

Förste adds that Nanotron's offering can be used both for tracking and productivity solutions at a time when mining companies are typically seeking to reduce the number of technologies carried by their vehicles and people. "While the vehicles and the people are protected by collision avoidance, they are tracked at the same time," he says.



## Airborne IoT

# DRONE IT YOURSELF

Data from drones is increasingly proving crucial for businesses in areas that include utilities, mining, oil and gas, and agriculture. If a business is using drone data, should it rely on specialist inspection companies or learn to operate its own drones?

■ By Stian Overdahl

**W**ith some industries now relying on drone data for mapping, inspection, and other applications, one question many companies are asking is whether to continue to rely on inspection service providers or carry out drone flights with an in-house team.

Many companies are turning to drone inspections companies to act as consultants and help them understand the benefits and the costs of the technology. Cyberhawk Innovations is a UK-based drone inspections company that specializes in oil and gas industry applications, with a client list that includes BP, Statoil, and Saudi Aramco. Around 18 months ago, in response to market demand, it began offering consultancy services to companies that were interested in bringing their drone operations in-house, says Jenny Adams, sales and marketing manager at Cyberhawk.

Often the jump-off point is reached when companies find themselves paying large fees for numerous inspections: at this stage they begin to look at whether carrying out operations in-house will save money, says Adams. One approach is to classify jobs based on complexity and consider carrying out simpler jobs in-house, retaining specialist operators for the more difficult jobs which will require special competencies and permits, such as those that involve flying close to the public or climbing higher than usual, she explains.

Having in-house operations isn't as simple as just buying a drone. A com-

## Lofty Insights



### ■ Line of Sight

While there's a popular fascination with the latest flying machines, when it comes to commercial applications it's not the drones themselves that matter but the quality of the data collected, the sophistication of the software used to collate and refine the data, and the ability to extract actionable insights. "The drone is just a tool for data acquisition," says Thomas Nicholls of Delair, a French manufacturer of fixed-wing drones. Nicholls, who previously worked at Sigfox, sees drones as an important part of IoT. "Terrestrial IoT tends to be done with small contextual sensors that will detect movement, temperature,

rotation in an engine, or something like that. In the world of drones, we focus on what can be seen." One area of development is the more advanced merging of data and insight from terrestrial drones, says Nicholls. "Customers are able to combine data, even terrestrial sensor data, that is then combined with digital twins created thanks to drone imagery, and that gives them the full insight," he explains. "What will drive development and the speed of developments will be customers realizing they can improve their profit and loss, or generate new revenue, thanks to these new data sources and the type of analysis you can do on them," Nicholls adds.

pany will need to hire an unmanned aerial vehicle (UAV) pilot or train staff to fly the drones and maintain them. It will also need to ensure there is enough work to enable pilots to fly



### ■ No Easy Sell

Drone use in agriculture is less developed in precision agriculture, where data from drones could be used to plan the use of fertilizers and pesticides.

regularly to maintain their skills. This makes the proposition look better for larger companies that will have the necessary volumes of work and can afford to hire pilots.

While experts note a general trend toward in-house drone operations, there are pronounced differences between industries. In some cases, the use of drones matches existing business practices – industries that typically rely on subcontractors being more likely to continue to rely on specialist drone service providers, explains Colin Snow, a drone analyst and founder of Skylogic Research. In construction, contractors have traditionally relied on specialist surveying companies that often have drones integrated into their mapping ac- ➔

## Drone-in-a-Box



### ■ On Their Own

One future technology that is already on the market is the fully autonomous drone. There are a handful of companies offering these “drone-in-a-box” solutions, where a customer receives a drone with a housing unit that takes care of charging the drone, running diagnostic tests, and protecting it when it’s not in use. Percepto is an Israeli-based company whose drones are able to fly completely autonomously. By adding geo-fencing and flight path restrictions on a site, the drone can be kept outside of critical areas, says Illy Guber, Percepto’s marketing manager.

One of the main intended uses for the Percepto UAV is security and it can transmit live video, via a secured LTE network, to the manufacturer’s cloud-based software. Flight patrols can be scheduled within defined areas, such as a site’s perimeter, at set time intervals or can be scheduled to run randomly so that potential thieves can’t predict its route. The system can also respond if on-site sensors, such as a smart fence or motion detection sensors, are triggered, sending the drone to provide a visual feed of the area, says Guber. When the drone is not being used for security, it can also be used for operations-related tasks such as inspection and monitoring of equipment and infrastructure, with both RGB and thermal cameras on board. The software suite can also perform change detection and anomaly detection, alerting the control room if there is something different within the field of view, she explains. “We designed the solution to work in critical infrastructure and industrial facilities. Our

assumption is that there is some critical infrastructure that has to be protected, and optimized in the way it operates.”

Average flight time is around 40 minutes, while charging takes a similar period. That means a customer with two or three drone and box packages can have a drone in the air at all times during crucial moments. Although the drone-in-a-box hardware is much more expensive than just purchasing a standard commercial drone, the investment can pay for itself because there’s no need to hire or train up pilots. It also has the advantage of being on call 24/7, whereas a piloted drone would require at least three pilots working in successive eight-hour shifts every day.

The greatest challenge is not the technology or being able to prove value to customers, but complying with regulations, Guber says. Today Percepto can be found in ten countries, including South Korea, Italy, Spain, Mexico, Israel, and the US. Most countries require drones to be monitored by a pilot at all times or have stringent processes to apply for waivers. In some cases, it starts with intermediate waivers where they can use the autonomous drones but still need observers in place. “We do fully respect the need for these regulations and we work hand in hand with authorities to ensure that we get the waivers,” she added.

Guber expects that autonomous drones will be in widespread use when regulations change. “For industrial facilities, I have no doubt that within three years’ time the acceptance will be completely different from today,” she predicts.

tivities. The offshore oil and gas sector typically relies on external contractors and might continue to rely on drone inspection companies, observes Snow, adding that he is seeing more use of in-house drone operations for onshore operations.

The more acclimatized an industry is to the use of drones, the more likely it is to want to carry out its own operations. The mining industry is a good example. When mines first started using drones, they would rely on surveyors to do their stockpiling measurements and do their terrain models, says Jean-Thomas Célette, managing director of SenseFly, a manufacturer of fixed-wing drones. As practices have matured, mining companies have come to rely on them and started to fly drones themselves. “Once they understood the workflow well, they started integrating that process and running it in-house,” he explains.

### Precision Agriculture

In contrast, drone use in agriculture is by and large less developed. Thomas Nicholls, the chief marketing officer of Delair, a French manufacturer of fixed-wing drones and cloud-based software solutions, concedes that the use of drones is widespread in some sectors of agriculture, such as seed research and on large-scale farms, such as rubber or sugar cane plantations, but it is less common in the field of precision agriculture, where data from drones could be used to plan the use of fertilizers and pesticides. This is partly due to difficulty: precision agriculture requires calling in a skilled agronomist, while insights may only be applicable to a local area, given the complex interactions between a specific crop and the climate and terrain.

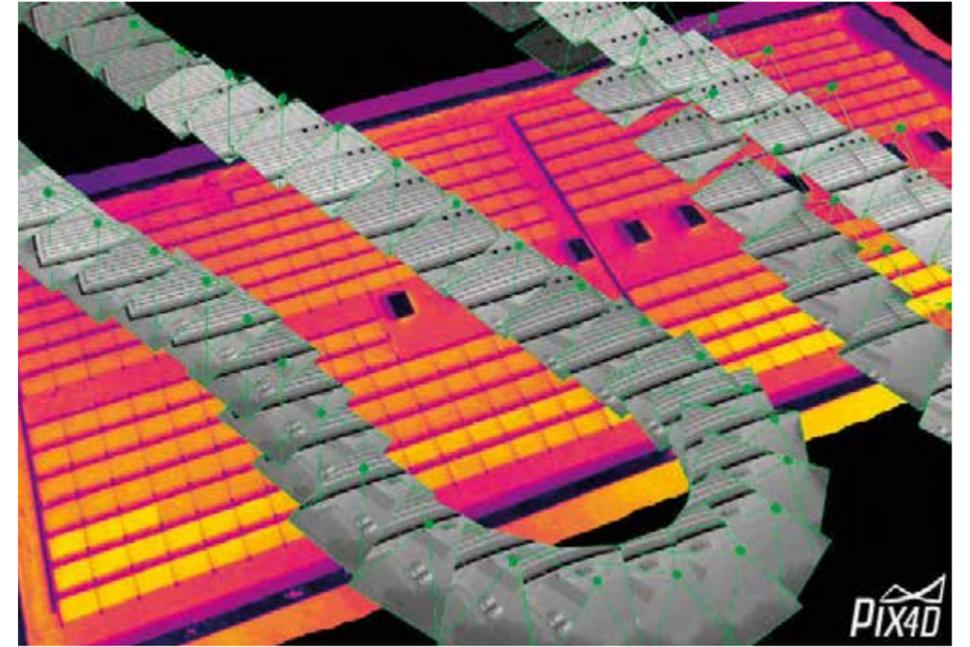
Scale is another factor. Électricité de France (EDF), the largest electric utility organization in Europe, has a fleet of around 200 helicopters which it uses for aerial inspection of power lines. While helicopters still have important advantages over drones for large-scale inspection of power lines, drones are increasingly being used for smaller inspection projects. EDF

now has an internal drone business unit with around 30 people carrying out inspections formerly done by helicopter, says Nicholls. SNCF, the operator of the French rail network, also has a significant drones business unit, called Altmétris, which also operates independently to perform inspections for other companies.

Improvements in drone technology are also driving in-house consolidation. DJI Technology, the world’s largest producer of drones, claims to offer enterprise UAVs that are as easy to fly as its hobby drones.

Software companies are also playing an important role in this. Pix4D develops professional photogrammetry and drone mapping software, in addition to its long-established flight path automation software. It also provides tools to correct hobby drone camera images that display rolling shutter artifacts – where fast-moving elements appear distorted or fragmented – to allow them to be used for professional mapping.

A major focus area for the company is to use machine learning and artificial intelligence to extract elements from the mapping data, replacing time-consuming manual processes, says Nikoleta Guetcheva, head of marketing for Pix4D. Simplifying drone operations reduces the cost and the time it takes to train staff, potentially speeding up the shift to in-house operations, she adds.



All this is having a definite influence on attitudes, says Adams at Cyberhawk: “Because drones are easier to fly, it takes less specialist skills in a lot of cases so, for a lot of larger enterprises, that’s what’s opened up their eyes to the fact that they could be doing this internally themselves. Certainly, automation is changing things a lot and will continue to change things.” While some companies are already offering drones that promise full automation (see Drone-in-a-Box), regulation in many countries remains a major stumbling block for allowing drones to

#### Ground Control

Pix4D is a drone software tool that captures thermal or multispectral images to create 3D maps and models purely from images.

be flown without direct human oversight. Enabling beyond visual line of sight (BVLOS) operations is a key issue for the industry and could prove transformative, especially for fixed-wing drones, by allowing longer flights.

While there are expectations that future regulations will open up BVLOS to a wider set of customers and use cases, there’s also awareness that the actions of rogue individuals flying drones in restricted areas, such as around airports, has had a damaging effect on the industry, and is resulting in even stricter regulatory controls.

#### Powerline Inspector

DJI’s Matrice 200 is hardened against electromagnetic interference (EMI) and also features a camera that can look up.



### Driving Innovation

The growth of in-house drone operations may sound like a threat to third-party inspections companies, but those that spoke to Smart Industry see this shift as creating new opportunities. Many drone inspections companies have deep expertise with software and have begun offering products and services to help customers to develop their own data management platforms. As specialists, these companies have extensive expertise in their innovation centers that are likely to outpace in-house operations when it comes to developing new techniques and technologies. →

ABJ Drones, a US-based company, has developed a technique to use thermal technologies to “see” up to 15 cm inside wind turbine blades for signs of cracks, delamination, problems with bonding, and the effects of impacts or lightning strikes. Ordinary drones only give a “skin-deep” view and manual inspection of blades, with people hanging off the turbines on ropes to tap the blades, are of limited use, says Richard Scriven, ABJ Drone’s chief operations officer. “As most issues with blades tend to start subsurface, often you don’t see the problem until it’s too late.”

Scriven says the trend towards in-house is creating new opportunities for specialists to act as consultants, ensure compliance with regulations, and keep companies updated on the latest technological advances. “More [drone work] will go in-house but there will always be the need for consultancy and other services.”

Cyberhawk is also developing new techniques, such as performing contact, rather than visual, non-destructive testing (NDT) in hazardous or difficult-to-access spaces. Current applications include working in oil storage tanks, both onshore and on oil tankers, where drones can measure the thickness of tank walls to check for degradation or corrosion. Using drones for maintenance tasks as well as visual inspections is “probably where some of the current generation of drone service providers will move to,” says Adams.

Also in the oil and gas industry, drones are beginning to be used to carry out inspections under the decks of offshore oil rigs. The platforms are highly difficult areas to fly around in due to factors that include electromagnetic interference and a lack of Global Positioning System (GPS) tracking.

Despite a lot of work moving in-house, Adams believes there will always be demand for highly experienced pilots and inspection engineers. “We have some of the world’s most experienced pilots on our books, and that part of the business is going to be as large as ever if not still growing,” he says.

## Countermeasures



### ■ Beware of the Toys!

As the number of drones around the world grows, so do the related incidents that threaten operational security around major sites and events. Airports around the world – including in Dublin, Dubai, and London – have experienced shutdowns due to drone incursions in their airspaces. Just before Christmas in 2018, Gatwick Airport in the UK was closed due to drone sightings, with around 1,000 flights being canceled. In July 2018, Greenpeace flew a drone into the side of a nuclear power plant in France to show how vulnerable the site is. And hobby drones have been used by the Islamic State using bombs attached to consumer drones as weapons.

Enter the burgeoning field of counter-drone technology, which aims to detect rogue drones and bring them down. The systems provide radar detection, optical identification, and countermeasures including radio frequency jamming, GPS spoofing (drones can be set on automated flight paths, which makes jamming ineffective), or physically damaging a drone’s electronics via an electromagnetic pulse. Other solutions include “catcher drones” that can fire a net at the rogue drone to bring it to the ground in an uncontrolled way. This, however, is not a good solution if the drone is flying over a busy area such as a sports stadium, explains Celia Pelaz, head of Hendsoldt’s spectrum dominance and airborne solutions division.

The range of a detection system varies significantly between locations. Classification is also important: optical systems can show whether a drone is carrying a suspicious package.

Apart from airports, drones are recognized as a threat in other areas such as major public events, or for attacks on politicians and other VIPs, as when an at-

tempt was made to assassinate Venezuela’s President Nicolás Maduro in August 2018. Drones have also been used to fly contraband into prison. For corporates, sensitive events revealing intellectual property that can be spied on and photographed, such as the testing of new vehicles, is also a danger.

ESG, another supplier that is working closely with Rohde & Schwarz and Diehl Defence, develops the Guardian counter-drone system, which is used by police for high-profile events, including the state visit of President Obama to Germany in June 2016. Protecting VIPs is currently the main civilian use of counter-drone systems, believes Christian Jaeger, head of the counter-drone business unit at ESG.

There are a number of unanswered questions that may be slowing uptake at airports and other big organizations. Regulators in Germany, for example, have yet to wake up to the new reality, and it is unclear exactly what rights airports or other public utilities have when it comes to defending their sites from drone incursions, says Holger Kraft, head of security at Munich Airport. The big question about where responsibility lies also has implications regarding who should pay for the systems, says Jaeger. It’s no idle question – the price of a permanent counter-drone system typically starts at around €1 m, but smaller, mobile solutions can be far cheaper.

Some see an economic asymmetry in spending more than a million euros to protect against a €100 toy. As for all business security issues, the real calculation has to be to balance the cost of protection with the potential losses of business interruption, says Jaeger. In some cases, the argument is obvious. After all, shutting down an airport like Gatwick can cost several million euros a day.



Out of the ashes of disaster, **drones are rising to the challenge of setting up communications to help the rescue services** fighting to save lives in the most trying of environments.

■ By Eric Doyle

**W**hen disaster strikes, buildings collapse, roads become impassable, and communications break down. Chaos reigns and rescuers have to battle through the devastation to minimize loss of life and reestablish some semblance of order. The first need is to reestablish a communications network so that rescue teams from numerous countries can coordinate their efforts and prevent further loss of life – and to enable isolated communities to call for help. Traditional cell networks take time to set up and rescue teams often set off, independently, with basic walkie-talkie radios. Two innovations have arrived that could vastly improve this situation: unmanned aerial vehicles (UAVs), or drones, and small-cell telecom transmission pods.

The idea of drone-based, small cellular networks (DSCNs) captured the imagination of phone service providers several years ago as a way to provide pop-up, local base stations. The initial idea was to use DSCNs to provide connectivity in remote regions or in mountain areas where masts are uneconomical or simply don’t work. The main advantage of DSCNs is that they enable standard cell phones to be used – so anyone, rescuer or citi-

zen, can use the network without specialized equipment, and the height at which drones operate massively increases the coverage.

Cheap commodity drones have made the provisioning of wireless networks even more economical, but there is a downside: the greater the weight carried by a drone, the faster the battery is drained. Consequently, many drones being used are tethered to the ground by power cables to ensure they can run indefinitely – but at the cost of maneuverability. The power issue is benefiting from “femtocell” developments – small 4G and 5G transmitter/receiver cells which are light and run on low power.



**On Station**  
Pop-up base stations combine unmanned aerial vehicles and latest small-cell telecom technology.

These femtocells, picocells, microcells, and macrocells, listed in increasing transmission ranges from around 10 meters to 35 kilometers, can dynamically reconfigure the heterogeneous networks (HetNets) they form to ensure resilience if things go wrong. This has fired up several test beds, with Nokia joining mobile operator Vodafone to produce a system for firefighters in Dusseldorf, Germany, and the Finnish comms equipment maker also pairing with EE to test a DSCN in Scotland.

### The COWs Are Coming Home to Roost

The most advanced drones, AT&T’s Flying COW (Cell on Wings) UAVs, are already in use. Art Pregler, AT&T drone program director, says, “We started investigating the use of drones a few years ago to bring connectivity to first responders and the public during emergency situations. AT&T first deployed its Flying COW in Puerto Rico as a part of our disaster recovery efforts following Hurricane Maria. This was the first time an LTE cell site on a drone had been successfully deployed to connect residents after a disaster.” Drones were also used in the US last year in recovery efforts after hurricanes Michael and Florence. Pregler says standard Flying COWs can handle 40 kph winds, while carrying a 13 kg payload, while all-weather drones can handle 60 kph winds and 80 kph gusts.

In the near future, autonomous cars and other smart city systems will rely on 5G and the work being done now will help when mini-disasters strike and black out an area.

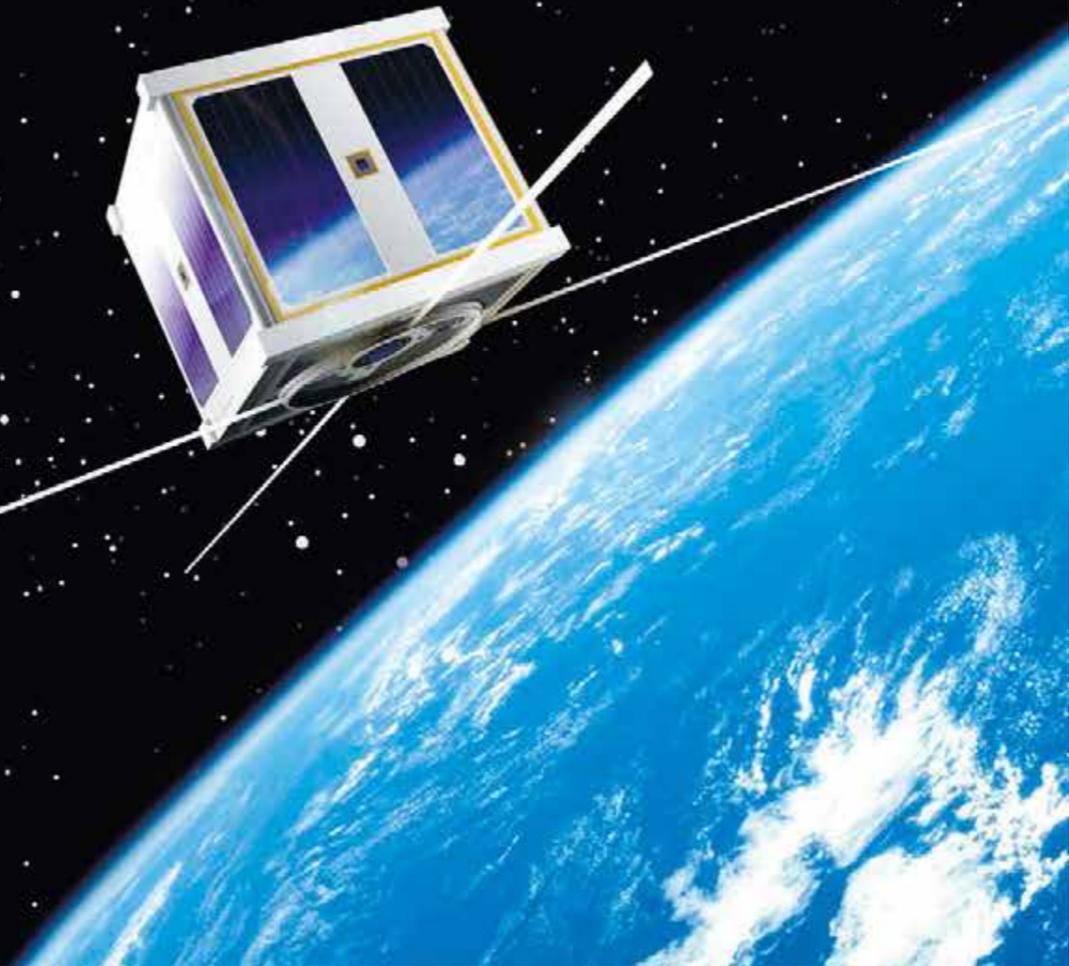
### Things Go Wrong

Nokia and Vodafone are developing femtocell networks to help firefighters communicate during emergencies.

# Low-Earth-Orbit Satellites THE NEXT SPACE REVOLUTION

Over the past few decades, small satellites have dramatically changed the future of humans in space. The big money is now on business and space exploration has moved from one-of-a-kind systems performing specific missions to satellite constellations working in concert to achieve a larger purpose. Like the industrial revolution, when new manufacturing processes marked a historic turning point, **low-Earth-orbit satellites (LEOs) are poised to transform our relationship with outer space.**

■ By Gordon Feller



limited field of view from the antennas on board each spacecraft. Having been used over a longer period of time, there are many more GEO players. Among some of the main operators are: Intelsat, SES, Eutelsat, and Telesat. LEO satellites use a new, and growing, technology, and there are currently three major players: SpaceX, LeoSat, and OneWeb.

“SpaceX will build a network of 12,000 satellites as part of our Starlink project aimed at bringing ultra-high-speed Internet to the world,” SpaceX CEO Elon Musk said in November 2018. In the end, he plans to further digitize every industry in the world, one satellite data burst at a time, which told a technology story that many outside the satellite industry might have previously thought was irrelevant to them.

In fact, to achieve even minor Internet coverage over the developed countries, Musk only needs 420 satellites. “That might be my lucky number,” he joked to journalists, referring to California’s State Senate bill legalizing Marijuana.

SpaceX is certainly not the only player looking to accelerate and alter the universe of LEO satellites, and SpaceX is not the only major company positioning itself to deliver a whole new kind of service. Some relatively unknown firms have been formed and financed to grab hold of the opportunity. For example, a company known as LeoSat Enterprises was recently established to leverage the latest developments in satellite communications technologies. →

**W**hile mass production of small satellites conjures up thoughts of large factories with assembly lines rolling out standardized products, it may not be that simple. High-volume production would be necessary to achieve the global coverage sought by commercial and government stakeholders. In that business, new problems must be solved in quality control, standards, and in designing for manufacturability, as well as the challenges of automated assembly, integration, and testing – all of which must be balanced with cost considerations that are critical to the success of starting up. The development and launch of tens, hundreds, or even thousands of small satellites is starting to happen and it will almost certainly produce revolutionary effects. The first low-Earth-orbit satellites were launched many decades ago.

Those “birds” were owned and operated by national governments – at a huge cost to taxpayers. Despite the cost, over the past two or three years the LEO industry has been growing exponentially in the private sector, which raises the question of what is attracting this interest. The major purpose of these groups of thousands of small satellites (constellations) is to have connectivity that gives 100 percent global coverage. The world is currently comprised of approximately four billion active Internet users, which means there are approximately 3.5 billion additional people who currently lack access. Once in orbit and fully operational, each new constellation brings total coverage closer but, at the same time, they will also provide 100 percent coverage in other domains – such as constant worldwide surveillance and imaging. Two definitions might help here:

- When it’s in a geosynchronous orbit (GSO), a satellite has an orbital period that matches the Earth’s axial rotation period of approximately 23 hours 56 minutes and 4 seconds (one “sidereal day”). Various called a geostationary orbit, geostationary Earth orbit or geosynchronous equatorial orbit (GEO), the path taken forms a circle round the equator at around 35,786 kilometers above the equator and following the direction of the planet’s rotation.
- Low Earth orbit is classed as an altitude of 2,000 kilometers above the Earth’s surface, with an orbital period that stays between 84 minutes and 127 minutes. Any objects below a threshold of approximately 160 kilometers will experience very rapid orbital decay and altitude loss, so LEO satellites fly well above this danger zone. Typically, all the privately owned

and operated satellites have been launched into fixed positions on the GEO belt, keeping pace with the Earth’s rotation, and positioned at a very large distance from the Earth – much further out than the LEO belt. Because of this, each GEO satellite can cover larger areas of land mass and bodies of water. Some of the main limitations of GEOs, compared with LEOs, include these four critical factors:

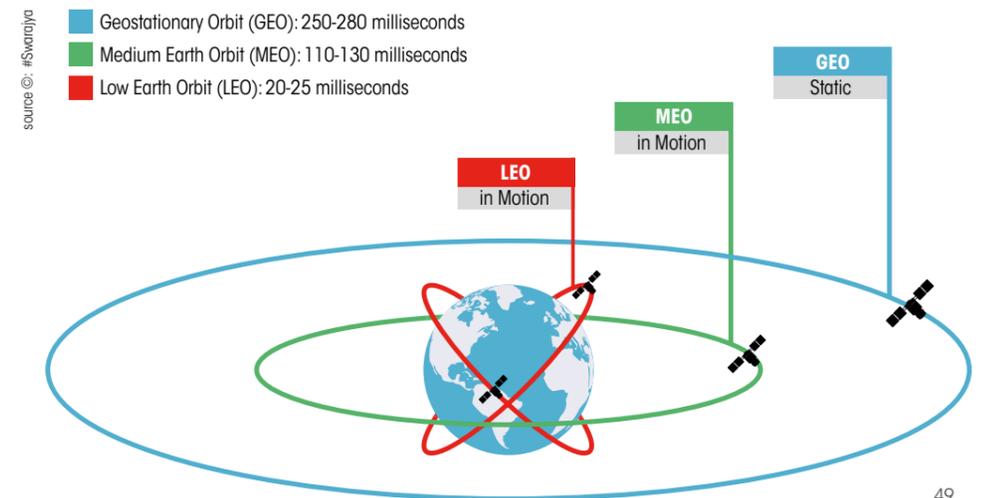
- The GEO’s entire frequency spectrum is shared across the entire coverage area.
- Many of the GEO’s users are in a single satellite coverage area.
- Mobile antennas must point at a GEO satellite. As the mobile antenna moves further away in longitude from the orbital slot location (the skew angle) signal quality drops.
- There is no GEO coverage around the polar caps.

Thousands of smaller satellites are be-

ing launched into low orbit in order to have them work together and operate, effectively, as one unit or one system. Large constellations are required to achieve global coverage, especially given their location relative to Earth. Since LEOs are closer to Earth, they have the disadvantage of covering much less territory. This is due to the

**Closer to Home**

Unlike geosynchronous satellites, LEOs fly as low as 2,000 kilometers and are thus able to pick up weaker signals. However, this requires a network of thousands of satellites in order to provide global coverage.





**SpaceX wants to bring ultra-high-speed Internet to the world.**

**Elon Musk,**  
CEO of SpaceX

Competing with SpaceX, its focus is to develop and launch a new LEO satellite constellation, providing what it claims will be “the first commercially available, business-grade, extremely high-speed, and secure data service worldwide.”

With up to 108 low-orbit communications satellites in the constellation, LeoSat wants to be the first to have all the high-throughput satellites (HTS) in the constellation interconnected through laser links. If successful, this approach will create an optical backbone in space – which would be 1.5 times faster than terrestrial fiber backbones, and without the need for any earthbound touchpoints.

Based in Washington DC, LeoSat is currently working with the Franco-Italian aerospace firm Thales Alenia Space to establish the LEO network. LeoSat’s launch of its satellites is expected in 2020. Once operational, the constellation will provide high-speed, low-latency, and highly secure communications and bandwidth for business operations. The company’s focus is on three markets: telecom backhaul, energy, maritime, government, and international business.

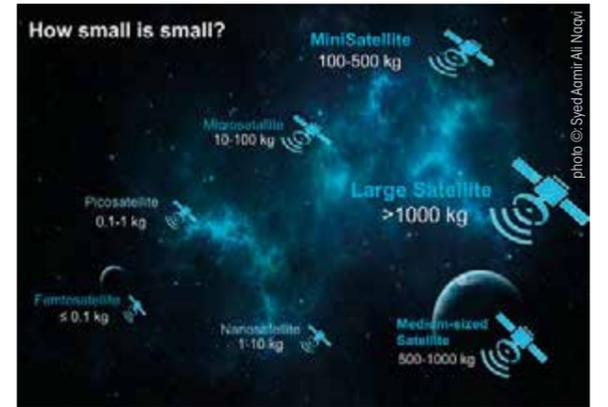
The biggest LEO advances are being made with small spacecraft and satellites. These are the “smallsats” which have been helping to advance scientific and human exploration, reduce the cost of new space missions, and expand access to space. Through technological innovation, smallsats enable entirely new architectures for a wide range of activities in space

with the potential for exponential jumps in transformative science. Some of the NATO members are contemplating alternatives to individual government-developed satellites for producing high-resolution imagery. The concept is for the US to commission proven and successful commercial satellites, with minimal non-recurring engineering costs, to help

augment current systems deployed by individual governments. The benefit of this proposal is to bolster the reliability and affordability of a system that is currently used in space, thereby reducing risk and production times significantly. It is predicted that new constellations of extremely small commercial satellites, each with short life cycles

that are reconstituted on a monthly or quarterly cycle, will invigorate the commercial satellite workforce and allow for more resilient production of future systems. The useful lifetime of GEO satellites averages about 15 years, a limit primarily imposed by the exhaustion of on-board propellants. These propellants are needed for “station-keeping” – maintaining the satellite in its orbital slot and orientation, or attitude, so that the satellite’s antennas and solar panels point in the right direction.

11 cm but they have also been built in 1.5U, 2U, 3U, and 6U sizes. Small spacecraft represent an emerging class of satellites, robots, and systems that exploit their small size to take advantage of sharing in single launch opportunities (ridesharing) at reduced cost. Small spacecraft also capitalize on the growing number of technical capabilities that are appearing in the high-technology and electronics industries. As a result, small spacecraft and platforms are becoming more and more capable as their overall size continues to decrease.



**Shrinking Satellites**

Small spacecraft and platforms are becoming more and more capable as their overall size continues to decrease. Due to their size, they can share launch vehicles, which further reduces costs.

problems facing both business and science.

Space-based measurements from small satellites have great potential to advance discovery and to increase our collective understanding of what’s taking place on Earth. As a result, some national governments are ramping up their financial support of firms and universities that are working with small satellites to develop systems; construct, launch, and then operate them while in orbit; and, ultimately, to analyze the rich data.

In summary, great changes are taking off in the satellite industry. Small satellites are maturing to offer agility, affordability, resiliency, and high-resolution imagery. Simultaneously, government leaders are examining the potential threats posed by numerous military adversaries to space-based “legacy systems” already in orbit.

Deborah Lee James, former Secretary of the US Air Force, recently shared some of her reflections and predictions. Calling the present a time of innovation and investor excitement, with the promise of new space exploration and new ways of doing business, she said, “We’re only just at the cusp of the Space Renaissance period we have now entered.”

Increasingly, the emerging LEO smallsat technologies are being looked upon as providing a complementary layer to the larger-scale systems – especially GEO satellites – providing a necessary new approach to ensure space-based capabilities continue to expand.



**We’re only at the cusp of the Space Renaissance period we have now entered.**

**Deborah Lee James,**  
former Secretary of the US Air Force



THE STATE OF

# GLOBAL BROADBAND CONNECTIVITY

Though it often seems like everyone is connected 24/7/365, that isn't the case worldwide. There is still enormous opportunity for service providers to connect the unconnected and continue expanding their service offerings.

**Advances in communications continue to change the way people live.**

- In 2016 alone, Sub-Saharan Africa will welcome over 15 million new internet users.<sup>1</sup>
- In emerging markets, 97% of people believe that connectivity has transformed the way they complete essential and everyday tasks.<sup>2</sup>

**As well as expectations for connectivity when they're on the move.**

- 97% of airline passengers carry at least one internet-connected personal device.<sup>3</sup>
- When choosing which ship operator to work for, 72% of crew members stated that connectivity played a major role in the decision.<sup>4</sup>
- Total revenues from passenger connectivity are expected to increase from \$700 million in 2015 to almost \$5.4 billion by 2025.<sup>5</sup>
- On average, crew members take three devices on board. The most popular being smartphones, laptops and external hard drives.<sup>6</sup>

**BUT OPPORTUNITY ABOUNDS.**

**Many parts of the world remain unconnected, plagued by unreliable or non-existent terrestrial infrastructure.**

- 34% DEVELOPING COUNTRIES
- 80% DEVELOPED COUNTRIES
- By the end of 2015, 34% of households in developing countries had internet access, compared with more than 80% in developed countries.<sup>7</sup>
- Internet access is still only accessible to 35% of people in developing countries, and over 90% of people in the 48 UN-designated Least Developed Countries have no internet connectivity.<sup>8</sup>
- 35% DEVELOPING COUNTRIES
- 90% LEAST DEVELOPED COUNTRIES

**“The latest advances in satellite technology are playing a key role in helping deliver broadband to rural and isolated areas.”**

**How do we close the digital divide cost-effectively?**

The Intelsat Globalized Network is helping service providers fill these gaps in connectivity by integrating satellite and terrestrial infrastructures into existing systems and business models, making it practical and profitable for organizations to be everywhere they need to be. For more information, visit [www.intelsat.com](http://www.intelsat.com).

**INTELSAT**  
Envision. Connect. Transform.

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**Cut Off from Tomorrow**

There are still enormous opportunities for service providers to connect the unconnected and continue to expand their service offerings, INTELSAT believes.



## Smart Cities Need Intelligent Infrastructure

# SMARTER COMMUNITIES POWERED BY SMARTER TOOLS

Everything urban is now getting connected – from healthcare to education, government services, buildings, physical security systems, and much more. Cities embracing these emerging tools will be leading the future.

■ By Gordon Feller

City governments don't have a reputation for moving quickly. However, if you've been paying attention to your local government, there is a good chance significant, tangible changes have happened over the past couple of years. You may have noticed changing traffic patterns, such as car lanes converting to bike lanes; maybe there are new forms of transportation zipping around town, such as bicycles, scooters, or even autonomous vehicles; you may even be benefitting from using a mobile app for some, or all, of your city-center parking. These and numer-

ous other changes are increasingly visible signs that many of today's cities are changing and changing rather quickly in some dramatic cases. What's behind all this? In part, it comes down to the pressures resulting from growing city populations and to increasing competition between cities. According to United Nations' demographers, the world is rapidly becoming more urbanized. In 2016, an estimated 54.5 percent of the world's population lived in urban areas. That number is expected to rise to 60 percent by 2030. As more people start living in the same geographic area it creates numerous

challenges. One of the main questions is how we can keep the city clean, safe, and appealing under the added strain of a larger population. Having more cars on the roads isn't an attractive option for anyone, so one of the first changes we've seen is cities reworking their streets to support alternative forms of transport. They also need to handle more trash, more cellphone use, potentially greater air pollution, and other strains on the infrastructure. In addition to growing populations, cities are also changing in the face of growing competition. As more people and businesses seek cities to call

home, local leaders want a fair share of the potential growth. Growth is an indicator of a thriving city and councils realize that they need to deliver the services and quality of life people seek. Several elements brought into focus during the public competition for Amazon's second headquarters also apply to most businesses. Factors at work include an educated workforce, a forgiving tax structure, transportation, room to grow, and the ability to stand out. Employees have different criteria for selecting where to live and spend their free time and every person's set of priorities is unique. Citizen's choices are driven by issues such as safe neighborhoods; work and educational opportunities; housing costs; efficient transportation; the convenience of arts, leisure, recreation, and community activities; and the "energy" given off by the community.

### Bullish on Smart Solutions

To address the urban challenges that come with such growth, and to become more competitive, municipal authorities are embracing technology as they become especially bullish about "smart city solutions," adopting them as new but essential tools. By adding Global Positioning System chips, sensors, cameras, and other devices to traditional municipal assets, such as streetlights and trash cans, cities are transforming into a digital conurbation that can be measured, monitored, and analyzed to improve outcomes.

Smart city solutions are data-driven systems that either provide managers with greater situational awareness leading to better decision-making, or that drive automatic actions, increasingly assisted by machine learning and artificial intelligence algorithms. Peter Drucker, the great management thinker, offered his own guidance on this: "You can't manage what you can't measure" – a rule that's being applied in earnest in today's cities.

The most prevalent of the new city solutions is smart lighting. As with the death of traditional incandescent bulbs, the bright new hopes of high-pressure sodium (HPS) and metal

halide (MH) streetlights are now dimming. The replacement fixtures are LEDs because they reduce energy usage and cut costs by up to 50 percent. LED replacements don't make a city smart but they can be deployed along with a lighting control system to make each streetlight a manageable asset. Such control gives a city's department of public works new capabilities that improve the lighting service delivered. These new capabilities add abilities such as remotely turning lights on and off, or dimming them during different parts of the day throughout the year. When combined with motion detectors, lamps can be automatically turned on if the presence of a person or vehicle is detected. Controllers can also help cities reduce the maintenance costs of streetlights by 30 to 50 percent and reduce energy usage by an additional 25 to 30 percent. Customer complaints about burned-out lights could be eliminated by giving management staff proactive alerts to imminent lighting issues.

Beyond lighting there are numerous other solutions being deployed today, including keeping watch in crime-ridden areas, rapidly informing first responders, measuring economic activity, improving traffic at dense intersections, correlating weather conditions to electrical and other intermittent problems, tracking road conditions, and providing municipal announcements to citizens. The variety of smart city applications is matched only by the range of city problems.



Streetlights will be the eyes and ears of tomorrow's smart cities.

Anil Agrawal,  
CEO Cimcon Lighting

Specific technologies have come to the forefront to solve these diverse challenges. Most notably, there are sensors that can be attached to streetlights to transform the lighting infrastructure into a citywide mesh to create a digital canopy across the city. Readings can be transmitted from the sensor network back to a central management system where the data can be aggregated, correlated with other information, and analyzed.

One such smart city platform is NearSky offered by Cimcon Lighting. According to Anil Agrawal, the company's CEO and founder: "We had a vision that NearSky could soon transform the nondescript streetlight infrastructure into a platform that would be the eyes and ears of tomorrow's smart cities. The convenience and density of the streetlight infrastructure, which provides street-level resolution, was unmatched. It also offered the physical real estate and power that were essential elements for deploying smart city solutions."

Technology alone isn't the answer. It may turn the outdoor world into a series of data streams but it still takes people to act. In the same way cities have begun to invest in smart technologies, they have also begun to invest in their management teams.

A smart city strategy is usually led by a chief technology officer, a chief digital officer, a chief information officer, or a chief innovation officer. All of these roles stem from the need for challenges to be addressed by a person or team with a cross-departmental focus. Systems were deployed originally as point solutions with their focus on a single department but it has become clear that a smart city is built over time and there is a need to have a data management strategy that spans all departments and all projects to get the best outcomes.

The smart city is not a radically new concept. People have been imagining the benefits for decades but the concept is finally gaining traction. There is an increasing sense that not having a plan for becoming a smarter city could mean your municipality will be on the outside looking in for →



decades ahead. This competitive pressure, along with the need to address growing populations, should accelerate the adoption of technologies over the coming years. Cities may never be recognized as dynamic, fast-moving metropolises but they are certainly changing in meaningful ways.

Transformation of urban systems will require a shift of the business models in use by today's urban-focused enterprises, such as electric power companies. Changes now underway are irrevocably altering the 90-year-old utilities models. The good news is that there are ways to transform industries that are affordable to consumers.

For transformation of the power grid's intelligence and efficiency – from generation to consumption – end-to-end Internet protocol (IP) communications platforms will continually need to be designed. Delivering increased grid reliability, security, resiliency, and power quality will not be easy. A missing ingredient is the technology framework that would enable smart grids to become open platforms for innovation. “The goal is the complete integration of information and communication technology (ICT) and existing energy

**New types of smart city systems** can provide real-time data feeds from multiple smart sensors for both environmental data such as heat or toxins as well as information about traffic flows.

infrastructures for increasingly decentralized development, monitoring, and management of a resilient grid,” writes Monjur Mourshed of Cardiff University – which is why it's so important to focus on an open platform for innovation.

Collective efforts must focus on developing solutions that transform energy production, distribution, and consumption, while using a highly secure, open-standards-based system built around the common language of IP networking. The goal must be to help utilities do something that has long been discussed: to provide a more reliable and efficient delivery of electric power from the generation facilities to businesses and homes, and creating better energy management to provide positive economic and environmental benefits.

Next-generation grids will need to be: **Observable** – Making a smart grid work will hinge on the observability of the fast, reliable, and secure exchange of data all across the grid. This capability can emerge through pervasive, real-time sensing measured in increasingly shorter durations – as short as 120th of a second.

**Automated** – Employing pervasive sensing means developing the ability to automatically respond to conditions and events beyond traditional protection and controls. This will eventually become mainstream and will allow more refined control of what is becoming an increasingly diverse and stochastic electric system.

**Intelligent** – Energy networks and other grids will evolve over the next ten years to enable diverse sources of supply and responsive loadings. Sophisticated analytics, coupled with advanced distributed control schemes, will enable adaptive teleprotection and intelligent systems to manage inherently unstable systems.

**Transactive** – As IoT converges with the “electrification of everything,” hundreds of millions of energy-smart devices will be able to interact with energy markets. This can lead to trillions of micro-transactions. The technology required is worth investigating because there are elements

of the tech story that are not obvious. The ongoing process to electrify energy is having two notable impacts that are hidden from public view:

- Increasing the roles played by clean electricity in fueling our economies
- Improving the positive relationship between electricity consumption and economic growth

Convergence of multiple networks is now underway and one element that stands out is where information, communications, and electricity networks interplay with social networks. This is providing a platform for a smarter grid that empowers customers.

### Networks Are Platforms

In the long term, energy interdependence linked with cleantech economic policies is the right direction for government. More immediately, there is the need to balance the new demands on the electric grid and operations with minimizing cost increases to customers.

Using energy networks as platforms means the entire energy ecosystem can be made smarter, faster, more agile, resilient and, most importantly, more secure – from power generation to its consumption. A customer's ability to pay the price for this modernization and the implementation of clean energy policies is stretched owing to an increasing population that is on fixed or low income.

Rising global demand means traditional approaches to increase electric generation and distribution capacity will no longer suffice. Companies and governments will need to work together to create a more secure and scalable end-to-end communication infrastructure to provide real-time information on the performance and health of the grid operators. That system will also need to allow customers to do more than consume – they must be empowered to collaborate with the utility companies in efficiency energy management. Employing the network for energy management will enable utility companies to optimize power supply in response to demand, improve security and reliability, integrate renewable energy resources onto the

grid more efficiently, and reduce operational costs.

Governments and private firms are realizing that transforming supply, delivery, and consumption depends on three interdependent elements: policy, economics, and technology. Together they will drive transformation by creating a sustainable, reliable grid. Indeed, legislation and regulations triggered the fundamental transformation that is now underway.

Without new technology, none of this will work because new infrastructure is needed. Utility companies are responding to mandates and incentives to integrate significant amounts of wind and solar-generated power, while pursuing massive capital programs to replace and expand the electricity infrastructure. Many recognize that modernization also includes deploying information and communications technologies.

Economics are often the most critical factor in making policy and technology choices – and these choices have impacts on societal, customer, and business value. While there is much discussion among stakeholders, there remains a lack of clarity regarding the value in each of those areas. Understanding and articulating customer value is a key to the success of smart grids.

Transforming electricity delivery and consumption while delivering new value to customers is going to depend on many factors. But the fact remains that near-real-time information allows utilities to manage the entire electricity system as an integrated framework, actively sensing and responding to changes in power demand, supply, costs, quality, and emissions across various locations and devices.

Making the grid smarter, more secure, and more resilient is one of the great business and technology opportunities of this century. There's an exciting convergence going on already between energy technology (ET) and information technology (IT). In order to realize the benefits of this convergence, the technology architecture must align to the business architecture. Utility companies and technology manufacturers need to be as knowledgeable about the business issues as they are about the technology. Electricity companies have significant challenges in implementing their converged ET/IT platforms; among which are the issues of legacy integration and deployment management. The legacy device and system issues can dominate technology adoption, making it impossible to make wholesale and immediate changes to utility infrastructure for both financial and logistical reasons. Any technology



The goal is complete integration of information and communication technology and existing energy infrastructures.

Monjur Mourshed  
Cardiff University

### Employing the network for energy management

will enable utility companies to optimize power supply in response to demand, improve security and reliability, and integrate renewable energy resources onto the grid while reducing operational costs.

upgrade plan must take these points into account and the business implications of a proposed upgrade must be understood.

In addition to the need to accommodate the existence of legacy devices and systems, it is also necessary to understand that new technology implementations are done via rollouts and transitions and that operations and services need to be able to keep up. While these issues may be challenging, they have been addressed successfully in other industries. However, the unique needs of the power industry and the ways in which business processes and financing impact such a technical transformation must be integral parts of the convergence process. Business architecture is the integration of corporate strategy, business models, processes, and functions. It's the starting point for determining the appropriate organization-specific technology architecture. The strategic options facing utility industry executives involve an uncertain future and a period of rapid transformation.

Disentangling the complex links between public policy and business strategy makes it easier to determine the cost benefits of specific investments, to understand the architectural context, and to assess investments in terms of sequencing and synergies when developing robust technology roadmaps.

There are many ways to innovate. This means that it's not just about new boxes or devices. It's increasingly about looking at the challenges and solutions in different ways. A strong architecture enables a rethink of the entire situation: applying protocols in innovative ways to achieve performance levels unachievable in the past.

Investment in new technology along with replacement of an aging transmission and distribution infrastructure will create a stronger and more resilient grid. Investments in operational information and communications technology via discrete investments as part of the infrastructure upgrade could result in smarter grids that are also more secure.



# Micromobility GETTING E-ROUND

E-bikes are all the rage, but increasingly they are being joined by growing fleets of e-scooters. For urban planners, new forms of **on-demand mobility are increasingly being viewed as a quick way to reduce congestion in the inner cities.**

■ By Marcel Weiss

For urban residents this means more options to get themselves around the city. Being able to use light vehicles to get from A to B, picking them up and parking them wherever one pleases, makes this mobility mode a convenient option. However, it also provides challenges.

Today's city infrastructures are first and foremost built for cars. Single-person two-wheelers offer lots of advantages over cars – for one thing, they are much smaller. In congested traffic, they are usually a lot faster and they are better for the health of a city's inhabitants because they produce less pollution.

But e-bikes and e-scooters are being tacked onto an infrastructure that wasn't built for them. This mismatch keeps them from realizing their full potential. Analyst Horace Dediu, who coined the term "micromobility" for vehicles below 500 kg, expects the concept to be adopted by up to 80 percent of cities worldwide within the next ten years.

So how can city authorities jump on the bandwagon? On-demand mobility, micro or not, requires sophisticated mobile apps powered by GPS and the Internet. This allows service providers to collect transportation data on a whole new scale. Pooled information can give urban planners a wide range

**Forget Uber**

Montgomery County plans to test an app-based system that will allow riders to request a ride through the Via app on an 11-passenger shuttle.



photo ©: Passport

of new insights into how and where to build, or optimize, roads and parking spaces and even where to expand public transport and develop housing and commercial buildings.

One of the primary promises of IoT is to constantly connect objects with the Internet in order to better understand complex systems and linkages. In the case of urban development, this is already underway with sensors providing weather and air pollution data with great precision on an increasingly local scale. Now the same thing is happening with mobility.

**Getting the Data**

Micromobility initiatives are springing up around the globe. In the US, Detroit in Michigan, Omaha in Nebraska, and Montgomery County in Maryland are working together

to build a framework to obtain data from shared mobility services. These cities are sharing best practices to eventually build a new national regulatory model.

Data sharing is often mandated for start-ups wishing to get a foot in the door. Even smaller communities such as East Lansing in Michigan have successfully made that demand, thanks to fierce competition in the mobility sector.

Already, start-ups are providing data platforms to mediate between mobility services and cities. In California, Los Angeles, which is building a new standard for sharing mobility data, is cooperating with Remix, a young tech company based in San Francisco that offers data and planning tools for public transportation organizations. Detroit, Omaha, and Charlotte work with Passport, whose mobility software platform enables real-time, digital coordination of all modes of transportation to manage its curbside and street space. Washington DC uses a product called Populus Mobility Manager.

Micromobility does not ask for more, Dediu says – it asks for less: less money, less energy, less pollution, less pavement, less parking, and less congestion. In return it gives more: more health and longer, more meaningful lives for citizens.



## Your path to analog



**THE COMPETITIVE EDGE OF IOT**

Most of the focus on IoT innovation relies on digital technology. What is often lost in the discussion is that the edge of IoT is actually the analog world as seen and measured in light, pressure, temperature and proximity. The quality of the analog input determines the quality of the digital data, and the accuracy of analog output influences how effective an IoT application can be. So optimizing the analog part of the IoT application can be a real game changer. Find a path to analog through components and services designed for a digital mindset with your partners in IoT development, Avnet Silica and Microchip.

[avnet-silica.com/microchip-analog](http://avnet-silica.com/microchip-analog)



## Autonomous Transport

# TRAINS AND BOATS AND PLANES

More than fifty years ago, Dionne Warwick had a hit with *Trains and Boats and Planes*. Today, all of these vehicles are operated in ways nobody would have imagined back then – but **what we can expect in the near future** is even more astonishing.

■ By Rainer Classen

the Dutch railway company ProRail is searching for ways to make better use of the existing infrastructure.

“There are so many trains on the grid that the distance between them is relatively short,” said Rick van der Mand, project manager of an autonomous driving experiment that ProRail carried out with partners Arriva and Stadler in March 2019. “It’s so busy that congestion is never far away. Automation may prevent that.”

In a week-long trial on the Groningen to Zuidhorn line, the group tested a modified railcar produced by Swiss manufacturer Stadler, undertaking a first run operating in Grade of Automation 2 (GoA 2) – semiautomatic train operation where starting and stopping is automated but a driver operates the doors, drives the train if needed, and handles emergencies. With a driver in attendance, the train made automated stops at Groningen, Hoogkerk, and Zuidhorn. ProRail hailed this as a success and is continuing the trial but the company is not yet ready to set a date on when the first autonomous trains will be in everyday operation.

ATO (Automatic Train Operation) not only allows trains to operate more frequently at shorter headways and to stop more precisely but also improves energy consumption through the op-

**T**hese days you read a lot about autonomous cars but you rarely see any. Of course, there are assisting systems that make steering a lot easier under certain conditions – but when the driving environment becomes more complex, the systems are less reliable. It will probably still take a while until you just have to climb into a car and tell it where to take you.

There are other means of transport, of course, and many of them move in surroundings that seem a lot easier to handle. So what’s new on the tracks, on the water, and in the air?

### All Aboard the Auto-Train

With increasing traffic jams and rising awareness of the environmental impact of cars, many people are switching to public transport. The Dutch rail network, for example, projected that the number of passengers would increase by at least 45 percent by 2030. Freight volumes are also rising and



### Best of Both Worlds

The Dutch railway company ProRail is experimenting with semiautonomous trains built by Arriva and Stadler. Stopping and starting is automated, but a driver handles the doors and intervenes in case of an emergency.

timization of acceleration, speed, and braking. ProRail is also investigating the use of ATO on freight trains and, in conjunction with Rotterdam Rail Feeding and Alstom, they ran a modified locomotive on the Betuwe route in 2018. A more impressive example of an autonomous freight train is already operating steadily on the other side of the world: in the Pilbara region of Western Australia in July 2018, mining company Rio Tinto delivered iron ore by autonomous train for the first time. The AutoHaul project train consists of three locomotives, is 2.4 kilometers long, and can carry up to 28,000 tons of iron ore. It travels more than 280 kilometers north from the mining operations in Tom Price to the port of Cape Lambert.

### Getting the Ore Out

The Australian mining company Rio Tinto hauls up to 28,000 tons of iron ore a day via a 2.4-kilometer-long driverless train aptly christened “AutoHaul.”

The train operators are located in the Rio Tinto Operations Centre in Perth – which is more than 1,300 kilometers south of the mines. “There is a train controller at the Operations Centre in Perth who sets the route – but once it’s running the on-board computers





**Leading the Way**

This freighter built by Vard still requires a small crew and can only hold about 150 shipping containers, but larger, fully autonomous ships are already in planning.

International, a producer of crop fertilizers. In 2018, it presented plans for a vessel named *Yara Birkeland*. The company announced it as the world's first fully electric container feeder.

"Investing in this zero-emission vessel to transport our crop nutrition solutions fits our strategy well. We are proud to work with Kongsberg to realize the world's first autonomous, all-electric vessel to enter commercial operation," says Svein Tore Holsether, president and CEO of Yara.

Norwegian shipbuilder Vard will deliver the ship for launch in early 2020 and, compared to the large container ships on the oceans, it will be rather small with a capacity of 100 to 150 shipping containers. Initially, the vessel will be operated by a small staff but will gradually move to fully autonomous operation by 2022. With the aid of GPS, radar, cameras, and sensors, the ship will be able to navigate, dock, and leave the quay without assistance.

Yara's project shows some of the obstacles in the way of the rapid development of autonomous shipping:

- Harbors need to have the necessary infrastructure
- Communication between ships must function reliably

ing is enormous but the system also improves safety. "We are removing the need to transport drivers 1.5 million kilometers each year to and from trains as they change their shift. This high-risk activity is something that driverless trains will largely reduce," says Costa.

**IoT Is All At Sea**

Trains have one big advantage over automatization of other vehicles: they roll on tracks and there are rarely any obstacles that cannot be foreseen so navigation is rather easy. With ships it is completely different. When trying to make a boat navigate autonomously, wind and current have to be considered and there is always a risk of hitting reefs or other vessels.

A pioneer in the field of autonomous shipping is Norwegian company Yara



**Investing in zero-emission vessels fits our strategy well.**

**Svein Tore Holsether,**  
president and CEO of Yara



and the computers at the Operations Centre take over and it makes its own decisions," says Lido Costa, principal engineer on the AutoHaul project, "and there are a whole lot of other devices in place to protect people and equipment. For instance, if one of the wheels has a fault, the train will be brought to a stop, or if one of the couplers in the train is broken, the system will pick it up and stop the train." The computers keep the train to the speed limit and protect it from collisions with other trains or obstacles and all public rail crossings on the network are fitted with CCTV cameras.

Before the AutoHaul project, the trains had to stop three times during each trip to change drivers, adding one hour to each trip. As the train network is a core part of the mining operation, the effect of the time-sav-

**Making Waves**

An autonomous, purely electric container ship commissioned by fertilizer manufacturer Yara is part of Norway's plan to position itself as a global pioneer in alternative propulsion systems.



- Ships need to be able to communicate wherever they are – even under bad weather conditions
- Technology has to be integrated into the existing infrastructure
- Solutions have to be compulsively cost-effective

In this case, the project is operating in a rather small and very safe area. There are just two harbors involved and they're only about 30 kilometers away from the production facility. Since the project replaces the expensive road transportation of goods, amortization of the high cost will not take very long. In addition, the vessel serves as a beacon project. The developers describe the whole project as "a huge turning point for the global shipping industry."

There are many small companies and start-ups doing development and research in this area but we will probably see remote-controlled ships long before they go fully autonomous. Netherlands-based Kotug demonstrated this live at the international tug, salvage, and offshore support vessel (OSV) convention ITS 2018 in Marseille, France. For the presentation, a captain took over control of the steering and engine systems of a tug in Rotterdam (over 900 km away) using a secured Internet connection and live cameras. The company stated: "The real-time sensor technology makes it possible to give the remote-control captain the situational awareness that is needed for safe operation. Combined with the drone technology to connect the towline, unmanned shipping is commercially and technically getting closer."

**Robo-Pilots Ready for Takeoff**

In a Q-Series Report in 2017, investment bank UBS stated, "Commercial jets already take off and land using

their on-board computers, and several other in-flight functions are performed or confirmed by computers. Indeed, the pilot's task is increasingly focused on managing and overseeing the aircraft and its systems."

While the vast majority of ships carry cargo, airplanes are mostly used by travelers. This leads to one of the biggest obstacles in the way of autonomous planes: fear. The UBS worldwide report *Flying Solo: How far are we down the path towards pilotless planes?* concerning the future of air transportation canvassed more than 8,000 people. The authors found that 54 percent of the respondents said they would refuse to board a pilotless aircraft – and a lower fare would not make them change their mind. The number of people who said they'd be happy to fly on a plane without a pilot was only 17 percent. The report's conclusion shows that the question was current: "Technically speaking, remotely-controlled planes carrying passengers and cargo could appear by 2025."

Sooner or later they will appear, since the report also found the industry spends more than \$30 billion on pilots annually. Before passenger ac-



**Liftoff Achieved**

Also in January, Boeing successfully tested its first autonomous passenger air vehicle (PAV) prototype, an electric vertical takeoff and landing (eVTOL) aircraft, from an airstrip in Manassas, Virginia.

**Taxis in Flight**

In January, Airbus' Vahana team successfully flew their autonomous air taxi for the first time, combining electric propulsion and machine vision in order to "democratize personal flight."

ceptance increases, the first noteworthy steps in this direction will likely be seen in cargo flights. The two big players in this field, Airbus and Boeing, are working on the subject, but they are keeping quiet about it and there is hardly any information available.

Both companies are more open about their smaller, autonomous air "taxis." Boeing, for example, proudly published information about a successful test they did with an autonomous passenger air vehicle in January 2019. The prototype completed a controlled takeoff, hover, and landing to test the autonomous functions and ground control systems.

It's not only the big companies that are working on this theme; start-ups, like the Bavarian company Lilium, are developing quickly. So it may well happen that small, battery-driven air vehicles will be the first commercial autonomous flying objects – and if passengers have trust in them, they may eventually accept bigger planes without pilots.

It looks like we are very close to revolutions in trains and boats and planes. The technology for autonomous vehicles is already available but what's still missing are standards for communications across several systems, acceptance with passengers, and more results from field testing. We have only looked at a few use cases but there are many more examples and the revolution could happen faster than we think.

# The Future of IoT

# IOT AND ITS DISCONTENTS

Technology is making it ever easier to build an IoT network. Integrated automation solutions will potentially link systems and applications and, indeed, almost everything. **Whether this represents progress or, on a more practical note, whether people affected by this change will accept it is an open question.**

■ By Alan R Earls

One thing is clear: increasing levels of automation create a new set of social issues that could potentially stunt the growth of IoT. We discuss these concerns with a futurist and a labor leader.

## Future Imperfect

### Aric Dromi

Aric Dromi, based in Gothenburg, Sweden, describes himself as a “professional troublemaker” and futurist. In addition to a corporate job, he runs his own company where he focuses on changing “the way we experience the world, the way we think about thinking,” and transforming the way we understand change and abandon old paradigms. Dromi says he appreciates technology, including IoT, but is troubled by how it is used and what its unlimited deployment has done to aspects of human life and culture:

“When it comes to human behavior and economic growth we’ve lost control over technology.”

Aric Dromi  
tempusmotu.com



“A lot that I write about is what are the societal impacts [of technology]. When it comes to human behavior, and also economic growth, we’ve lost control over technology. “My first take on IoT is that there is a fundamental difference between the Internet of Things and things on the

Internet. We have gotten locked into a reality where people are selling and using things on the Internet about which we are completely ignorant. The accumulated value of reciprocal relationships is gone, as is the true value of what is provided. “What is the reason for putting a 17-inch flat-screen on a fridge and connecting it to the Internet. Is it to make a grocery list? You don’t need that to create a list. The telecom industry says we will have 3G, 4G, or 5G connectivity to bring that fridge on to the Internet. Why? You don’t need that. I think we have become locked in with these surface touch points rather than the real value. We are pricing things based on production rather than usability. “That is the difference between IoT and things on the Internet. Golden Krishna, a designer and author of the best-selling book *The Best Interface Is*

*No Interface*, asks some great questions that triggered me regarding how far we are extending the focus of touch points rather than the logic behind those touch points.” [Krishna currently works at Google on design strategy.]

“A genuinely intelligent environment doesn’t need me to interact with it all the time. The fridge should predict the things I need.

“Then there is my connected toothbrush. When I was in the US, I said maybe I should upgrade my toothbrush – and I found this connected toothbrush. It can map your face in real time. It starts Bluetooth and gains access to a camera. Why? Because Oral-B wants to see me brush my teeth. What is the value of that? What is the value to me? That is the part we are missing. We have no idea of the value, not just of me as an individual but the value that my own existence is creating.

“I think that is the point we are missing when we are striving to connect everything together. Instead of liberating technology, we are creating jails for ourselves.

“I don’t believe technology should replace humans and I don’t believe we should compete against technology. We should find a common ground to work together to find the next stage of evolution – a mutual evolution of technology and humans.

“Our discussions are not around these things. I’ve come to the point where I think we can summarize it in two sentences:

- We live in a world where we can search and google but no one knows what to search for.
- We live in a world where we can operate everything but no one knows how anything works.

“They are talking about folding phones as the next thing – but what is the value of a thousand devices in someone’s pocket? If we are talking about driving ahead and improving things, we need to be driving and improving things with a focus. It doesn’t make sense to have ‘smart’ before everything. We are focusing just on technology rather than utility.”



## Labor Does Not Mean Luddite

### Aida Ponce Del Castillo

Aida Ponce Del Castillo is a lawyer with a European doctorate in law, which highlighted regulatory issues of human genetics, and a master’s degree in bioethics. She works within the European Trade Union Institute’s Foresight Unit where she focuses on strategic foresight and on the legal, ethical, social, and regulatory issues of emerging technologies such as IoT, which she views as an enabler for further automation:

“When people say more jobs will be created [by new technologies and IoT], I would like to see hints of where. So far, we don’t have any idea where people will be needed. Everybody’s 100 percent agreeing that digital skills will be needed, but no one is able to really decipher which ones, or how to prepare. “Obviously, automation has increased as a buzzword over the last two or three years but, so far, automation and IoT has only had real impact in a few visible sectors like IT, the automotive industry, and other types of manufacturing.

“We should perhaps look at other sectors where IoT or automation is not yet as visible; the service sector for example. Some people make the assumption that this is now a threat to white-collar workers more than blue – or it could be the opposite.

“However, unemployment or underemployment seems likely to become an issue. OECD [The Organisation for Economic Co-operation and Development] and some universities have forecast that jobs will be lost, but the studies are not consistent so we can’t draw firm conclusions – but we can see how jobs are being removed, like at supermarkets.

“I’ve talked to blue- and white-collar workers and I can see that their perceptions are mixed. For both, we need to look at the consequences to the

**Aida Ponce**  
Everybody’s 100 percent agreeing that digital skills will be needed, but no one is able to really decipher which ones, or how to prepare.

“Look back over the past, with its changing empires that rose and fell, and you can foresee the future, too.”

Marcus Aurelius,  
Roman emperor and philosopher

workers. It depends, in part, on the computer literacy of the worker or the individual in terms of how they use a computer and how they relate to the Internet – it is not simply a divide between blue-collar and white.

“Looking at services more concretely, where automation has great potential, there is fear that more of those jobs will be lost and there is a concern about the next generation and whether there will be job opportunities for them.

“In fact, we can’t really predict what jobs the children in the next generation will have.

“Deskilling is another consequence of automation; namely, the decreased opportunities for people to learn skills or to maintain any professional knowledge. The skills and knowledge that have defined a person will be lost to automation. This is why many people are opting for reskilling or upskilling.

“With these technologies there could also be different types of risk related to computing or cybersecurity where there would be loss of autonomy and control by humans, relying more on platforms or algorithms to make decisions. In fact, algorithm-based decision-making is one of the bigger consequences of automation.

“The same happens for nurses and the health professions. They are increasingly relating to the files and the computer, in addition to directly taking care of patients. Nurses, in particular, are being controlled by aspects of IoT in terms of how often they wash their uniform, because a chip is integrated into it. In effect, nurses are being subjected to surveillance and their shift assignments are often algorithm-based, too. Or perhaps it could be someone driving a truck and they are feeling the impact of an algorithm telling them where to go.

“Ultimately, there’s no division in the impact; so, for labor unions, it’s one of the top priorities for discussion. Of course, people have a problem with wages first and then their concerns about digitization and automation. Really, I don’t think they want to rebel against it. They want to take part in it and shape the trend instead of making a revolution against it.”

Security

# RACE TO THE EDGE

Analytics services are moving to the edge but ensuring **the physical security of edge devices can be a real headache.** Security providers often take very different approaches to securing the edge, and finding the right strategy for enterprises and organizations will vary by IoT business case, not to mention risk management.

■ By Oliver Schonschek



The cloud ain't what it used to be. "The traditional model of moving huge amounts of data from edge devices to a central cloud for processing poses certain challenges in terms of bandwidth and scalability, slowing down operations and raising compliance and privacy issues," says Satyam Vaghani, vice president and general manager for IoT and AI at Nutanix, a software company specializing in hyperconverged infrastructure (HCI).

"Given the right edge computing platform, these challenges can be met with ease, at low cost, and on a global scale," he maintains, adding that worldwide edge intelligence can clear the road for many companies to unleash their innovative power. According to Vaghani, the race to the edge is already on: "In manufacturing, edge means many more machines and facilities can undergo predictive maintenance because parts can be inspected in situ through image analysis which shows up quality problems



The cloud is the wrong place to store data. Instead, intelligence should be transferred to where it is really needed – at the edge.

**Satyam Vaghani,**  
vice president and general manager for IoT and AI, Nutanix

faster than ever before. Retailers are empowered to analyze patterns in purchasing behavior down to the level of individual outlets. In every case, recognizing and reacting to trends becomes faster and more flexible."

### Securing Mission-Critical Edge Solutions

The data produced by these forms of analysis is extremely valuable for the enterprise and provides a tempting target for hackers and cybercriminals. Protecting data stored at the edge must be given top priority. "Despite its undisputed benefits, edge technology does make management's job harder," warns Dr Martin Klapdor, senior solutions architect at Netscout, a provider of application and network performance management solutions. Edge computing, he is convinced, is best for use in Industrial IoT (IIoT) and machine-to-machine (M2M) applications and environments which focus mainly on such technologies as sensor networks, mobile data capture, signature analysis,



Edge security needs to follow the business case instead of vice versa.

**Dr. Martin Klapdor,**  
senior solutions architect, Netscout





**Akamai has 240,000 edge servers world-wide.**

**Elmar Witte,**  
product marketing manager for security, Akamai Technologies

peer-to-peer applications, and ad-hoc connectivity solutions. "Since these are usually mission critical and highly interdependent, breakdowns of individual components can have drastic and lasting effects on business," he believes.

How can applications that live out there at the edge be secured? A wide range of providers offer solutions, often based on very different approaches to the problem. Finding the right one for a particular company can be daunting – to say the least. Edge security needs to follow the business case instead of the other way around.

### Edge Security as a Service

In order to bring online services closer to their customers, enterprises do not always need to invest in their own edge infrastructure. In fact, there are a number of providers willing to offer Edge as a Service (EaaS).

One of them is Massachusetts-based Akamai, whose Intelligent Edge platform currently runs on more than 240,000 servers around the world. "We are very close to the customers of our customers," asserts Elmar Witte, product marketing manager for security at Akamai. He claims there is a big difference to more traditional cloud providers because Akamai is focused on services such as media delivery, web performance monitoring, and security, whereas Amazon Web Services (AWS) and Microsoft Azure typically rent storage

### Thyssenkrupp Steel

implemented its first edge data center, provided by Rittal, as far back as 2017.



photo © Rittal

space and computing power. "Our performance services speed up the delivery of online applications and online content," he says. A good example from Witte of a "cloud first" strategy is a use case of a large international banking firm which initially spread its cloud development over various platforms including AWS, Azure, and Google Cloud. It then decided to realize uniform security standards over all its services by integrating Akamai into an edge-based security layer. In addition, it opted for Akamai Edge Platform to increase the speed and performance of their websites and online applications.

Another edge security specialist, Limelight Edge Compute, has gone a



**Limelight reduces network latency by routing conferences through its proprietary global network backbone.**

**Steve Miller-Jones,**  
vice president of product strategy at Limelight Networks



photo © Limelight Networks

different route by reducing network latency for operators of online conferencing solutions. "These users expect perfect voice and video quality no matter where in the world they use the service," says Steve Miller-Jones, vice-president of product strategy at Limelight. Slow loading and buffering can exacerbate transmission delays, frustrating customers and leading to more support tickets, not to mention loss of business. "Limelight reduces network latency by routing conferences through its proprietary global network, thus offering uniform service quality worldwide, which makes our customers very happy indeed."

### First and Last Defense

Enterprises that prefer to build and operate their own edge infrastructure can turn to specialist vendors offering security elements as add-ons, creating a kind of bulwark system to protect their assets at the edge. One of these, Netscout Arbor Edge Defense, has been described by its manufacturer as the "first and last defense against incoming and outgoing cybersecurity risks."

Dr. Martin Klapdor of Netscout believes that demand for edge security will explode over the coming years as 5G mobile technologies go operational. "Smart cities, mobile health services, augmented reality, and au-

tonomous vehicles are all in very early stages of development," he believes. "To get out of the pilot stage they will need robust security like the kind Netscout provides."

Ideally, he says, an edge-based security solution should identify outgoing communication attempts to suspicious IP addresses, domains, and individual URLs. This can help stop malware from entering the company's network, where it could start draining off sensitive data. In case of attack, Arbor Edge Defense collects information about the type and scope of the attack so IT professionals can react fast. The solution comes equipped with a host of pre-configured connectors and interfaces to hook up with existing security systems within the company.

### The Packaged Edge

Besides various service or hardware options for existing edge infrastructure, enterprises can choose to purchase preconfigured "edge containers," or even a complete edge data center with built-in security. A leading provider in this field is Rittal, a German provider of industrial enclosure systems, including power distribution and climate control as well as for IT infrastructure and software and services. Rittal sees itself as an industry leader in this field, explains Andreas Keiger, executive vice president of Rit-



photo © Rittal

tal's Global Business Unit IT.

"In order to facilitate the creation of data centers we have chosen a modular design that is like a set of building blocks, enabling clients to construct their own facilities to their own specifications," he says. To that end, Rittal has partnered with leading global solution providers such as Swiss-Swedish multinational ABB, Hewlett Packard Enterprise (HPE), and IBM. Services are hosted in Germany by Innovo, a leading cloud service provider whose job is to bundle all this into turnkey, edge solutions including hardware, software, and services. A good example of a Rittal deployment in the field of manufacturing is Thyssenkrupp Steel, the German industrial giant. It has installed edge data centers connected to the cloud



**We expect to see many enterprises decentralizing their IT infrastructure in 2019.**

**Andreas Keiger,**  
executive VP at Rittal

at all its production facilities in order to facilitate the digitization of day-to-day manufacturing processes. The amount of data being transferred back and forth has grown enormously, as has demand for shorter latency and seamless data access.

Thyssenkrupp installed its very first IT containers as production units back in 2017. These were designed by Rittal to fit the exact needs of the company and realized through Rittal's partner network. The containers are assembled on site and are configured as edge data centers with direct access to the cloud.

Another example is the edge data center located at Cloudpark Höchst, near Frankfurt, which was developed by Rittal with Innovo. It was designed specifically for local companies around Frankfurt and provides them with fast, secure IT services through standardized edge containers.

This goes to show that there are a number of possible paths to the edge from which companies can choose. Finding the right one will depend on the business case. As a rule of thumb, it can be said that in the coming years the closer you are to the customer, the more important edge computing will become. To secure edge installations, calling on edge service providers may be best but if speed and simplicity are key, special edge containers or whole edge data centers will probably be right for you.

### Cloudpark Höchst

is a data center for companies located in the Rhein-Main region of Germany. Prefab IT containers supplied by Rittal provide a wide range of IT services.



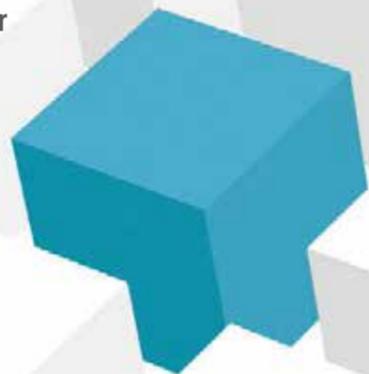
photo © Rittal

## Edge Computing

# FROM BIG DATA TO SMART DATA

As technology advances, businesses are amassing more and more data. With the advent of cloud computing, and with more servers and greater bandwidth than ever before, we now have the ability to both generate and store enormous volumes of it. However, **it's one thing collecting all this data and another knowing what will actually provide useful, timely insights for us.**

■ By Frank Sauber



The goal is always to derive insight from data in a cost-effective way and, with the emergence of edge computing, businesses are increasingly able to process data where it is generated – to decide what is valuable and what is not at source without having to convey it, at considerable expense, to a data-processing warehouse first. This is both cheaper and more efficient than transferring a constant flow of data, much of which may be completely irrelevant to a company's needs.

“  
Edge computing and cheap sensors are fueling the rise of predictive maintenance.”

Frank Sauber  
is director of ecosystem partners at Sigfox



In the context of the Internet of Things (IoT), sources of data generation are usually “things with sensors” or embedded devices. For example, a smoke detector might be constantly transmitting data between itself and a central system, but the ability to access and analyze that data only matters if something is wrong – if the device starts detecting smoke. At that point, you want a lot of data or information so you can assess the situation quickly and take the appropriate action to get things back on track.

By installing a simple, secondary system that remains dormant and only transmits data or wakes up the rest of the system when the need arises, businesses can be far more efficient and cost-effective in their practices.

### Predictive Maintenance

Edge computing, together with the decreasing cost of sensors, is leading to the rise of predictive maintenance – the ability to determine the condition of equipment and estimate when maintenance should be carried out. With tasks performed only when needed, rather than imposing regular “just in case” checkups, businesses can save time and money by not taking perfectly good equipment out of circulation.

A low-cost sensor could be connected to a low-power network and placed on a motor, for example, with an alarm programmed to trigger if a certain temperature is exceeded, or when the motor has reached pre-defined operating hours. Shock detection could also be factored in to calculate impacts on defective bearings. Once the alarm is triggered, either a technician could be sent to inspect the motor, or the system could activate the sensor over broadband communication and request a complete monitoring log to allow for more detailed analysis.

### Giving Peace of Mind

For businesses, operating a complementary communications system is not only more cost-effective in the long term but can act as a backup for primary systems in case of a breakdown or security breach. A backup system can sense when the primary system has been compromised – be that hacked, jammed, or out of power – and kicks in to keep the service up and running.

For example, Freebox, an Internet set-top box from French company Free, uses IoT service provider Sigfox to remotely diagnose millions of its boxes for basic failures, to ensure a more reliable service and a better customer experience. It also provides a backup channel if the Internet con-

nection goes down and additionally helps customers during the installation phase, as well as being a source of backup information during IP backbone maintenance.

Additionally, Verisure, a security company that provides professionally monitored home alarms and connected services for smart homes, uses Sigfox's global network to back up the company's home alarm systems and to provide anti-jamming capabilities. The alarms are connected to a central system using a GSM phone link but savvy thieves can sometimes use jammers to scramble the GSM signals and deactivate the alarms. Because Securitas Direct's backup system uses Sigfox and not the GSM network, it can kick in at this point to ensure the service doesn't go down. This not only brings peace of mind to customers at a low cost but provides a competitive advantage to Securitas Direct.

### Enabling Better Access

A secondary system that runs on a different network can also help to enable better access for different stakeholders. In a smart building there might be a local area network (LAN) but if it's owned by the building operator, not the building owner, communication might be there but not accessible to everyone.

In the case of building maintenance,

### Network of Security

Professionally monitored home alarms like Verisure's Securitas Direct connect services for smart homes using Sigfox's global network for backup and anti-jamming. Because the system does not run over the GSM network, it can kick in at this point to ensure the service doesn't go down.

communication systems might be accessible to building operators, but not to maintenance staff or cleaning personnel, through a digital subscriber line (DSL), with solid protection through firewalls preventing access to straightforward information like temperature or humidity. By placing low-cost sensors onto objects and creating a secondary network, maintenance staff can monitor environmental conditions without needing to be granted access to the primary system. This helps them to diagnose problems faster and keep everything running smoothly.

Employing simple, low-cost, and complementary communications technologies that only transmit data if and when needed means they can also act as a backup for existing systems or simply work alongside them. In the coming years, we are likely to see an increasing number of companies bringing intelligence closer to devices, filtering data to a far greater extent before sending it to the cloud or server farms, and an increasing demand for “smart” data where collection is “as needed.” The future lies in businesses having a mix of communication technologies, employed for different purposes, that can be accessed by different owners. This will not only provide them with greater flexibility and security but be much more cost-effective, too.





IoT and Hospitality

# THE ROBOT WILL SERVE YOU NOW

In the world of tomorrow, **service robots and automated assistance systems will serve us just like human waiters** used to do. But is the hospitality industry ready for the next technological revolution?

By Robert Brunner

**R**obots used to be stationary machines; powerful and usually expensive automation systems programmed to do repetitive tasks. For example, industrial robot arms repeat the same action over and over again

with the utmost precision. Service robots, on the other hand, open up a new field – one of flexible, semi-autonomous, or fully autonomous, robotics. It is no longer just about automating certain human tasks. It's more about flexible and (partially) autonomous robots enabling new and much more complex workflows. In short, robots are no longer one-trick

ponies that automate a single task. Thanks to falling component costs, technological advances, and novel business models, robotics is finally leaving the realm of science fiction. Service robots will soon be commonplace in hotels, hospitals, restaurants, warehouses, and retail stores, and even in our homes, performing staff services and housekeeping tasks.



Service robots will soon be standard at any hotel.

Robert Brunner, B'Impress.



### The Time Has Come

The hospitality industry is a perfect example of the emerging worldwide market. Products are available from established manufacturers like Savioke and Omron Adept, as well as start-ups like Fetch Robotics and Fellow Robotics in the US, and Robotise in Germany. In addition, there are humanoid robots such as Kuri from Mayfield Robotics in the US and Pepper from Japan's SoftBank Robotics (formerly Aldebaran Robotics, France). All of these companies are in the process of developing disruptive technolo-

gies and making them useable for new applications and markets. "Robots are booming – this applies both to the industrial sector and increasingly also to private use," says Martin Hägele, chairman of the Service Robotics Group at the International Federation of Robotics (IFR). "The growing interest in service robotics is partly due to the variety and number of start-ups that currently make up 29 percent of all robot companies. In addition, established large companies are increasingly investing in robotics, often through the acquisition of start-ups." The European manufacturers of service robots already play an important role in the global market, accounting for 290 out of the 700 registered providers. North America ranks second with around 240 manufacturers and Asia is next with around 130 manufacturers. In the US, around 200 of the providers currently working on new service robots are start-ups, compared with 170 in the European Union and Switzerland, followed by Asia with 115 start-ups. Virtually all economies are seeking to create a vibrant, entrepreneurial business environment to support service robotics.

### Help Wanted

In many areas of the service sector, kiosk or assistant robots have found their way into everyday life. None of these humanoid robots will replace people in the foreseeable future but they help out in times of bottlenecks

or to help remove mundane tasks to make jobs more attractive, especially in areas where there is a chronic shortage or high turnover of staff. Effectively, robots enable employees to work better, faster, and safer. People are elevated to leadership roles or can be freed up to perform higher-value activities, as subordinate or repetitive work is delegated to service robots. In restaurants or hotels, the use of robots relieves the staff of routine tasks and ensures consistent quality and reduces, for example, the risk of wasting food by exceeding the best-before date (or expiration date). In hotels, robotic delivery can replace some room service duties, routine internal delivery services, or even take over maintenance tasks. One of the current advantages of robots in public areas of restaurants and hotels is to generate excitement and advertising impact, especially while the majority of competitors don't have them. But, in the long term, service robots will eventually become standard tools and raise the service portfolio and level. SaviOne from Savioke can communicate with elevator and telephone systems to perform its job. The robot is about 90 centimeters tall, weighs about 45 kilograms, and moves at walking pace. Most SaviOnes have been commissioned by hotels in California, where they supply snacks and other essentials, allowing hotel staff to focus on the less-mundane needs of their guests. ABB's Yobot is a robotic arm used as



**On board** the world's third-largest cruise ship, Royal Caribbean's *Anthem of the Seas*, a robo-bartender mixes cocktails in the Bionic Bar.

an automated baggage storage and retrieval system in the Japanese Henn na Hotel in Sasebo, and in the lobby of some of the largest New York hotels. At Henn na, which famously features service robots in its "hands-off" lobby, Yobot is theatrically illuminated and housed behind a secure glass enclosure. Its main use is to store bags for guests who have signed out of their rooms but are not immediately ready to leave. On being shown a barcode receipt, the robot picks up the guest's luggage from one of the 117 lockers and delivers it to them. Royal Caribbean's *Anthem of the Seas*, the world's third-largest cruise ship, offers innovative entertainment, novelties, and drinks at its Bionic Bar. In the middle of the bar stand two large robotic arms, bent to emulate human elbows, ready to serve a predefined robot cocktail or a traditional classic. Beyond mixing cocktails, automation of food preparation in the catering industry has increasingly become an area for the use of robots. One example is the Flippy fast-food kitchen assistant from start-up Miso Robotics which can deep-fry food or flip burgers. Moley Robotics intends to take food preparation one step further in more professional kitchens. This design has two robotic arms with skilled "hands" that can learn and repeat the actions of a master chef preparing a gourmet meal. Moley is also planning to release a consumer version of its Robotic Kitchen later this year which will integrate the four kitchen elements: robotic arms, oven, hob, and touch-screen device. Robotise from Munich is also planning to launch its first hospitality →

### At Your Service

The robo-server SaviOne by Savioke supplies snacks, allowing staff to focus on the less-mundane needs of their guests.



Large companies are increasingly investing in robotics, often through the acquisition of start-ups.

**Martin Hägele,**  
CEO, Service Robotics Group

service robot in the near future. The autonomous, self-propelled delivery robot can run errands from the front desk, act as a mobile minibar, or deliver small gifts to guests – saving staff time by doing small but time-consuming tasks. Robotise calls its robot Jeeves, named after the all-knowing valet (a personal butler) in the very British short novels written by P. G. Wodehouse.

In a typical scenario, a guest would order something via the hotel app on a smartphone, or call the front desk to make a request. A short time later, the guest's doorbell rings and Jeeves automatically opens the appropriate delivery compartment to deliver gifts, fresh towels, toiletries, or drinks and snacks.

### The End of the Minibar

Stocking up the minibar is a time-consuming and unpopular activity for

**Quick Service**  
Mobile robots such as Omron's LD-60 are already being used by hotels in linen and room service delivery.



hotel staff – and the energy costs of the cheaply manufactured refrigerators are not to be underestimated. A service robot as a “rolling minibar” could bring relief and allows a wider selection of fresh snacks and drinks to be supplied.

A service robot also allows the hotel to provide additional services. For example, some hotels have cut-off times for room service because many of them radically reduce staffing at night. If only one person is on the reception desk overnight, they

cannot leave to perform messenger services, but a service robot ensures punctual deliveries without disruption.

We are just at the beginning of the rise of the service robots in Europe but they will soon be a standard part of any hotel's provisions – and the robots' capabilities and intelligence will grow. So next time you order something in your hotel room, don't be surprised if you open the door to find a robotized butler named Jeeves.

**Carry On, Jeeves!**  
Robotise's robo-valet Jeeves, named after the manservant in novels by P. G. Wodehouse, runs errands, serves drinks, and even delivers small gifts.



**Gourmet Robot**  
Moley Robotics uses two robotic arms to prepare gourmet meals under instruction from master chefs. A consumer version will be out by the end of this year.



**Short Order**  
Flippy, the fast-food kitchen assistant from start-up Miso Robotics, can deep-fry food or flip burgers.

# LONG-TERM STORAGE GOING, GOING – GONE!



**E**xcuse me – I need some help. For a long time, I've been wanting to store my data permanently. No, I don't mean on a USB stick or a hard drive. I mean something really, really durable.

I read somewhere that papyrus scrolls have survived unaided in the arid Qumran desert for more than 2,000 years. The Icelandic sagas were inscribed on cowhides more than 900 years ago, and the illuminated manuscripts produced by medieval scribes on vellum gathered dust for centuries unprotected before most of them were transferred to modern, climate-controlled museum vaults. A few years back, copies of the very first Charlie Chaplin films were found in a garbage dump. They could still be played and are now preserved in digital copies.

The data stored from my early computer years weren't so lucky: they're gone forever. Whatever happened to all the stuff we stored on our Ataris and Commodore 64s? The hard disk on my first PC gave up the ghost before I could make a backup. When I see the mountains of hard disks to be found in every data center I have ever visited, I tend to think the problem persists even today.

Personally, I always had a penchant for Fujitsu's magneto-optical storage device, the fabled MO disk – but Fujitsu discontinued it, so that's not an option, either.

Of course, there's always tape – but just how reliable are they? NASA says 1.2 million tapes containing data and images from decades of space exploration, including from the Apollo 11 moon landing, are gone – either misplaced, erased, or crumbled to dust due to unsuitable conditions in the space agency's storage warehouse. Even if the tapes survived or could be found, that doesn't mean they would still be readable. Just ask the people at the former East German spy agency, the ill-famed Stasi.

Magnetic tape cost real money back in the days of the great socialist experiment, so scientists devised a way to compress the data with the help of special mathematical routines. Unfortunately, nobody remembers how

they worked so, while the tapes still exist, their contents are irrecoverable. But today we have DVDs, don't we? They are made from plastic that should be indestructible, right? Actually, nobody knows for sure. Experts believe that a DVD may last as long as 30 years, which is a big step from the old CD, which deteriorates after five to ten years due to oxidation of its metallic film coating.

Many still think that film is the answer. In 2004, scientists at the Fraunhofer Institute started what they called Project Ark, which featured laser recording technology for long-term storage of analog originals and digital data on color microfilm they said would last at least 500 years. The system was designed to work without the need for copying or running lots of servers. In 2006, funding ran out, and little has been heard since.

Maybe my best bet would be HD Rosetta, a system developed by the US firm Norsam which specializes in microscale technology. In Rosetta, information such as texts, line illustrations, or photos are etched on nickel plates and can be read with the help of an electron microscope. The company maintains that a single plate can hold up to 160,000 pages or images and are immune to water or radiation damage and safe for at least 1,000 years – not that I'll be around to check if they're right, mind you.

If you travel in Africa or Asia, you might see vintage airplanes like the DC-4, which first flew in 1938, or old Cessnas built in the '50s and '60s. If you are ever in Austria, make a point of taking a ride on the Achensee Cog Railway. The steam engine was built in 1888 and, if they keep taking good care of it, it might still be running well into the next century. That is if they can still find the manual and the blueprints which are, unfortunately, mostly stored digitally nowadays. When they're gone, the choo-choo's days are numbered.

I discussed the storage problem with an old colleague of mine a couple of weeks ago, and he had an ingenious suggestion: punch cards! Or does anyone have a better idea?

**NASA lost 1.2 million tapes – including the ones from the Apollo moon landing.**

**Bernd Schöne**

is a veteran German Internet journalist and an expert on cybersecurity

## Connected Homes

## ALMOST THERE

The smart home industry continues to evolve along the lines of connectivity and interoperability but many challenges remain. **As the industry moves from closed to open ecosystems, business models will be freed up** and continue to grow rapidly.

■ By Thomas Rockmann

It has been an exciting few years in the world of the smart home and IoT. Not only has the industry innovated technologically, it has evolved significantly to offer an enhanced range of entry models for enterprises and delivers better consumer value and recognition in the marketplace. From the many evolutionary strands visible today, it is possible to extrapolate the shape and trajectory of the smart home market overall.

As predicted several years ago, there has been fierce competitive pressure in the smart home market and consolidation has been rife. However, the result has been positive and can be summarized very simply – overall growth.

We have seen enormous increases in market awareness among consumers, as well as penetration of devices into homes and businesses across the globe. Various key drivers have also emerged and a recent report from analyst firm Juniper Research predicts that increasing smart home security adoption will drive global home automation, delivering revenues from an estimated \$12 billion in 2018 to more than \$45 billion by 2023, a significant growth rate of more than 260 percent over the forecast period.

**“**  
New open ecosystems will accelerate growth and create strong demand.  
**”**

**Thomas Rockmann,**  
VP Connected Home at Deutsche Telekom.



The researchers also singled out the value of the open ecosystem in this predicted growth, stating that the open ecosystem will rapidly accelerate growth, reaching a billion automation and monitoring devices by 2023, up from 176 million in 2018. One additional reason is the relative success and strong demand for AI-powered smart speakers, particularly those that combine an inclusive ecosystem with an attractive price point – a redoubtable combination. The popularity of artificial intelligence digital assistants is certainly booming, with a recent Gartner report predicting that 25 percent of households will use them as the primary interface for connected home

services by next year. Major technology players are pursuing voice control and, currently, AI assistants serve two specific purposes: semantic assistance, by using AI to recognize not only the words or phrases, but also the context; and bridging the gaps between devices, services, and products, which is where the smart home market really benefits.

By blending devices and services from multiple sources, accessed via the AI overlay, consumers are divorced from the intricacies of technology and freed up to live their lives. One example is in leveraging AI for ambient-assisted living purposes, where the network of smart speakers in an average home can be activated by the user simply by saying “Emergency,” which triggers a confirmation response. If the response is affirmative, the service sends a preconfigured message to nominated people. These recipients can then “drop in” to activate two-way communications with the speaker – an immediate voice link to enable the correct help to be delivered as quickly as possible. The move from closed to open ecosystems is being driven by a host of variables, including a rapidly broadening range of business models. Pay-monthly, subscription-based services are a familiar concept, as

are pay-as-you-go models. Utility companies are driving bundled services packages, by bringing together connected home products with new green energy tariffs. For example, a German utility provider has launched a new combined offering, giving a smart home base unit to customers for the contract period of their electricity and gas tariffs to incentivize conversion.

Loyalty-based models have also seen significant uptake, where consumers are provided with the latest connected home thermostats to significantly reduce customer churn. In other cases, insurance companies are partnering with third-party, smart home manufacturers of security products to extend their reach and user base.

### Connectivity and Interoperability Are Key

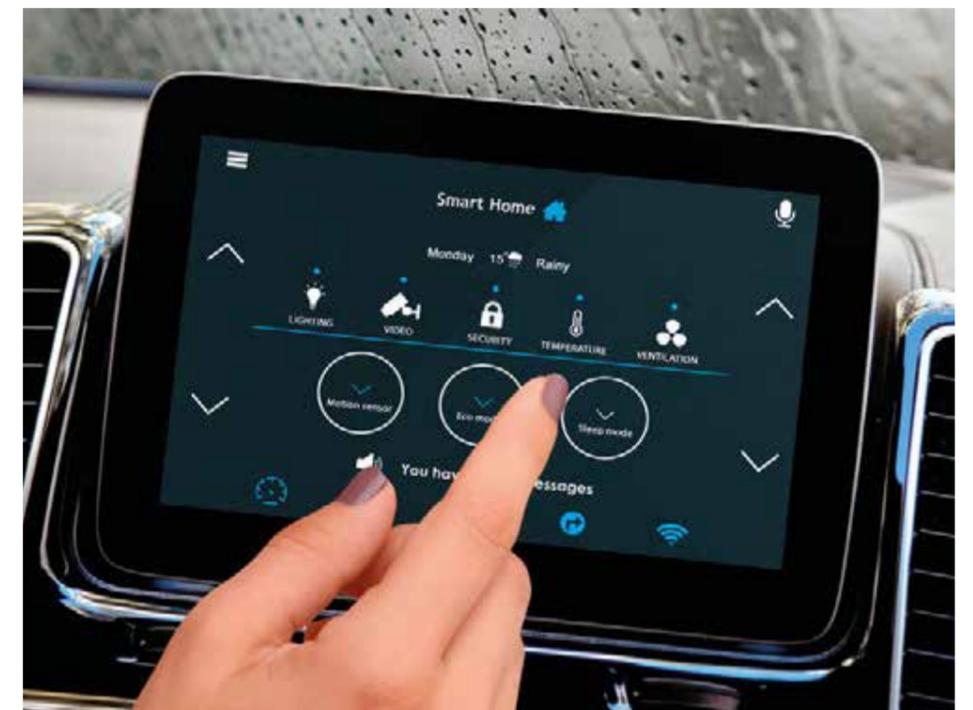
While current business models are forced to work alongside a range of technical limitations, the diversity of business models will free up as these are lifted and will increase. As the story of the connected home began with connectivity and interoperability, this will prove to be the future of the sector as well.

One area closely related to the connected home that has seen enormous expansion clusters around the

connected car. As the number of hybrid and fully electric vehicles (EVs) on the roads increases, the number of traditionally powered vehicles containing onboard data connections will continue to skyrocket. Initially, these connections were used for telematics and diagnostic purposes, then for location and tracking-style applications, and only recently for

### Car owners

will be able to seamlessly control their smart home via their car’s infotainment system, activating or turning off preset scenarios on their way home.



non-core motoring functions. It was announced at CES 2018 that Amazon Alexa will be embedded into Toyota and Lexus cars later this year.

Deutsche Telekom has partnered with Volkswagen and its Car-Net App Connect to enable owners to seamlessly control their Magenta Smart-Home via their car’s infotainment system. Using the control panel, the driver can activate or turn off preset scenarios while driving. For example, a scenario called Coming Home could be created so that the garage door opens and lights in the driveway and house entrance turn on when the vehicle returns home.

The changes that fully connected smart cars can bring to our homes and cities are significant. Electric charge points are springing up across towns and cities already and design changes in new homes have been made to accommodate charging stations. The expectation that home devices will be able to interface with the connected car is a genie that will not go back in the box. Whether future changes will be shaped more by environmental protection regulations or by consumers themselves is perhaps a moot →

point – but the changes have already begun.

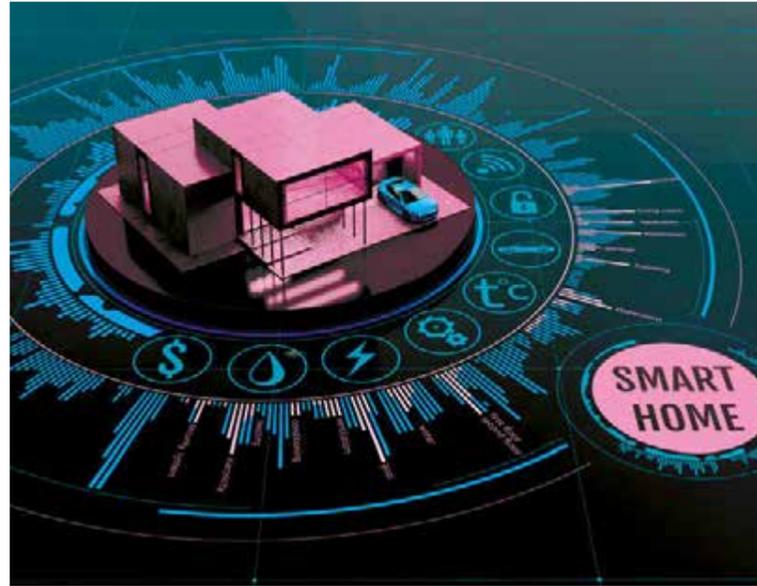
Deutsche Telekom's Magenta has created an open smart home platform upon which firms across multiple sectors can build growth strategies and exploit opportunities in the market, while developing and releasing their own home automation propositions. These products integrate into the platform's open and interoperable architecture ecosystem, which has been designed to be agile and ever-expandable to support a wide range of partner and third-party services, solutions, and devices. Support, flexibility, connectivity, and interoperability are the overall themes for the smart home market and it is promising that the products and services that have seen success all rely on these elements to ensure uptake.

### Catering to the Needs of Older Populations

One change that has been going on for years is the incremental shift towards an older population on a global scale as lifespans lengthen. This trend saw the phrase Ambient As-

#### Open and interoperable ecosystems

designed to support a wide range of partner and third-party services, solutions, and devices will provide support, flexibility, connectivity, and interoperability in the smart homes of the future.



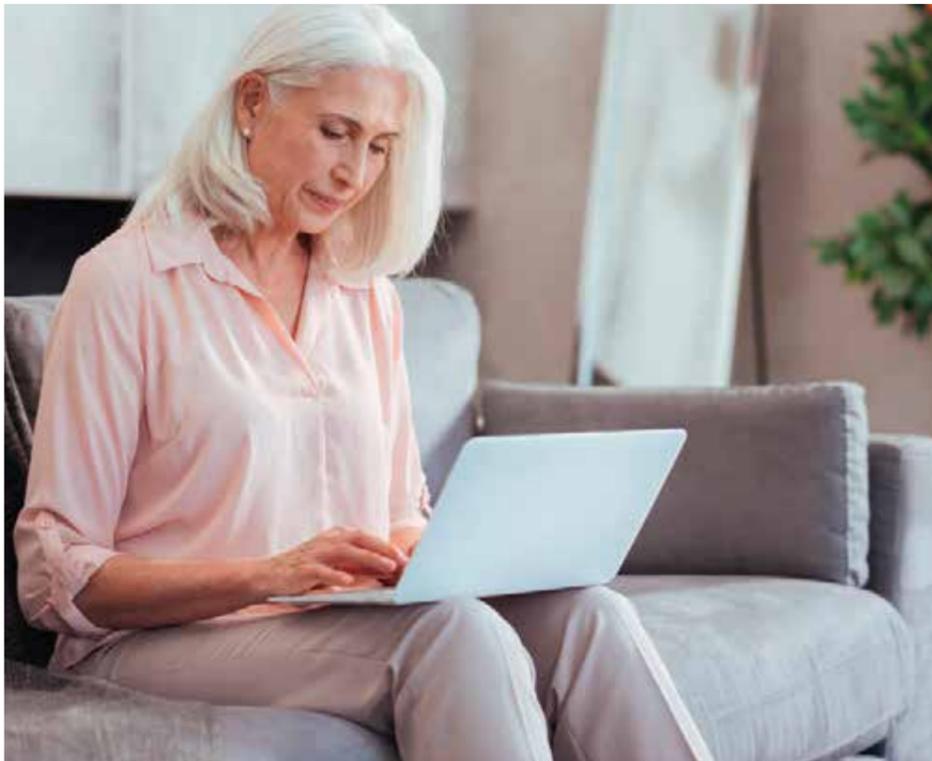
#### As lifespans lengthen, Ambient Assisted Living (AAL)

will play a bigger and bigger role, enabling a wide range of new smart home products and services.

sisted Living (AAL) coined some time ago, but the adoption of AAL technologies has been slow at best, often stalled by technological constraints and perceptual barriers. However, the rise of viable smart home products and services are already chipping away at this historic bulwark, solving both issues in one fell swoop.

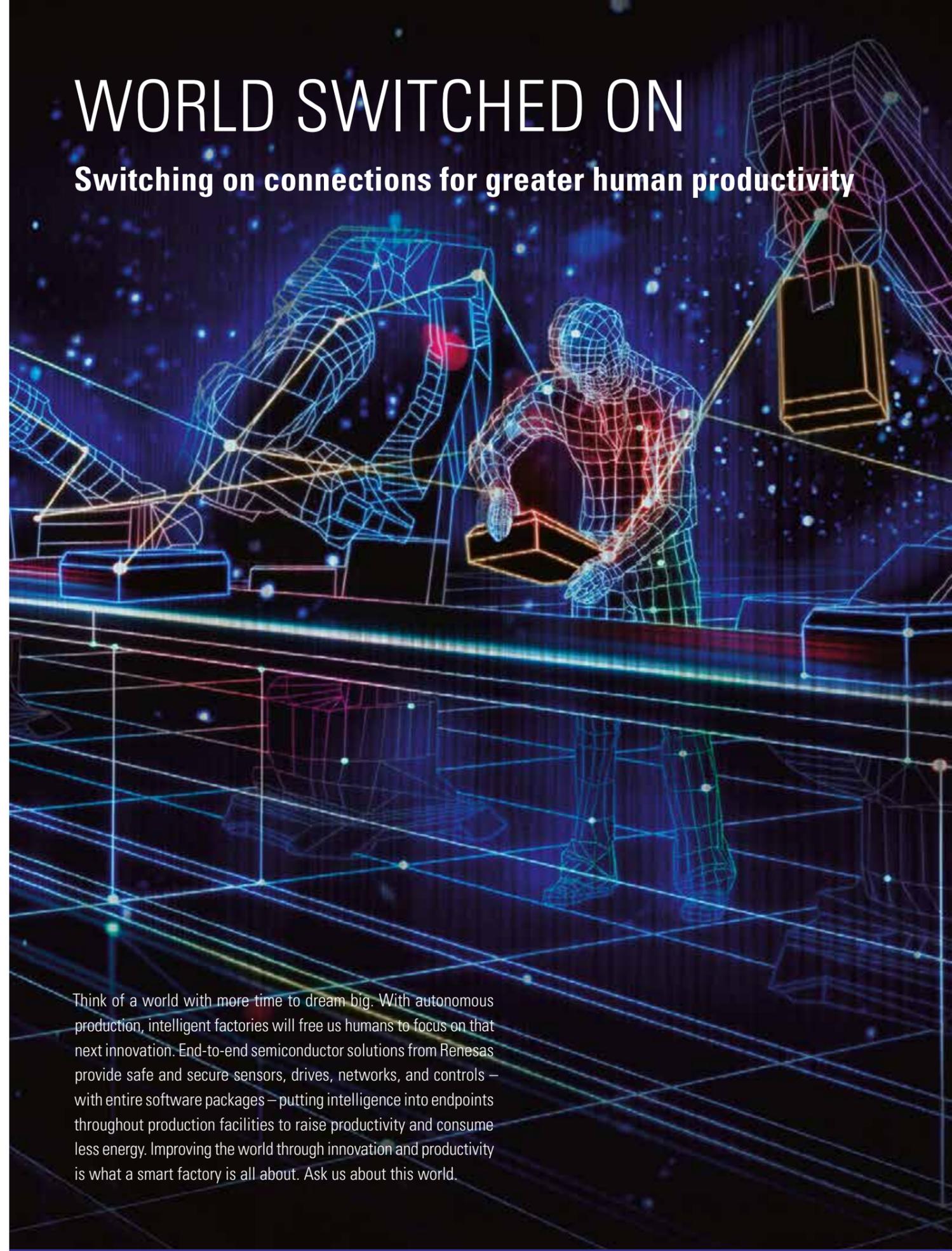
The wide range of smart home sensors coming on to the market, from water and moisture meters to smoke alarms and motion detectors, can easily serve dual purposes in an AAL environment. By networking sensors to communications devices, smoke detectors using Digital Enhanced Cordless Telecommunications Ultra Low Energy (DECT ULE) could connect to mobile or fixed line networks to raise the alarm in the case of a fire-related emergency, for example. Overall, the smart home industry is in rude health and will continue to evolve along these lines of connectivity and interoperability. There are still many challenges in the market, notably in keeping pace with the ever-present questions around security and personal data controls, as well as ensuring that complexity is kept to a minimum. This latter point is particularly important because ease of use and simplicity in use case are both essential in the overall value proposition. However, the smart home industry has advanced a long way in recognizing and mitigating these challenges already and will undoubtedly continue to do so.

As the rapid evolution of smart home technology uses directly results in the growing popularity of this sector, the future looks bright – and the future is connected.



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## Smart Factories

# FROM PREVENTIVE TO PREDICTIVE MAINTENANCE

Predictive maintenance (PdM) is outgrowing industrial applications and starting to transform consumer products. **More accessible and cost-effective solutions will change the way we relate to technology.**

■ By Andrea Onetti

**W**hen we think of high-volume manufacturing, we often imagine a smoothly running factory with every machine functioning perfectly to turn out finished products efficiently and in volume. For the people running such a fac-

tory, their objective is to keep the factory running at its optimal speed with minimal downtime. This objective recognizes every machine with moving parts suffers some wear and tear and will inevitably need to be serviced or have some parts replaced. The question is when is the best time to do this: do you do it according to a fixed schedule or do you wait for the machine to start showing signs of failure?

### Approaches to Maintenance

A first approach is to schedule maintenance tasks based on a fixed predetermined schedule, which ignores the actual condition of the equipment. Think of a regular car checkup at fixed intervals or mileage. This approach

has the advantage of being simple to plan but also has significant drawbacks in that maintenance may happen too late, resulting in equipment damage and danger for workers, or it may be carried out when it isn't necessary.

A smarter approach is condition-based maintenance. This approach drives maintenance actions based on the estimated condition of the machine, which is typically monitored through inspection or using data from embedded sensors. This has the benefits that maintenance will happen before failure and only takes place when necessary, but the drawback is that maintenance only begins after the machine begins to show signs of failure and the necessary maintenance intervention

may not be optimal for production scheduling.

A third approach is Predictive Maintenance. Here the aim is to predict, at the earliest point in time possible, the maintenance actions that will be required at some point in the future. It is an approach based on condition monitoring combined with a dynamic predictive model for failure modes. This has the advantages of optimizing maintenance to both the machine's life and the factory's production efficiency, although it does require a more complex overall system.

The primary promise of predictive maintenance is that it enables corrective maintenance to be scheduled at a convenient time while maximizing the equipment's useful life by preventing equipment failures. With the knowledge of when machines need to be serviced and what needs to be done, maintenance work can be planned optimally with the right people and parts ready. This approach aims to eliminate unplanned line stops and reduce stoppage time overall. In addition to increasing the factory uptime, there are other advantages including a reduction in accidents associated with equipment failure and increased equipment lifetimes.

### Building a Predictive-Maintenance System

To build a predictive-maintenance system a number of elements are needed.

First, automated condition monitoring must be installed on the target machines. This monitoring can involve visual inspection with cameras, measurement of vibration with accelerometers, measurement of noise levels or ultrasonic sound with microphones, and heat or humidity measurements, for example.

Next, some embedded processing is required to handle the first analysis of the raw data, turning it into useful information that can be shared with supervising systems. For example, the embedded software can continuously run a comparison of the vibration characteristics of the machine over time to determine when changes are occurring. By embedding the processing capabilities in the sensor unit, the amount of data that needs to be communicated is vastly reduced. This is particularly important for visual inspection, where the amount of data can quickly become huge.

Next, the information must be communicated to local and remote supervising systems. This communication must be done securely and efficiently taking into account the infrastructure of the plant to determine what kind of connectivity is best suited to the task. For example,

**The conditions for widespread adoption of predictive maintenance are now in place.**

Andrea Onetti,  
STMicroelectronics



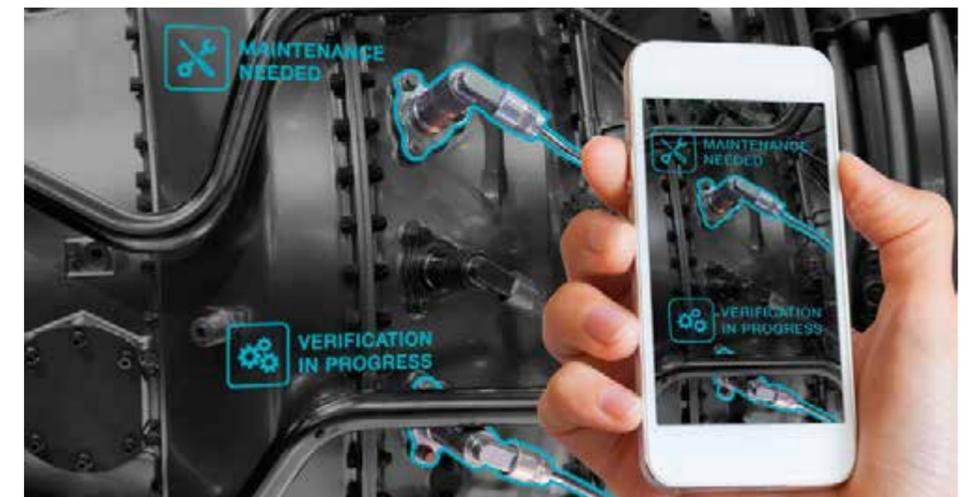
an existing plant lacking wiring for sensors would best use wireless communication as a cost-effective and fast way to implement a connected sensor network.

Lastly, a predictive model for the equipment failure mode(s) must be created. Engineers can build this model on theoretical failure models combined with the data collected from actual field installations. When a large and reliable dataset is available correlating the sensor data and actual failure mechanisms, you can use machine learning techniques to create a more refined predictive-maintenance model.

The conditions for the widespread adoption of predictive maintenance are now in place with the availability of all the key components, combined with cloud services and artificial intelligence.

### Secure and Efficient Communication

Wireless communication is a cost-effective and fast way to implement the kind of connected sensor network connecting local and remote supervising systems.



## Wireless Deployments

# GIVING ANTENNAS A REMOTE CHANCE

The cost of IoT sensors continues to fall, allowing more organizations to roll out remote IoT and M2M deployments that often require hardware to tough it out in harsh conditions with minimal maintenance. **Antennas are particularly vulnerable and bad buying decisions can make them the weakest link.**

■ By Andy Bird

Today, we are seeing the boundaries of IoT applications expanding and a rich variety of industrial deployments driving major returns on investment for organizations. Shell is a prime example. The global oil and gas company has used IoT technology to monitor the condition of remote oilfields across Nigeria and has reportedly achieved a million-dollar saving through the reduced requirement for regular physical site inspections.

Now we are looking beyond the Shells of this world and seeing IoT projects that are no longer limited to the largest businesses. Think of an agricultural firm that has deployed Global Positioning System (GPS) trackers to monitor the location of vehicles and machinery spread across an extensive region.

By tapping into real-time positioning data, agricultural managers can moni-

“Cutting maintenance time and physical inspections can be crucial to performance.”

Andy Bird,  
the managing  
director of  
GTT Wireless



tor driver technique, identify areas for optimizing tractor coverage, and ensure vehicles are nearby for scheduled maintenance.

### Beware the Rising Damp

With these deployments come regular hardware and geographical chal-

lenges. For organizations with assets operating across a vast area, constant connectivity and high levels of reliability are vital. Hardware that is proven to resist challenging conditions such as heat, dust, and repeated vibration, without sacrificing performance or functionality, is essential to cut the need for continuous maintenance or replacement.

It is important for organizations to prioritize hardware components and M2M applications that are proven to endure challenging conditions in outdoor environments. Antennas are no exception.

We see a lot of antennas sporting a subminiature version A (SMA) coaxial connector. These may be cheap and readily available, but they are by no means suitable for mission-critical operations – water being a major threat. These antennas might deliver suitable connectivity but incremental stresses, such as the slow accumulation of

moisture, can have a catastrophic effect on housed circuit boards.

### Threats from All Angles

To meet industry needs for rugged IoT-capable antennas, manufacturers have begun to develop extensive, enterprise-grade ranges specifically tailored to resist challenging and remote conditions. Antennas that incorporate waterproof N-type connectors are ideal because they are highly resilient to shock, vibration, and other physical disturbances, as well as being IK09 rated against external impact up to 10 joules.

Mushroom-style antennas in particular are designed to enable IoT applications and support key communications standards such as Wi-Fi, LoRa, and LTE for greater data speeds, low power consumption, and long-range transmission. These low-profile designs reduce the threat of vandalism or strike damage and are typically IP67-rated (impervious at a meter's depth for half an hour) for protection against dust and moisture.

### No One-Size-Fits-All

Flexibility is a key consideration when implementing IoT projects. Each deployment has specific hardware requirements – and indoor or

sheltered IoT deployments may not require rugged hardware. For this reason, it is important for designers to identify an antenna that offers multiple connectivity options for greater customization, whether this is N-type connectors, jack plugs, or SMA pigtail cables. If the scope of a wireless project changes from 3G connectivity to GPS, for example, designers must take care to ensure suitable antennas are available from the same range to ensure project continuity, interoperability, and comparable protection levels over the entire project.

### Test is Best

GTT Wireless operates a dedicated component IP67 testing facility to verify the durability of its N-type antennas to ensure the aerial will not be the weak link of an ambitious wireless project.

The company strongly encourages designers to test interoperability by using a visual design tool to demonstrate how compatible antennas can be integrated into an enclosure. This is particularly important when selecting an accompanying variable-sized rugged enclosure to ensure seamless integration of all components. Each component should be color-coded

### Magic Mushrooms

Mushroom-style antennas reduce the threat of vandalism and strike damage and are protected against dust and moisture.



for instant identification to support easy installation, especially for large-scale deployments with hundreds of units.

### Time to Connect the Dots

Deploying IoT for real-time, remote applications, such as vehicle movements and operations across a large area, can give a major competitive advantage, but this can be compromised by the unreliability of poorly protected off-the-shelf components. Although SMA connectors certainly have a role to play in many wireless projects, there is little doubt that N-type connectors are now a key component for outdoor or remote wireless deployments. As IoT technology continues to mature and the use cases expand, it is vitally important for businesses to start to implement resilient outdoor connectivity now.

### Out and About

With widespread use of GPS in agriculture to monitor vehicles and machinery over an extensive area, hardware needs to meet lots of new challenges.



# SMART COMPANIES



## Port Harcourt: Honey Flow Africa

### Putting a Buzz into Beekeeping

Bees don't just make honey; they are vital to agriculture as pollinators for all kinds of crops. Unfortunately, bee populations are susceptible to many threats, such as diseases, climate change, and predators. Mites, viruses, and fungi are the bees' worst enemies, global warming affects seasonal behavior, and bee hunters such as insects, moths, and birds are rising – not just in number, but also in levels of attrition.

Honey Flow Africa, a Nigerian start-up, has a multidisciplinary team with years of experience in management and product design focused on beekeeping. Its goal is to use IoT



**Amaete Umanah,**  
CEO of Honey Flow

solutions to increase survival rates and population growth and to boost honey production through smart time management of nectar flows. The Hive Monitoring System is based on the BeeTeck Communication Modules, which can be placed quickly and easily into each beehive where they automatically gather key markers and sends them to the cloud. All the beekeeper has to do is to check a computer, smartphone, or tablet to see if all is well.

"BeeTeck is the brain of the beehive," says CEO Amaete Umanah. "This module reads everything about what happens with the swarm in-

side the beehive, like knowing if the queen is laying, assessing if the temperature is comfortable, and if the level of humidity is at required levels." Umanah believes it is time to digitize beekeeping: "We empower African beekeepers to understand their bees better. Moving from calendar-based decisions to data-driven solutions helps optimize beekeeping operations and keep healthy bees."

African honeybees, which mainly live in the wild and are more aggressive than their European cousins, are not picky about which flowers they visit. Nigeria now exports bees to areas in Europe and North America, where native bees have been dying at alarming rates for the past ten years, worrying scientists, the public, and politicians.

US beekeepers reported losing about three of every 10 bees in the winters of 2006 and 2007. The global reduction in numbers is affecting people all over the world because it poses a risk to food security.

Among the causes of the decline are disease and poor nutrition, which are difficult to fix. Another culprit, chemicals, is uncertain and widely debated – but that hasn't stopped bee lovers from assigning blame. Some countries have even outlawed certain pesticides.

By bringing the dynamics of IoT to beekeeping BeeTeck hopes to solve bee problems globally through remote monitoring of the apiaries and identification of the presence of diseases, pest infestation, pesticide exposure, and toxicity. Umanah believes that continuous monitoring of such sensor data is crucial to maintaining a healthy bee population.

[honeyflowafrica.com](http://honeyflowafrica.com)

## Tallinn: Taxify

### A Unicorn Takes to the Road

Every start-up dreams of one day becoming a unicorn. Members of this elusive "species" are young tech companies which have achieved a valuation of more than a billion US dollars – often virtually overnight.

Bolt, which was originally called Taxify, was founded five years ago in the Estonian capital of Tallinn and it is busy chipping away at the dominance of Uber in the European ride-hailing

market. Markus Villig, Bolt's founder and CEO, believes that catching up to Uber is a realistic goal: "If you look at the transportation business, there's enough room to grow another 100 times from where we are today."

Using money borrowed from his parents, Villig's original plan was to build a service for his native Estonia, but this vision has expanded and the service is now present in over 25 coun-



**Markus Villig,**  
CEO of Taxify



tries, predominantly in Europe and Africa. In 2017, it entered the highly competitive London market, considered to be the biggest ride-hailing marketplace in the world. Bolt currently has more than 500,000 drivers with over 10 million users and, according to Villig, the company's ride volume grew tenfold last year.

Estonia has been home to several successful start-ups, notably Skype, the telecommunications platform that was acquired by Microsoft in 2011. Both Villig and his brother Martin worked for Skype before branching out on their own to found Taxify. In 2019, they changed the name because scooters and electric cars were becoming increasingly important for the firm. The company has attracted the attention of Daimler, the German carmaker that owns the Mercedes-Benz brand and which has recently become heavily invested in ride-hailing, carpooling, and vehicle sharing. Together with Taavet Hinrikus, founder of the billion-dollar Estonian fintech company Transferwise, Daimler provided \$175 million in new funding, which took Bolt into the unicorn bracket. "Taxify is an ideal addition to our existing portfolio of mobility services," says Joerg Lamparter, who leads the mobility division at Daimler Financial Services. The company will use its windfall to develop its technology further and expand its services in Europe and Asia, with plans to enter the US market under consideration. It has also partnered with the Chinese ride-sharing company Didi Chuxing Technology, sharing investment and technology. "I believe this partnership will contribute to cross-regional, smart transportation linkages between Asian, European, and African markets," Didi's founder and CEO Cheng Wei said at the announcement of the partnership.

[bolt.eu](http://bolt.eu)



## Bandung: eFishery IoT Goes Fishing

Fish farming promises lots of fresh protein at low cost but its environmental impact can be catastrophic due to the large amounts of waste generated by these factories.

Feeding typically accounts for 50 to 80 percent of a fish farm's overhead costs but, since feeding is a manual task, it's mostly unmeasured and inexact. This is bad for business and for the environment because overfeeding means much of the feed goes to waste and the marine environment surrounding the farm becomes polluted, causing the health of the fish to decline. On the other hand, underfeeding can gradually kill the fish.

Based in Indonesia, eFishery hopes to alleviate waste problems resulting from both over and underfeeding through its smart feeding device that bases the amount of food dispensed on fish behavior.

The automatic feeder makes it easier for farmers to monitor and schedule



**Gibran Huzaifah,**  
cofounder and CEO  
of eFishery

feeding times using a smartphone app. Using artificial intelligence, the eFishery app senses the fishes' overall appetite by monitoring their vibrations, which correlate with their level of hunger. The data can also predict how much fish the farmers can harvest and sell, allowing them to connect with buyers before arriving at market.

Gibran Huzaifah, eFishery's cofounder and CEO who once worked on a fish farm, claims his company's product can increase yields by up to 35 percent and double net profits by reducing wastage. "As the first 'fishtech' start-up in Indonesia which provides an IoT solution and data platform for fish and shrimp farming businesses, we are helping

hundreds of millions of farmers at the bottom of the pyramid, while at the same time taking on the global challenge of food security," he says. Fish farming is big in Asia, and especially Indonesia, which is one of the biggest seafood producers in the world with 9.45 million tons (8.6 million tonnes) of farmed seafood produced in 2012. Referring to Lake Toba in Indonesia, Huzaifah says, "The waste from aquaculture, including uneaten feed and antibiotics, is the biggest cause of water contamination, making up more than 60 percent of all pollutants."

The feeding system already dispenses pellet feed for carp, catfish, tilapia, snapper, and vannamei shrimp (king prawn) but more research and data will have to be gathered to calibrate eFishery to understand the behavior of other species.

To finance expansion, eFishery has raised a total of \$5.2 million in funding over five rounds, including a major investment by Teddy Rachmat, owner of the Triputra Group, one of the biggest privately held business groups in Indonesia.

[efishery.com](http://efishery.com)



## Amsterdam: Connecterra

# In Search of Smarter Cows

Bovine technology is nothing new, witness the milking machine, but Dutch software start-up Connecterra has its sights set much higher – on the "connected cow," no less.

According to founder and CEO Yasir Khokhar, it is important for farmers to know if their cattle are getting enough exercise. This kind of monitoring is currently achieved with a glorified pedometer, he says: a gadget, akin to the popular Fitbit wearable used by millions of joggers, attached to the cow's ankle which can tell the owner whether the animal is walking too little or too much. This, in

turn, tells the farmer a lot about the health of the animal and whether it is in heat and ready for insemination. Connecterra's sensor, called Ida, goes beyond this. It is a collar that allows farmers to monitor seven types of behavior to warn of problems ranging from each cow's movement to its feeding habits. It can also show which genetic lines are producing the most milk so that breeding can be optimized.

Khokhar, originally from Dubai, moved to work for Microsoft in the Netherlands, where he lived on a dairy farm and saw the need for



**Yasir Khokhar,**  
CEO of Connecterra

more advanced bovine technology. He founded Connecterra in 2000 and quickly caught the eye of Breed Reply, an IoT investment firm based in London. Khokhar maintains that the Ida app offers a fivefold return on investment for farmers and tells the story of a farmer who, with Ida's help, discovered that three cows in his herd were eating twice as much as the others but produced only half the milk. Needless to say, the three soon became beefburgers.

[connecterra.io](http://connecterra.io)

## Hamburg: Cargonexx

# One-Click Trucking

Established in late 2015, Cargonexx's goal is to reduce the running of empty trucks through a concept it calls "one-click trucking." The founders of Cargonexx view data intelligence as the future of transportation and its neural network is learning lessons from current and historic freight data. This will improve its accuracy and soon it will be able to predict and handle prices and transportation volumes, regional peaks, and unexpected shortages.

CEO Andreas Karanas has even bigger plans: "The spot market is only the first step... With our data intelligence we will be able to offer many new smart services to shippers, freight forwarders, and carriers."

The company already counts more than 60,000 trucks in its network, and shippers can order trucks for loading per mouse click. The technology predicts peak periods and automatically sends the trucks best suited for the job to where they are needed. This means fewer trucks on the roads: the



**Andreas Karanas,**  
CEO of Cargonexx



**Rolf-Dieter Lafrenz,**  
CEO of Cargonexx

shippers save money and the transporters earn more. Cargonexx was one of the four winners of the European Startup Prize for Mobility. The company has initially focused on Germany which, with its vast size, ac-

counts for approximately a quarter of the total European transportation market. Long-haul trucks often need to cross borders, so regional expansion is always a logical objective for any European transportation start-up. Several of Germany's neighbors, including Poland, Austria, and the Netherlands, are reportedly next in line for Cargonexx. Karanas is ambitious: "We are the first transportation company with an artificial intelligence technology in Europe and we are willing to extend this competitive advantage as fast as possible."

[cargonexx.com](http://cargonexx.com)





## Smart Factories

# VALUE FIRST

The smart factory offers an inexhaustible range of technical opportunities – but manufacturing companies cannot start using every possible technology all at once, and not every technology is suitable for every company. **The starting point should not be the technologies but the goals.**

■ By Antony Bourne

Creating a smart factory provides manufacturing companies with a cornucopia of technologies and associated opportunities. First and foremost, this includes the networking of machines, plant, and other equipment with IT systems using sensors and the Industrial Internet of Things (IIoT). This network en-

ables manufacturing companies, and others, to increase transparency in their workflows, in turn allowing them to make their processes more efficient and increasing their agility. For example, using a “digital twin,” built using IIoT data, allows a virtualized manufacturing workflow to be displayed digitally in real time and planned changes to processes can

be tested in the form of “what-if” scenarios. This enables manufacturing companies to optimize their basic workflows and to adapt to new orders coming in at the last minute, or to plans changing at short notice, in a much more flexible way. Networking also provides them with the chance to improve quality and security on the shop floor by using sen-

sors installed along the assembly lines to identify defects and faults by using physical or optical measurements. If companies also integrate sensors into their employees’ work clothing, they can monitor workers’ movements while they are handling hazardous materials or equipment, for instance, and sound the alarm immediately if an employee has not been active for a certain period of time. It also allows geo-fencing to be used to warn if a worker gets too close to a dangerous machine.

Finally, networking can open up additional revenue sources through new services or business models. “Track your order” services, for example, allow customers to follow the real-time progress of their order in the manufacturing process, giving manufacturing companies the chance to set themselves apart from the competition. The same is true for service-orientated business models in which the customer only pays for a machine when they actually use it, rather than purchasing the entire machine.

### Lots to Offer

The smart factory also has an abundance of other technologies to offer alongside the networking of IT systems and manufacturing equipment. These include:

- 3D printers and additive manufacturing machinery: These allow prototypes to be manufactured at a lower cost and replacement parts to be produced faster.
- Augmented reality: Employees can use smart glasses to superimpose the information they need for their work directly on a machine. This way, they can be guided efficiently through their work and become more productive because they have both hands free. Company experts are also able to connect to the smart glasses remotely so they can guide less-experienced colleagues through operational or maintenance tasks.
- Artificial intelligence: Chatbots that are proficient in natural language processing enable users to speak to



Smart factories shouldn't start with the technology but with how a company wants to give value to its business.

**Antony Bourne** is industries president at business software provider IFS.

IT control systems, making communication more efficient. Machine-learning algorithms that learn from IIoT historical data make predictive maintenance highly efficient. This includes anticipating mechanical faults or failures before they occur and lead to real problems.

- Physical robots: For example, robots can transport materials or parts to the manufacturing lines, pick up the finished products at the end of the line, and take them to the warehouse.
- Software robots: Robotic process automation (RPA) can assist in many upstream and downstream processes. This enables production

steps to be automated for inventory control, receipt of goods, or invoice verification, for example.

### All About Business

It is, of course, impossible for manufacturing companies to introduce all of these technologies at once – and not every technology is suitable for every company. In any case, the transformation into a smart factory should not start with the technology but should begin with how a company wants to benefit and give value to its business. Companies should always define the goals they want to achieve with the transformation before changing anything. Aims could include decreasing costs; increasing efficiency, agility, or security; or becoming more competitive by introducing new services and new business models.

Only after careful planning will they be in a position to select the right technologies to support the desired goals and implement those that promise to deliver the largest or fastest return on investment. When it comes to implementing these technologies, the best advice is to start small to begin with and make sure the technologies do actually benefit business in a manageable context. Afterwards, they can then be gradually rolled out across the entire factory.

**Smart factory** features include the networking of people, machines, and IT systems.



# THE NEXT STEP AI AND IOT GO HAND IN HAND



In the past, IoT was focused mainly on getting things connected through sensor networks that were capable of collecting huge amounts of data – but the bigger questions remain: What should we do with all this data? How can we use and monetize it? Increasingly, artificial intelligence (AI) and machine learning (ML) are becoming the enablers for completely new use cases; ones that are making a ton of difference in all kinds of markets. As we move forward, smart business models will need to bring together very different technologies from very different angles. Together, AI and IoT are only now beginning to show their true potential.

When it comes to AI, most people think about image processing, machine vision, and video surveillance applications. Other uses include object detection and face recognition, and, as everyone knows, AI will be the key technology as autonomous vehicles take to the roads. This is only the tip of the iceberg; AI and ML will take us so much further.

In Industry 4.0 applications, the health of a motor, an electric drive, or a robot determines the reliability of the processes and helps meet productivity targets. The raw data for monitoring the condition of a device is delivered by vibration analysis, infrared imaging, or ultrasound detection. This data, processed with the right machine learning models and algorithms, is the cornerstone of predictive maintenance. Maintenance costs can be reduced by up to 40 percent and extended machine lifetimes will add another three to five percent in savings. The next logical step will be to create new business models based on smart services.

In our homes, the impact of AI and ML-enabled solutions will be even more significant. They will not be limited to condition monitoring and maintenance of things like water pumps, washing machines, refrigerators, or air conditioners, just to name a few. New

services based on predictive maintenance will allow us to repair or to replace devices before we even notice something is about to go wrong. The days aren't far away when we will see people talking to their washing machines, ovens, or microwaves just like they would talk to another human being. The cost of voice control is falling all the time because of advances in hardware – but much more because of improved and widespread AI/ML algorithms. This will dramatically change our relationships with our home appliances and personal devices.



**AI and IoT are only now beginning to prove their true potential.**

**Marco Giegerich**  
is director for vertical markets and third-party management EMEA at Avnet Silica

No doubt, when it comes to AI and IoT, the opportunities are tremendous but many questions remain: How do I find the best AI/ML model or algorithm for my project? What are the right technologies to use to collect all data? How can I protect my data? What processing power is required and should it be edge or cloud based? What infrastructure and platform should I use? Developing such complex solutions will require orchestrating technologies and expertise from many disciplines. Hardware, software, and IoT platforms will need to work seamlessly together.

To address these requirements and simplify things, Avnet Silica offers turnkey and system solutions for applications, like condition monitoring, predictive maintenance, and AI-accelerated cameras, or platforms addressing end node to cloud applications and more. End-to-end solutions like these, designed for specific use cases and vertical markets, can be deployed relatively simply – and we support the entire ecosystem together with our network of internal and external partners.

The next level of applications in the Internet of Things will be enabled by artificial intelligence and machine learning. The combination brings new, exciting opportunities, and both are key drivers to accelerate innovation. The goal? AI-accelerated IoT.



**WHY  
CONNECTING TO THE  
INTERNET OF THINGS  
SHOULD TOP YOUR  
PROJECT LIST**



## YOUR THINGS HAVE A STORY TO TELL - ARE YOU LISTENING?

THE INTERNET OF THINGS (IOT) IS MADE UP OF BILLIONS OF SMART DEVICES, LIKE SENSORS AND CAMERAS AND CONTROLLERS, ALL USING WIRELESS TECHNOLOGY TO COMMUNICATE WITH US AND WITH EACH OTHER

Currently, there are around 15 billion devices in the IoT, with 5.5 million new ones connecting each day. And the insights gleaned from the data provided by all those connections is rapidly reshaping the world we live in.

From self-monitoring restrooms to self-adjusting HVAC systems, the IoT is empowering new capabilities and opening up new possibilities.

Whether you're looking to cost-effectively automate an existing structure, or build a smart new one from the ground up, the IoT empowers you to monitor, manage, and maintain all aspects of your building that impact operations, energy, and comfort.

[intel.com/iot](https://www.intel.com/iot)

## Sensors

# SMARTER THAN EVER

Sensors are the eyes and ears of IoT and **the latest generation can see, hear, and feel more than ever before**, allowing developers to pack in new features by the truckload.

■ By Bernd Schöne

**S**ensors are everywhere, doing their jobs silently, efficiently, and without complaint. They can take temperatures, determine levels of dampness or luminance, sense speed and movement, calibrate compression and vibration, ascertain acidity, sense stress and strain, and triangulate their own position to a millionth of an inch. Some can even diagnose diseases.

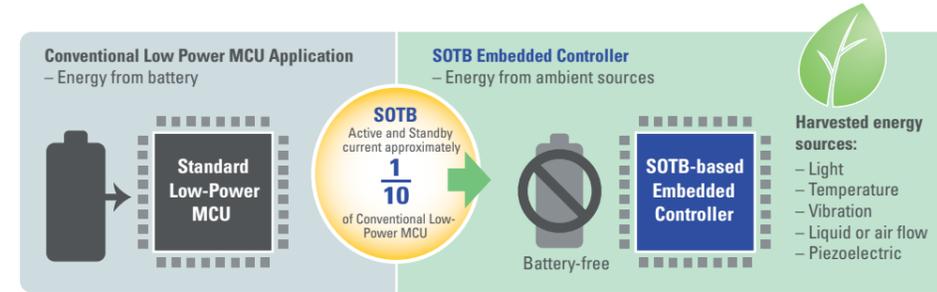
There's a quiet revolution going on in sensor development, with a new generation of components set to enter the market to expand the scope and range of sensing and open a plethora of new possibilities for developers and enterprises.

As sensors shrink, so does the amount of power required to run them – even to the extent of doing away with power packs altogether. At times, the latest units appear to make the inventor's dream of a perpetual motion machine come true. By reaping energy from the surrounding environment, these "no-power" chips can store their harvest in tiny condensers or accumulators – no more clunky batteries that need replacement; no more cable spaghetti. After all, how would you hook up a smart sneaker or wearable computer to the nearest socket?

The best news is that sensors are getting cheaper every day. Goldman Sachs and BI Intelligence say the cost of IoT sensors decreased between 2004 and 2014 by more than half, from \$1.30 to \$0.60, and prices are expected to shrink another 37 percent, to \$0.38, by 2020.

One reason for the change is that more IoT sensor companies are entering the market. As of 2017, there were nearly 3,000 IoT companies in North America alone and each year the number of businesses offering IoT technologies and platforms increases. As competition grows, sensor companies are offering more innovative types of sensors and looking for ways to decrease the cost.

Another important trend is towards chip integration. Sensors and the electronics needed to analyze results and turn measurements into



instructions can now be packed into a single sliver of silicon – and sensors are getting even smarter. Given enough computing power, they will become AI-enabled and pass on only data that is relevant to the task at hand, thus substantially lowering the network load and speeding up processes. Built-in coprocessors can perform powerful encryption on the fly, so that sensitive information can be transmitted from remote locations without worrying about hackers helping themselves.

Sensors under development can reconfigure and recalibrate themselves without the need for human intervention. Tomorrow's crop will be able to teach themselves new tasks and learn from experience. Pattern recognition and predictive analysis are already within the realm of some sensor's capabilities. Some devices can detect trends in processing requirements and adapt to them autonomously, storing results in memory elements that retain them even when the sensor has been inactive for a while.

It has been estimated that manufacturing companies worldwide will spend \$500 bn a year on IIoT technology, with the total value generated reaching \$15 tn per year by 2030. Add to that the increase in productivity with sensors that can predict, for instance, when a machine will fail, or track shipments of goods in real

time. No wonder experts estimate the productivity gain due to IIoT over the next couple of years in manufacturing alone at more than 30 percent. And all it takes is some really smart sensors.

### Renesas Cuts the Power

At Electronica 2018 in Munich, Japanese semiconductor specialist Renesas introduced its R7F0E embedded controller for energy-harvesting applications. This state-of-the-art chip operates at a power rating of 20  $\mu$ A per MHz of clock speed in active mode, and a mere 150 nA in deep standby. That is approximately a tenth of the power consumption of conventional low-power microcontroller units (MCUs).

To achieve this dramatic reduction Renesas employed a technology known as SOTB (silicon-on-thin-buried-oxide) which uses an extremely thin oxide layer to reduce electric loss. The new processor has enough computing power to run embedded artificial intelligence (eAI) applications, for instance to analyze medical data.

### Bosch Feels the Need for Speed

The BMA400 is billed by Bosch as "the first ultra-low power acceleration sensor without compromising on performance." It is capable of measuring speed and acceleration in



### Getting Thinner and Thinner

To further reduce power consumption, Renesas uses a technology called SOTB (silicon-on-thin-buried-oxide) which operates with an extremely thin oxide layer to reduce electric loss.



### Detecting Human Presence

AKM's new sensor can turn lights, air conditioners, and fans on and off every time a person enters or leaves the room.

### AKM Asks if Anybody's Home

Asahi Kasei Microdevices (AKM) has introduced what it calls "the world's smallest class ultra-low power infrared sensor IC with an integrated Human Approach Detection algorithm." According to the manufacturer, the AK9754 consumes less power, when compared to existing systems that need external signal processing, because of a built-in algorithm that makes it suitable for battery-powered applications. The AK9754 has a detection range of up to 1 m and does not need a lens. Typical uses include the automatic switching on and off of lights when a person enters or leaves a room, as well as control of air-conditioning and ventilation systems.

### No More False Alarms

Bosch's BMA400 power acceleration sensor can distinguish between real alarm situations like broken glass and false signals from random vibrations.

### TDK-Micronas Attracts Carmakers

Sensors for magnetic fields not only call for very precise measurement, they must also be immune to stray fields. Whether designing a new joystick or the driving wheel of a new vehicle, multidimensional magnetic-field measurement is essential. With its latest 3D HAL pixel cell technology, TDK-Micronas has introduced a line of sensors especially suited for use in electric vehicles where, for cost reasons, increasingly miniaturized magnets are being used, leading to increased sensitivity to magnetic interference. The company says the new sensors are suitable for use in valves and actuators, selectors and gear shifters, for the detection of pedal position, steering angle, or chassis position.



### TDK Gets Rid of Interference

TDK's new HAL sensor is especially suited for electric vehicles where miniature magnets are in widespread use.

fruit or cereal crops with the near-infrared LED (NIRED) installed on a smartphone or tablet running spectroscopy software produces reliable information about the sugar, water, and fat content. The SFH 4736 makes use of the absorption behavior of certain molecular compounds. It irradiates a sample with a defined spectrum of light and the spectrometer measures the wavelength distribution of the reflected light. These measurements indicate the existence and quantity of certain characteristics, allowing the farmer in the field or the vineyard owner at the vine to take samples and easily monitor the progress of their crops in real time so they can plan the ideal time to bring in the harvest.

### Running Cool

More than 80 percent of bearing failures in industries like mining and

manufacturing are attributable to inadequate lubrication. The ABB Ability Smart Sensor converts traditional motors, pumps, and mounted bearings into smart, wirelessly connected devices. It measures key parameters from the surface of the equipment which can be used to gain meaningful information on condition and performance, enabling managers to identify inefficiencies within their systems and to reduce risks. The sensor allows maintenance to be planned according to actual needs rather than based on generic schedules, ABB claims. This can extend the lifetime of equipment, cut maintenance costs, and reduce or prevent unplanned downtime due to breakdowns. The sensor attaches to the bearing housing and sends its data to a smartphone or other Bluetooth device, allowing data to be gathered from remote or hazardous locations as well as locally.

### Lubrication is Key

ABB's new smart sensors measure the conditions of bearing during operation and report back via smartphone app, resulting in less downtime and cost.



### Time to Bring in the Harvest

Farmers can pick the right time to gather their crops thanks to Osram's new opto-semiconductors for smartphones.



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# SMART PRODUCTS

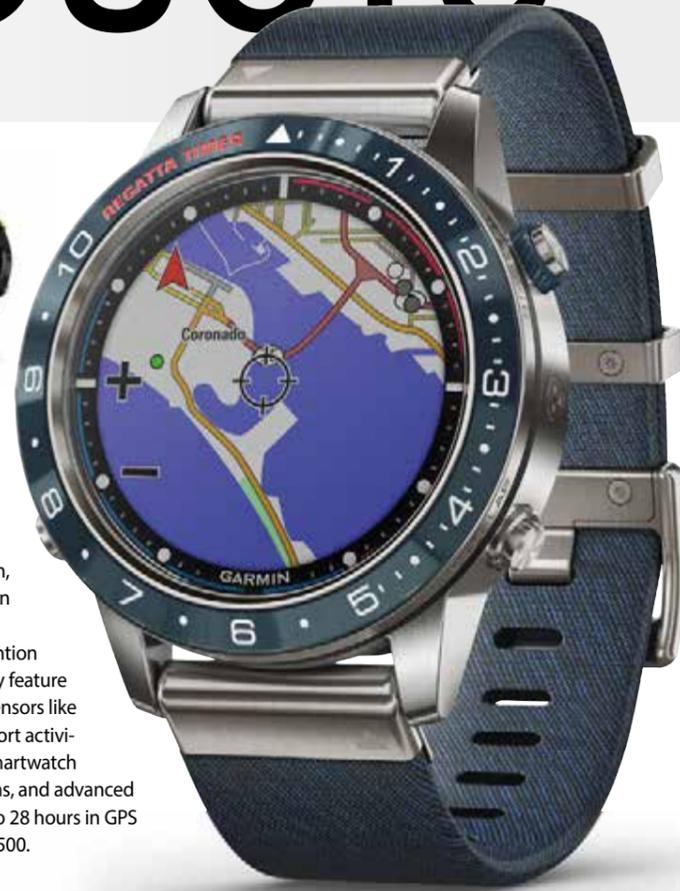


Garmin

## Introducing the Really Smart Watch

In celebration of its 30th anniversary, Garmin has released the MARQ Collection – a series of connected tool watches of traditional watch manufacturing quality. The five models are named Aviator, Driver, Captain, Expedition, and Athlete. They have special designs and features for people with a passion for flying, racing, sailing, exploring, and sports performance.

The MARQ smartwatches with their titanium cases were designed with attention to quality to help guarantee performance in demanding environments. They feature an always-on, sunlight-readable display, performance GPS, and advanced sensors like wrist-based heart rate and wrist-based Pulse Ox to track a wide variety of sport activities like running, cycling, swimming, and skiing. It also provides premium smartwatch functionality including built-in music storage, Garmin Pay, smart notifications, and advanced activity tracking. The battery life ranges from 12 days in smartwatch mode to 28 hours in GPS mode and up to 48 hours in UltraTrac mode. Prices range from €1,500 to €2,500.



MyoSwiss

## Getting Stronger and Stronger

Swiss start-up MyoSwiss – a spin-off from ETH Zurich – is close to finishing the development of the MyoSUIT: a wearable robotic garment suit that combines robotic and functional textiles. When people have difficulties moving due to genetic disorders, neurological conditions, injury, or just aging, the lack of movement can further increase their impairment – leading to even less movement. The MyoSUIT is intended to address this.

It can be used as a training device in rehabilitation clinics and physiotherapy studios to train people with mobility impairment undergoing gait-endurance and strength training. The lightweight device provides strength and stability like an extra layer of muscle. The company is currently testing prototypes with patients in clinics in Switzerland and France. The final product is expected to be launched in the second half of 2019.



Faurecia

## Cockpits Move Ahead

Connected vehicles, autonomous driving, ride sharing, and electrification are radically changing the driving experience. At this year's CES, French automotive supplier Faurecia showcased how the onboard intelligence and integrated design of the cockpit of the future will provide a more versatile, connected, and predictive environment. The Cockpit Intelligence Platform (CIP), which was developed in partnership with Accenture, is an electronics system that manages all the interior functions of the cockpit for intuitive interaction between occupants and the vehicle. With the help of artificial intelligence, the CIP learns from information collected from cameras and sensors to predict and personalize the onboard experience. It can recognize the driver and adjust seating and lighting preferences and create individual sound bubbles, simplifying interactions via voice, gesture, or touch. The CIP is built on an open source Android platform to support the development and integration of new apps and services. The morphing instrument panel is an extended full HD automotive-grade display developed in partnership with Japan Display Inc. When switched from driving to autonomous mode, the instrument panel surface smoothly adapts its shape and the display moves out from the instrument panel, creating a large central display surface that may also be used as an entertainment screen. Touch-sensitive controls are integrated into different surfaces of the vehicle to make it easier and more ergonomic to manage interior functions when in different traveling positions. An active safety management system was developed together with safety partner ZF. It links seat structures, safety components, and electronics. Via occupant monitoring and situational analysis the optimal safe seating position can be implemented in any situation, including an automatic emergency action returning seats to the safest position in the event of a crash situation.

Lifx

## Smart and Sustainable Light

The LIFX A60 LED light can transform living areas with vibrant colors and automation. Users can set moods for movie nights or dinner parties, taking homes from bold colors to cool pastels at the tap of a button. The connected home device allows users to create on/off schedules that automate lighting to suit various situations. Bulbs can be connected to Google Home, Apple HomeKit, or Amazon Alexa and then controlled by voice control. Unlike competitor products, the A60 doesn't require an external hub – it can be used without integration into an ecosystem. To get started with the smart bulb, it is simply connected to an existing Wi-Fi. The LIFX A60 LED light delivers over 1,100 lumens from 11 watts – that is sufficient to light an entire room, while using less energy than a standard incandescent lightbulb. The manufacturer promises a life span of 22.8 years.



Insta360

## Just Like Being There

As VR sets like the Oculus Go become more popular, you may want to create panoramic content for them yourself. With the new camera from Insta360 this is quite easy – and the camera allows shooting in two different formats. When the cubic housing is folded, the camera takes spherical HD videos or photos covering a full 360-degree view. When opened up, the two lenses shoot in the same direction, providing stereoscopic 3D footage. Watched with a VR headset, the impression is stunning – you get the impression of actually being where the photo or video was shot. The camera is available from the online shop at [insta360.com](http://insta360.com) at a price of €470.



Smart Friends

## German Partnership for Smart Home Products

Smart loudspeakers and voice command systems, like Amazon Alexa or Google Home, drive the growth of smart homes. But the systems do not always integrate too well with smart home products from other manufacturers. ABUS, Paulmann, Schellenberg and STEINEL – all influential brands in the German do-it-yourself market – have expanded their shared smart home system "Smart Friends" to be controlled via Alexa Voice control or Google Home. An app that includes the Alexa-Skill "SmartFriends" expands the Amazon Echo voice command system. Devices and scenes can then be controlled by voice right away. The original automated smart home processes continue to work as normal. The Smart Friends device places particular importance on a very high safety standard via an additional firewall between the personal smart home system and the voice command system. For safety reasons, All data are saved locally on the Smart Friends Box and not in the cloud. Among the devices that may be controlled are lights, sun shields, roller shutters, locks, sirens, motion detectors and heating systems.





**Withings**  
**Cardiovascular Monitor**

Withings announced BPM Core as “the world’s most sophisticated and wide-ranging in-home cardiovascular monitor.” It can measure blood pressure, take electrocardiograms (ECG), and listen to the heart via a digital stethoscope. The provided medical data was previously only available in a clinical setting. The ECG data can be used to identify atrial fibrillation (AFib), a serious form of irregular heart rhythm that can lead to heart failure, fatigue, and shortness of breath and is a major risk for stroke. Clinical studies found that people with high blood pressure are also at risk from both valvular damage and AFib. As symptoms are not continuous and may be missed if they do not occur during infrequent visits to the doctor, the ability to monitor all three conditions in one device is a game changer. BPM Core looks like a traditional arm cuff – but it is packed full of advanced medical sensors. Users just place the cuff on the upper arm and push the button. Within 90 seconds, it will perform measurements of blood pressure, electrocardiogram, and valvular health. The information is then recorded within the accompanying Health Mate app, which is available for iOS and Android. All data – including actual audio recordings of the heart – can be shared with the user’s medical and caregiving team. The product will be available in late spring 2019 at a price of €250.

**August Home**

**A Smart Way to Unlock Airbnb**



The whole reservation process and the payment for Airbnb accommodation is done online – but to access the rented apartment, you still need to pick up a key. August Home Inc., provider of smart, secure front door solutions, has come up with a smart solution. When a reservation is made for a property equipped with an August Smart Lock and August Smart Keypad, the software will automatically generate a custom personal entry code for the specific dates and times of the reservation. Hosts do not need to make copies of physical keys and coordinate meeting times to hand over and retrieve them, or provide guests with instructions on how to access the physical keys in a remote lockbox. Hosts can choose to use a custom PIN code that is automatically generated when an Airbnb reservation is made, give mobile phone access via the August app, or provide both of these options. Guests who reserve a property equipped with August products will receive an e-mail with all necessary information on how to open the apartment – reservation changes or cancellations automatically change the access times and days. When the reservation ends, access to the property automatically ends.

**Tompkins Robotics**

**Sorting and Transporting**

Distribution and order fulfillment are becoming ever more complex for retailers as they adapt to the realities of unichannel customer demands with high flexibility and throughput. Tompkins t-Sort is a robotic material handling system for unit and parcel sorting. The automated sortation system consists of robots that can head for the nearest waypoint autonomously. Robots, chutes, and induction stations can be added modularly

without interrupting operations. Robots can also be added for peak seasons and taken out of service when demand is low. Standard payloads are up to 30 kg, but this can be increased to 55 kg. t-Sort Plus moves in any direction and can be easily programmed to meet large item or parcel sorting needs. The robots run up to four hours on a five to eight minute charge, recharging automatically when needed.



**Nuraphone**

**A Headphone That Adapts to the Listener**



The hearing experience of each person is different. But conventional headphones deliver the same sound to every listener. Nuraphone – a group of music-loving scientists, engineers, and creatives based in Melbourne, Australia – has a different approach: at the core of their innovative product is a self-learning engine that automatically measures the hearing of the wearer by monitoring otoacoustic emissions. There is no need to take a “can you hear this?” test. Nuraphones use this information to adapt the sound of the headphones to perfectly match the wearer’s hearing and bring music into sharp focus. The setup takes only about a minute with the use of a companion app that is available for iOS and Android. Up to three personalized profiles are stored on the headset, delivering perfect sound from different sources like smartphones, computers, home stereos, or airplane seats. The headphones can be bought at a price of €399 from www.nuraphone.com.

**Sunflower Labs**

**A Drone for Home Security**

Houses with large gardens in remote areas are vulnerable to housebreaking. A start-up company with offices in Birmensdorf, Switzerland, and San Francisco is working on an innovative security solution for up to 6 acres of land. Apart from an intelligent system it consists of three components: sensors integrated in garden lamps that the company calls sunflowers, an autonomous drone that will fly over the property and take photos when alerted, which they call the bee, and a docking station for the drone called the hive. Unlike common motion-activated lights that work with only one or two motion sensors, the sunflowers contain over 20 sensors that can detect motion and vibration. They share information with one another, comparing notes to reduce false alarms. They learn a property’s daily activities and use information from other smart home devices to make the best alert decisions possible. When something alarming happens on a property, the system initiates the bee to take the fastest and safest route and find the optimal angle to capture the scene – making sure that the camera does not capture areas beyond the property. The bee then returns to its hive and lands safely within it – conductive charging rings quickly recharge the batteries to full capacity. The company has not yet announced when the system will enter the market and what the price will be.



**Audi**

**Speed Tips Help Minimize Stops**

Audi of America have announced an expansion of Traffic Light Information to include Green Light Optimized Speed Advisory (GLOSA). In 2016 they launched Traffic Light Information in collaboration with Traffic Technology Services. It enables cars to communicate with the infrastructure in certain cities and metropolitan areas across the U.S. – more than 4,700 intersections support the system. Now Audi introduces GLOSA as an industry first in vehicle-to-infrastructure (V2I) technology. GLOSA can provide speed recommendations to drivers of select 2017 and newer models to help catch the “green wave.” To do so, GLOSA uses traffic signal information and the current position of a vehicle. A speed recommendation intended to allow drivers to pass traffic lights during a green interval is displayed. If the driver follows the recommendation, the number of stops at red lights will be reduced. The distance to stop, the speed limit profile for the area, and the signal timing plans are all used to calculate the speed recommendation displayed to the driver. “Audi is committed to moving America in many ways, including through the development of industry-leading connectivity and mobility solutions,” said Mark Del Rosso, president, Audi of America. Future iterations of V2I technology could include integration with the vehicle’s start/stop function, optimized navigation routing, and other predictive services. All of these services are designed to help reduce congestion and enhance mobility on crowded roadways.

**Logitech**

**Focus on Business Headsets**

Open offices are great for collaboration – but it is not always easy to stay focused when working there. The Logitech Zone Wireless (€220) and Zone Wireless Plus (€300) headsets are designed to maximize communication, collaboration, and concentration in open office environments. They feature active noise cancellation to block out distractions. At the same time they deliver superior audio for calls or music and convenient Qi wireless charging capabilities. Logitech Zone Wireless is a mobile-first headset that’s comfortable enough to wear for hours. You can manage conference calls, customize the sound equalizer, and turn the active noise cancellation off and on through a smartphone app or the buttons on the headset. Both models offer Bluetooth connectivity; the Plus model also supports the Logitech Unifying plus Audio Receiver – a small USB receiver that can connect up to six Logitech products.



**IKEA and Sonos**

**Smart Sound and Light**



At Milan Design Week Ikea and Sonos presented the first products in their soon-to-launch collaborative range, by the name of SYMFONISK. The companies revealed the first prototypes to feature in the range: a connected speaker that can also be used as a bookshelf and enables a multifunctional usage in the home at a price of about €100. The other speaker resembles a HomePod with an integrated lampshade and will cost about €180. Both products will be available this summer at Ikea. “Together with Sonos we wanted to combine our home furnishing knowledge with their expertise in creating great sound experiences for every room of the home, and in Milan we want you to experience the real difference that sound and light makes in your life,” said Björn Block, Business Leader for Ikea Home Smart at Ikea of Sweden.



# BUSINESS AS USUAL IS OVER

**H**umanity will change more in the next 20 years than it did in the previous 300 years.

Yes, that's a big call and some people may snicker at the sheer audacity of the statement. "You're grandstanding!" they will say, "That's unbelievable!" While I agree it sounds dramatic, I nevertheless stand by it. If anything, it's an understatement when you consider the impact of exponential and combinatorial technological change.

When AI (artificial intelligence) meets HI (human intelligence), business as usual is dead.

The effects of the changes we're witnessing surpass pivotal historical moments, such as the industrial revolution or the invention of the printing press. Technology will no longer remain outside us but will, and is, relocating inside us in the form of wearables, brain-computer interfaces (BCIs), nanotechnology, and human genome editing. What we are experiencing is a shift in the very definition of what it means to be human.

Before, technological revolutions involved the material world around us. Now that infotech and biotech are converging and technology starts becoming part of us, the changes will be unlike anything humankind has ever seen before.

What worries me about the transhumanism debate is the default assumption by most protagonists that humanity has reached its limits and that to advance further will require some kind of technological upgrade. This is not something we should take lightly. Technological progress is clearly not something that we can reverse by stuffing it back into the box. Technology is growing exponentially and, while this will likely have some very positive effects on humanity (such as ending diseases and providing all the energy we'll ever need), we risk changing what it means to be human.

We need to embrace technology and harness its positive powers without ourselves becoming part of our technology. Human genome editing promises to treat cancer or even prevent it altogether, but this very same technology could enable us to program our babies or create hybrid human-machine beings.

Consider machine translation. Tools like this make life easier, no doubt, but that doesn't mean we should stop teaching our kids language skills in school. Direct and unmediated human interaction – in other words: F2F communication – is a precious element of humanity. Automating human interactions to such a degree that we can no longer function without an Internet connection would be a monumental mistake.



**We need to embrace technology without becoming part of our technology.**

**Gerd Leonhard**

is the founder of TFA The Futures Agency and author of the bestseller *Technology vs Humanity*. He is based in Zurich.

What will separate man and machine in the future? Our brains may one day seamlessly connect to the Internet via BCIs but if we go too far mankind will eventually cease to function without it. Who gets to decide how far is too far?

If this continues, technology will no longer be a means to an end, but an end in itself; no longer a servant but a ruler. Facebook used to be a great tool for finding and connecting to friends but now it has become a gigantic data-mining operation powered by AI – a global media empire that generates billions of dollars in advertising. Our so-called tools have developed minds of their own. They vie for our time and attention, following their own agendas which are becoming more and more self-evident as entire platforms are bought out and floated on the stock exchange.

I believe we must strengthen those human elements that technology will, but should never, replace; things like instinct, creativity, empathy, intuition, and imagination (attributes I like to describe as "androrithms").

Digitization and automation offer a giant boost in efficiency – which may be heaven for large enterprises but can also be hell for their employees. As a rule, datafication, automation, cognification, and virtualization (what I call the "megashifts") help to slash costs dramatically, but, on the other hand, they lead to new security and safety risks – especially in IoT – and they impact our privacy and human agency in a huge way. Technology may be morally neutral until we apply it, as William Gibson famously said – but we are applying it everywhere now.

Of course, the digital future will require massive regulation and oversight but will politicians be qualified to make the right choices for us about when to regulate and when to leave well enough alone? Building the digital future so that it will be worth living in will require wisdom and foresight from governments around the world. Exponential technologies will redefine what it means to exist as a human being. Why not force every politician and public official to pass a "future-readiness test"; a sort of driving permit for the future?

Progress isn't something we need to be afraid of. In fact, I believe things will turn out much better than many of us fear. But without global governance and a healthy dose of digital ethics and humanity, there's no knowing where this unstoppable tech revolution will lead us.

I have long proposed the creation of a Global Digital Ethics Council (GDEC) that would provide guidance to governments and businesses alike. Societies, after all, may be driven by their technology – but they are defined by their humanity.



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