SMART INDUSTRY

The IoT Business Magazine

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WHY CONNECTING TO THE INTERNET OF THINGS SHOULD TOP YOUR PROJECT LIST

intel experience what's inside™

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.

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THE NEW ROBBER BARONS

Tim Cole

Tim Cole is the editor of Smart Industry – the IoT Business Magazine

What is the biggest obstacle in the way of transnational IoT? Borders, of course – or, more precisely, national borders.

This might seem counterintuitive at first. After all, data flows around the world all the time without ever stopping for a customs check. Isn't that what the original Internet was all about – packet switching and avoiding network bottlenecks?

I distinctly remember the story told in the early days of the Internet of how the US military ordered a communications system that would re-route information around the craters left by Russian atom bombs. Even if Washington was just a smoking ruin, the generals in their bunkers could still press the red button to unleash a counterattack.

A couple of weeks ago my wife and I travelled from our home in the Austrian Alps to Waldshut, a quaint little town in Germany on the banks of the Upper Rhine. The quickest way to get there was through Switzerland, so we crossed the border at Constance and drove for about an hour and then crossed back into Germany.

At some point I tried to make a call but my smartphone wouldn't work. Instead, up popped a text message from my Austrian provider saying I had run up data roaming charges of over €1,600 – and they would only unlock my phone after I'd paid my bill. It looks to me like the Austrian telephone company I use has taken a correspondence course run by the Italian Cosa Nostra – who are also very good at holding people and property hostage for a huge ransom. But that isn't the point here.

I had, in fact, just recently signed up for a tariff called Europa Roaming by which I was supposed to be charged my local rate no matter where I used my smartphone in Europe. "Sorry, but Switzerland isn't part of the European Union," the guy from customer services informed me. That meant I was still going to be charged a ludicrously high roaming rate that only applies in Switzerland.

And to make matters worse, I was using Google Maps as a navigation aid. Google, it seems, keeps checking with the server every 30 seconds or so to determine the phone's new position. Every time a new connection was established, a charge for 1GB of data was added – even though only a tiny amount of data actually passed across the net. Turns out this is perfectly legal according to the complex codex of the phone industry. If only I'd read the fine print of my contract beforehand.

Which brings me, in a roundabout way, to IoT in general and autonomous vehicles in particular – the topic of our title story in this edition.

What will happen when self-driving cars start to cross borders, possibly into Switzerland? These cars will be connected to the Internet at all times via wireless GSM, LTE, or their future successors 5G and 6G. Imagine the roaming bill!

Presumably, many owners will be forced to sell their cars when they come home to be able to pay off their providers. Maybe autonomous vehicles will be banned from travelling to Switzerland – or carmakers will program them to stop and turn around at the border. Want to visit Italy? Better plan on going via France or Austria. Okay, it takes longer and the extra gas (or electricity) is expensive – but it would still be a grand bargain compared with letting your car take the direct route through the Land of the Gnomes.

Roaming charges have been the bane of Europe for many years. We all thought that the problem had been solved when the EU banned rip-off roaming charges within its territory back in the summer of 2017. Unfortunately, they're still around – and nobody really knows what kinds of mischief the telecoms providers will play as IoT systems are increasingly located in border regions. People in Austria living close to the border constantly complain about their mobile phones logging into the Swiss network by mistake, leading to horrendous charges.

Governments and regulators need to rein in the providers, the modern-day robber barons, and open the way to a truly transnational Internet of Things.

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Autonomous cars, trucks, and taxis are arriving much faster than anyone expected but are we ready for them? What roads will they drive on? And what happens if a self-driving car is forced to make a snap life-or-death decision?

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An IoT snapshot of Europe

The Internet of Things is reshaping the world. Just how well is Europe prepared and which countries are best positioned to reap the benefits?

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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.

David Politis of BetterCloud

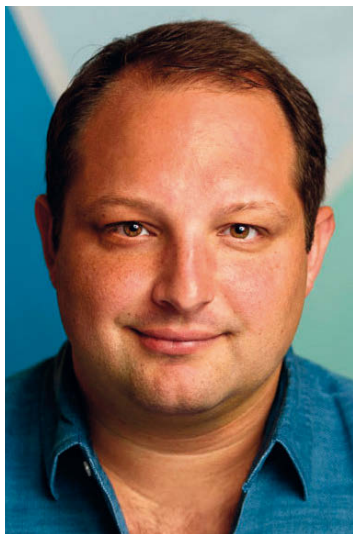
Building a better cloud

How do you build a better cloud? That question has nagged David Politis, founder and CEO of BetterCloud, ever since he first grasped the concept of distributed computing. In the early years of this century, buzzwords like SaaS (software as a service) had been around for some time but the concept was struggling, essentially because businesspeople didn't trust it.

"The rise of the SaaS-powered workplace is transforming the role of IT," Politis said in a statement. "What was once a behind-the-scenes department is now becoming deeply integrated into the business. But the explosion of SaaS offerings from thousands of providers brings a new and significant set of challenges for IT, including a lack of visibility across applications, manual processes that don't scale, and lack of awareness around operational risk.

"BetterCloud empowers IT with the solutions it needs to operate and scale today's SaaS-powered workplace."

> The rise of the SaaS-powered workplace is transforming the role of IT
>
> David Politis



His idea is to create software that lets IT departments manage employees' cloud-based applications at a glance. At first, BetterCloud focused only on Google's productivity suite. In 2015, Politis decided this was proving to be a cul-de-sac so he decided to start over again. The company laid off much of its customer-facing staff and spent $35m retooling over two years. Politis rebuilt the product so that it could manage any software used in business, from Salesforce to Slack, from Dropbox to Zendesk.

The resulting SaaS management platform now allows users to monitor any SaaS application connected to its dashboard via application user interfaces (APIs), thus enabling IT to monitor usage and user privileges and to create custom rules to automatically perform actions if specific conditions are met.

The idea caught on among investors such as Accel and Flybridge Capital Partners, who provided more than $47m in seed financing. The company has now turned the corner, Politis asserts, and in 2017 BetterCloud reported revenues of $21m.

Growing up in Salt Lake City, where he attended Brigham Young University, Politis is the son of an entrepreneur and this probably made it more or less inevitable he would become one, too. At least that's what he believes. "My dad had a lot of different businesses, including real estate development

in Harlem and the South Bronx, and project finance in emerging markets like West Africa.

"Because he was working and traveling so much, he often would take me with him. From the age of eight, I have memories of going to Harlem and going to building sites. He taught a real estate class at NYU [New York University], and he would take me to the class when I was nine years old, give me a pad of paper and say, 'Just take notes.'"

Simply creating an innovative product isn't enough, Politis maintains. "There are a number of things we do in terms of transparency that are crucial," he told *The New York Times* recently. "I share everything I can with the whole company. And, when we discuss it during company meetings, everyone can submit questions beforehand, anonymously, and I'll answer them. We also send monthly emails that explain what every department is working on that month, and what they achieved the month before."

People want to make a difference, he believes. "When you give them an area of the business that they can affect, the amount of stuff that gets done and the pride in their work is amazing. People make mistakes, but they learn from them and they continue to improve."

Giving people ownership of certain areas in the business is the key, he says: "It's amazing what happens when you do that."

Politis has also managed to convince some pretty heavy guns in the analyst community that he can improve the cloud. Influential analyst firm Gartner, in its first-ever market guide on Cloud Office Management Tools, wrote enthusiastically: "BetterCloud is the only vendor uniquely able to provide all functions, support multiple SaaS apps, and offer IT workflow automation for SaaS apps."

The future for BetterCloud, it seems, looks bright and sunny.

Ryan Petersen of Flexport

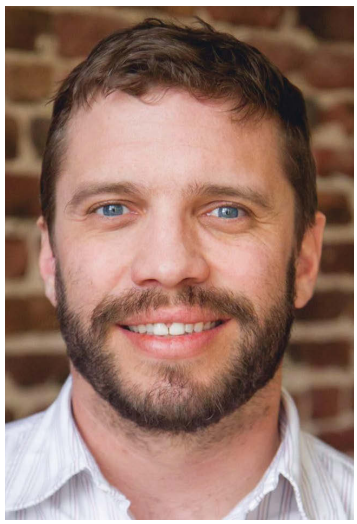
FedEx for freight

Package tracking has been around for years and generally involves small parcels, so keeping tabs on them with barcodes or wireless-emitting RFID chips is fairly straightforward. Global logistics companies have to do much more heavy lifting, and the systems in use today are, to say the least, slightly antiquated.

At least, that's what Ryan Petersen believes and it's the reason he founded his own company called Flexport. It all started in San Francisco back in 2013 with a deceivingly simple goal: "We want to do for freight shipping what FedEx does for small packages."

Five years later, Flexport has become a $9bn business and one of the fastest growing companies in the world of freight forwarding – but it still relies mainly on faxes and phone calls to co-ordinate its delivery chains. Petersen describes how the process works: "Freight forwarding involves lots of different companies. The freight leaves a factory in China, gets picked up by a trucking company, it's routed to a warehouse, loaded into a container where it gets combined with other

> Before we came along, there was no tracking. It was a relay race of paper document hand-offs
>
> **Ryan Petersen**



people's products. Another company transports it to the port, where it clears customs. Then it's put on a ship that's owned by yet another company and brought to the US where the whole thing happens again, with a customs clearance, a truck to the warehouse, and another truck to a customer. But often stuff gets delayed along the way. Twenty phone calls later you find out it isn't where you thought it was."

That was the problem he set out to solve. "Before we came along, there was no tracking. It was a relay race of paper document hand-offs."

His first step was to found a company that sold data about imports, which he called ImportGenius. In the USA, shipping manifests are a matter of public record. "We took all of the government data, organized it and sold subscriptions to our database for $200 a month," he recounts.

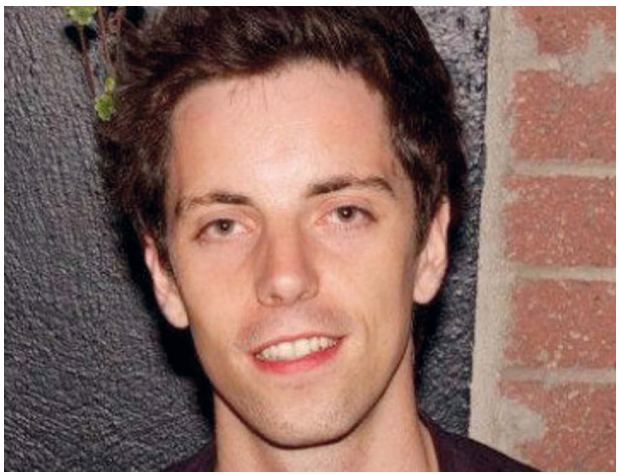
It was then Petersen had a legendary run-in with none other than Apple's boss Steve Jobs. It turned out that Apple's shipping records were also stored in the government database, and Petersen noticed the company was shipping something described in the manifesto as electric computers. "I decided that had to be some kind of a code name, I did some research. This was just before Apple launched the second iPhone."

Petersen wrote about it in his blog, and the news went viral. "There were more than 100 newspaper articles about it, and us," he recalls. ➔

Soon after, a US Customs employee rang up and told Petersen Steve Jobs had called – and Apple's CEO was not pleased. "In fact, he screamed at him," Petersen says. "Obviously, Jobs didn't understand how things worked."

Petersen subsequently decided to found Flexport, a company that would be based on all kinds of data available in the world of shipping. " In the future, we'll live in a world where machines talk to other machines," he believes. But the world that he entered still had people calling each other or sending faxes. Something had to change.

"We've been steadily chipping away at those processes," Petersen declares. With close to $100m in funding under his belt, Petersen now finds time to advise would-be entrepreneurs. He feels the most important tip is: "Don't wait for someone else's permission to do your business. First, make certain that other people see the same problem and will be willing to pay for your solution to it. Talk to users non-stop, and build things based on their feedback. Until you have product–market fit, any time spent doing anything that's either not talking to users or building something they want is wasted."



> The challenge is to turn a simple piece of hardware into a smart solution
>
> **Conall Lavery**

Conall Lavery of Wia

IoT is going places

Sensors are the eyes and ears of IoT but retrofitting existing legacy systems to handle them can be a nightmare, causing many IoT projects to falter or fail. What companies need is a simple toolbox for building Internet of Things solutions – at least, that was the idea that occurred to a young Ulsterman named Conall Lavery.

Almost three years later, Lavery's company Wia is well on its way with almost a million dollars in seed funding under its belt and ambitious plans to expand globally. Its mission: "We want to do for infrastructure what Stripe does for payments." Stripe is one of the hottest new players in the world of payment processing, and it's seriously challenging PayPal.

"When most people hear IoT, they think smart fridges, self-driving cars, and thermostats," Lavery explains. "These are just some examples of the wide range of devices that make up this ecosystem. The challenge is to turn a piece of hardware into a smart solution; you need a way to talk to each and every 'thing'.

"To do this, you need a platform," he continues. "The old way of doing things is to cram a bunch of developers into a room and get them to write hundreds of thousands of lines of code hoping that in a few months' time they have something that works. You just want to send a bit of data from there to here, keep the lights on, and make sure there are no unwanted visitors at home.

"We take away all that hard stuff. With our enterprise-grade platform, you can make anything smart within just a few minutes. We have everything you need to manage, capture, control, and integrate any type of device. You don't even need to know how to code," claims Lavery.

"At Wia, we're providing all the tools so customers can focus on the 'last mile'. So, whether it's a kid creating something in their bedroom or an enterprise customer building a million devices across the world, they can do it through our platform," Lavery adds.

And others, it seems, are listening: Wia won the Best Startup category at the Irish Internet Association awards ceremony in October and finished as a finalist in Lisbon at the 2016 Web Summit Spark of Genius competition, which was sponsored by ESB, the Irish electricity company. It was also tipped as "one to watch" in 2017 by Silicon Republic's Europe Startup 100, across fintech, IoT, SaaS, and data and many more fields.

Wia has attracted the attention of Suir Valley Ventures, Ireland's entrepreneur-led, venture capitalist fund run from Waterford by Barry Downes, founder of software startup FeedHenry, which was acquired in 2014 by Red Hat for €63.5m. Suir Valley focuses primarily on investments in high-growth, private software startups in the virtual reality (VR) and augmented reality (AR) spaces, with a secondary focus on fintech and IoT startups.

"Wia's end-to-end platform provides full device and application management, security, data capture and storage, analysis, control, as well as the seamless integration of enterprise systems. We are looking forward to working with Conall and his team to help them rapidly expand the Wia business with developers and enterprises internationally," says Downes.

Lavery, 28, comes from Dungannon in County Tyrone in Northern Ireland originally but has since moved south to Dublin. He studied advanced software design and AI at Queen's University in Belfast and has previously designed software solutions with Big Motive, Channel 4, BBC, Cambridge Silicon Radio, and Net-a-Porter. A few years ago, he even took a few months out to play piano in a bar in Manhattan!

Wia currently employs six people with plans to double its headcount over the coming months. The company operates out of a coworking space and is growing fast. "We intend to use the funding to grow the team out in Dublin and make a big move into the enterprise space," Lavery said.

At startup conferences or around his favorite Dublin pubs, Lavery likes to explain how young companies can be successful. "Go talk to as many people as possiblee," he says. "Gathering a good network is key to getting up and going and validating your idea." He also likes to go against the grain of conventional product development wisdom: "You don't need a product: that comes after you have some customers." And of course, "work, ➔

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work, work. Putting in the hours will increase your odds of success."
Following his own advice, he signals for a last round, then it's back to the office. This young man, it seems, is really going places.

Jérôme Pesenti of BenevolentAI

IBM's AI guru

IBM, like the residence in the Eagle's song *Hotel California*, is a place you can apparently never leave – or at least senior people seldom seem to do so. It came as a surprise therefore, in late 2016, when the world's leading artificial intelligence (AI) expert at IBM Jérôme Pesenti announced he was heading over to a British health-care company called BenevolentAI.
At IBM, Pesenti was the creator of, and lead vice-president for, IBM's Watson Platform – a set of cloud services that leverage natural language processing and machine learning, including the provision of cloud-based APIs, for the integration of AI technologies into third-party applications.
It was headline news. "IBM's AI guru leaps over to Brit biz," *The Register*, an online news site, registered in semi-shock – but market insiders weren't all that surprised. BenevolentAI had been quietly building itself a solid reputation for cutting-edge AI capabilities for quite some time. To hire someone with more than 16 years of thought leadership in the AI space made lots of sense.
At IBM, Pesenti also held the role of chief scientist for the company's core Big Data product portfolio. He joined IBM in 2012 when "Big Blue" bought Vivisimo, a search and text analytics company Pesenti had co-founded.
His new title is CEO of the company's technology division BenevolentTech, but he also sits on the main board of BenevolentAI, the group holding company.
BenevolentAI was spun out of the UK pharmaceutical firm Proximagen, a pioneer in molecule therapeutics, by its management team in 2013. At that point, Proximagen was owned by Upsher-Smith Laboratories, which became an early sponsor.
BenevolentAI describes its goal as being the harnessing of AI to enhance and accelerate scientific discovery by turning the world's highly fragmented scientific research data into fresh insights and usable knowledge that benefits society. Simply put, it aims to bring people and technology together to revolutionize the process of scientific innovation.
Data from patient databases and scientific papers is constantly expanding. For example, PubMed Central is a free, full-text archive of biomedical and life sciences journals' literature hosted by the National Library of Medicine, part of the US National Institutes of Health. It claims to upload 10,000 scientific papers every day but how reliable is all that information? Some might be true, some false, and some speculative. Sifting through this huge trove of data to find the nuggets of really useful information far exceeds human capacity so AI will have to do the job, Pesenti notes.
His task is to create systems capable of analyzing this data and forming connections through something he calls a Knowledge Graph, which allows researchers to observe patterns they may have missed. The data might show that a protein upregulates (or increases) a particular gene's enzyme output, he explains, and that could lead researchers to look for drugs in a totally different area.
Pesenti is as close as it comes to being a Renaissance man. He attended the Paris-Sorbonne University to study philosophy, moved on to University Pierre and Marie Curie to focus on cognitive science before completing his PhD in mathematics there.
After leaving Paris he served a brief stint in academia as visiting computer scientist at Carnegie Mellon, where he created Pittsburgh DataWorks as a local non-profit whose mission is to promote and provide access to Big Data education, projects, talent, and technologies and to help establish Pittsburgh as a leader in Big Data. Pesenti speaks fluent English, French, Italian, and Spanish.
Now at BenevolentAI, he admits to being excited about the chance "to create impactful AI technology which could bring enormous benefits to society," reports *The Register*.
Today, AI is already being used to find treatments for Parkinson's Disease and Alzheimer's Disease, and Pesenti's team at IBM worked closely with hospitals and research facilities in the US to develop personalized diagnostics for many kinds of cancer.
"Given Jérôme's incredible experience in the AI and deep learning space, we're delighted to have him on board," says Ken Mulvany, BenevolentAI's chairman. "Our ambition is to use our technology to accelerate all scientific discovery and apply AI to solve some of the world's biggest problems."
Pesenti is obviously delighted to be working for one of the most exciting companies operating in AI. Unlike critics of AI, such as Stephen Hawking, he is convinced technology will work for the benefit of mankind.
"Hawking conjures images of a world either taken over by Terminator's Skynet, or of a grand utopia where work has been abolished. The reality, however, is different," he believes. "AI is not going to take over the world as an autocratic malevolent machine presence anytime soon. It will, however, dramatically change our world.
"While the changes to our society won't be as spectacular or immediate as our imaginations get carried away with, they may end up being equally profound," he adds.
And he, for one, intends to continue to play a major role in shaping that AI future.

> AI will change our world dramatically in the future
>
> **Jérôme Pesenti**

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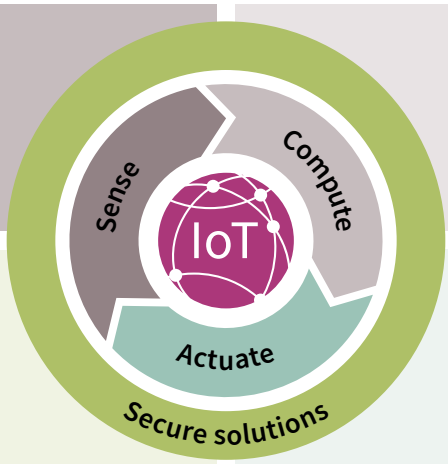

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Self-Driving

Self-Driving Cars

GETTING THERE

Autonomous vehicles are disrupting traditional business models within one of the world's largest industries and it's happening much sooner than anyone expected. What are the forces behind the push for self-driving cars? Is the necessary road infrastructure in place, or do we still need to build it? What happens if an autonomous vehicle needs to make life-or-death decisions? In this section we explore the possibilities – and the risks – involved when humans hand over control to robo-chauffeurs.

By Tim Cole, Gerhard Kafka, and Marcel Weiss

Four years. That was the answer given by Jensen Huang, CEO of Nvidia, early last year when he was asked how long it would take for artificial intelligence to enable fully automated cars. Then a funny thing happened. Suddenly, self-driving vehicles began to crop up on public roads all over the place.

At the Barcelona Motor Show in May, Audi unveiled the 2018 Audi A8, which it claimed as the world's first production car to offer Level 3 autonomy. Level 3 means the driver doesn't need to supervise things at all, so long as the car stays within certain guidelines. In Audi's case that means never driving faster than 60 kph (37 mph). Audi billed this feature as the AI Traffic Jam Pilot.

In the US, Las Vegas became the first city in America to have a self-driving shuttle operating in real-time traffic. However, on its first day of service the shuttle collided with a truck. The driverless bus couldn't back off when the truck was reversing into an alley so, technically at least, the human driver caused the crash, not the shuttle.

In September, General Motors showcased the third generation of its autonomous Chevrolet Bolt, which it has developed with recently acquired Cruise Automation, headquartered in San Francisco. Kyle Vogt, the CEO of Cruise Automation, called it the "first production model self-driving car in the world."

The time of the self-driving vehicle has come much faster than anyone expected. For Jensen Huang and Nvidia it means big bets are paying out even sooner than they'd hoped. ➔

The company has invested heavily in research involving machine learning, which Huang says is the "bottom-up approach to artificial intelligence" – and probably the most promising technology today. Machine learning requires the processing of huge amounts of data, and as it turns out, the company's computative graphics processing units (GPUs) can do the job both faster and using less energy than the traditional central processing units (CPUs) found at the heart of most mainframe, desktop, and laptop computers today.

The computative power of GPUs has increased as computer images have become more complex and, in 2007, Nvidia pioneered a new generation of GPU/CPU chips that now power many energy-efficient data centers in government laboratories, universities, and enterprises.

It was almost by accident that the company became a big player in the nascent autonomous car sector, but it now plans to release the Nvidia Drive PX2 platform next year, describing it as the first "AI brain" capable of full autonomy.

Nvidia's approach is so revolutionary that other chipmakers are scrambling to catch up. Intel and AMD, two of the largest manufacturers of computer chips, have teamed up to pool their resources in order to head off Nvidia by developing a GPU/CPU combo of their own. In addition, Intel made the biggest acquisition of its lifetime early in 2017 when it paid $15.3bn for Mobileye, an Israeli-based specialist in sensors, mapping technology, and camera-based devices for advanced driver-assistance systems (ADAS).

This is just one example of many that hint at the impending disruption autonomous vehicles will bring to the automotive and related industries.

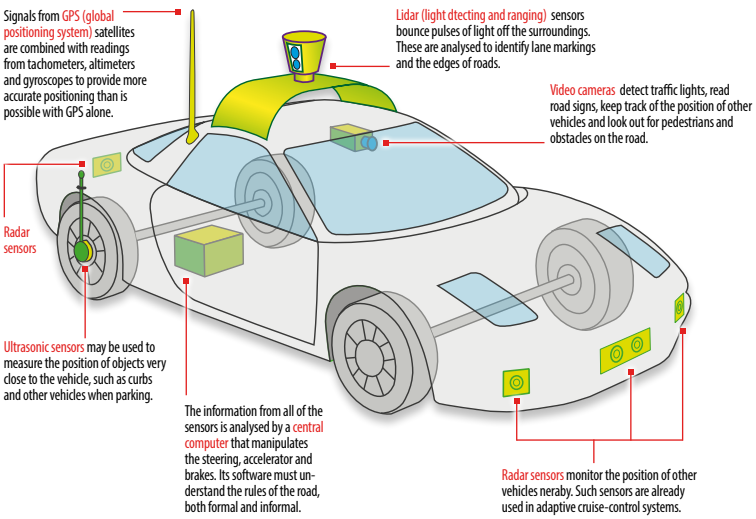
As for when self-driving cars will hit the mainstream, opinions still vary. But Tesla, Ford, Audi, General Motors, and Nissan are among those that believe cars operating without humans will be on the road within the next five years.

This visionary or perhaps doom-laden scenario, depending on your view, is driving the whole supply chain to frantically figure out where to position themselves. Delphi, a UK supplier of proprietary automobile components and integrated systems and modules, acquired NuTonomy, a developer of autonomous driving (AD) software solutions for $450m in November 2017. Delphi, which will soon change its name to Aptiv, has announced it intends to build a self-driving system it can sell to all the big auto makers.

ADAS requires immense computing resources to provide higher levels of predictability and autonomy.

Typical components are: radar, lidar (similar to radar but using laser light), camera, ultrasonic, vehicle-to-everything (V2X) wireless sensors ➔

How a self-driving car works



Ranking Autonomy Levels

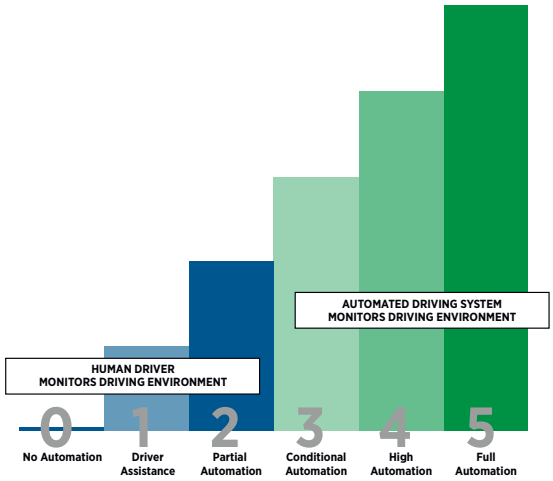


photo © SAE International and J3016

The Society of Automotive Engineers (SAE) definitions of vehicle automation

How autonomous is autonomous?

The Society of Automotive Engineers (SAE) International Standard J3016 offers some guidance on this important question with a six-level schema to describe the range of scenarios that are possible between traditional, unaided, and fully automated driving.

Level 0 No Automation. The full-time performance of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems, is left to the human driver.

Level 1 Drive Assistance. The driving mode-specific execution of either steering or acceleration/deceleration is conducted by a driver assistance system using information about the driving environment, with the expectation that a human driver will perform all remaining aspects of the dynamic driving task.

Level 2 Partial Automation. The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration is conducted using information about the driving environment, with the expectation that a human driver performs all remaining aspects of the dynamic driving task.

Level 3 Conditional Automation. The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task is conducted with the expectation that a human driver will respond appropriately to a request to intervene.

Level 4 High Automation. The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task continues even if a human driver does not respond appropriately to a request to intervene.

Level 5 Full Automation. The full-time performance by an automated driving system of all aspects of the dynamic driving task occurs under all roadway and environmental conditions that could have been managed by a human driver.

HOW ANTS AVOID GRIDLOCK

By Amber Blaha*

Traffic congestion is undoubtedly the bane of a driver's existence. One fender bender or a little rainfall and traffic slows to a crawl – a highway closure creates nightmare backups.

Most cities use low-tech approaches to study traffic patterns – people counting vehicles passing through intersections at peak hours, over a fixed period. From that, the city executives decide whether or not to widen a road, add a stop sign, or install traffic lights.

Swarm intelligence algorithms, such as Ant Colony Optimization (ACO) or Particle Swarm Optimization (PSO), could provide a better way to allow city planners to create simulations and help them understand congestion challenges based on how vehicles and pedestrians navigate public spaces.

Simulations using sensor-collected data would assist planners in identifying potential traffic challenges at granular levels – street, intersection, freeway ramp, and other locations. Congestion problems could be addressed more efficiently, cutting down the number of planning errors in the process.

High-tech methods leveraging the Internet of Things can aid in cutting down traffic congestion. For example, existing technologies can detect smartphone Bluetooth signals (short range) and Wi-Fi signals (longer range) from vehicles as they pass through points where sensors detect and record their presence.

By placing sensor detectors at key locations along roads, transportation managers can determine the general path of vehicles as they pass through these points. Having this greater insight into traffic flow and congestion points could help city planners to identify opportunities to smooth traffic flows and plan the infrastructure more accurately to support a city's growing needs.

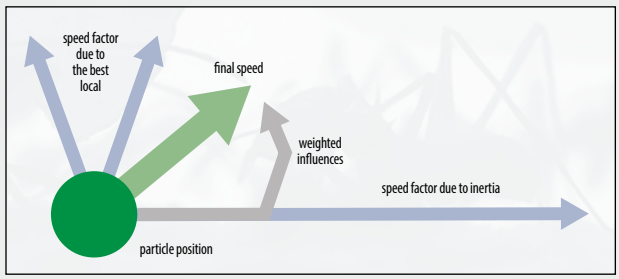
Most commuters have smartphones and many vehicles today have built-in electronics (Wi-Fi, Bluetooth, ZigBee) emitting signals that can be captured. Scanners in the streets, typically attached to street lights, can capture these signals. The number required will vary with the amount of traffic flowing through an area, distances between vehicles, and the level of reflection created by nearby signs, billboards, or any obstructions. These scanners need to be positioned in a pattern that increases the chance of detection.

Once the data is captured, the raw information contained in Bluetooth, Wi-Fi, and ZigBee data logs can be aggregated to provide greater insights into traffic patterns.

Swarm intelligence holds a terrific potential to totally transform the way traffic patterns affect our daily lives and our daily commutes. It is now up to city planners throughout our major metropolises to recognize the benefits of these simulations and to create the necessary infrastructure.

Swarm smarts

Particle Swarm Optimization (PSO) can point the way to lower congestion



*Amber Blaha is chief marketing officer at Ness Digital Engineering

GM paves the way towards car2car communications

Car talk

California has licensed 27 companies such as Lyft, Tesla, Uber, and Waymo to test driverless vehicles on public roads. San Diego will be the site of a first-of-its-kind field trial of cellular-connected car technology for autonomous vehicles to be conducted by the Smart Cities Council global lead partners Qualcomm and AT&T, plus associate partner Ford.

General Motors has become the first carmaker to make vehicle-to-vehicle (V2V) communications standard in a consumer car. The 2017 Cadillac CTS now comes with dedicated short-range communications that allow it to talk to sibling CTS cars.

(allowing see-through and 360° non-line of sight sensing), 3D HD maps, and precise positioning using the Global Navigation Satellite System (GNSS). V2X communications should improve driving comfort and has the potential to save lives by reducing accidents caused by human error.

More than 1.3 million people die on the roads every year. Automated driving, supported by safe and dynamic driving algorithms, could change this by delivering Vision Zero, an EU project with a target of reducing the number of traffic fatalities to zero.

Challenges ahead

Automated driving calls for extremely complex systems. Service-oriented, end-to-end vehicle control architectures require an holistic approach embracing cloud services and the delivery of software updates over the air. Safety, and system architectures need to be developed in tandem if they are to rely on one another. Reliability, safety and availability in particular depend on the real-time analysis of traffic situations, road conditions, weather, and other variables.

Increasingly, carmakers are addressing concerns about "carjacking," where hackers gain control of vehicles via wireless transmission to cause new kinds of problems, from vandalism, by intentionally crashing a vehicle, to holding passengers for ransom.

Car hacking is a hot topic. It's not new for researchers to hack cars and they have demonstrated previously how to hijack a car remotely, how to disable a car's crucial functions such as airbags, and even how to steal cars. The latest car hacking trick doesn't require any extraordinary skills to accomplish.

A research team from the University of Washington demonstrated in 2016 how anyone could print stickers at home, put them on road signs and trick autonomous cars into misreading the signs and potentially causing serious accidents.

The European Union Agency for Network and Information Security (ENSIA) published a guide in December 2016, *Cyber Security and Resilience of Smart Cars,* which contains good ➔

Interview with Janina Loh

THE ETHICS OF SELF-DRIVING CARS: KANT CARS VS ARISTOTLEMOBILES

Driverless vehicles will have to deal with those tricky life-or-death decisions philosophers have argued about for years. So **who will the artificial intelligences behind the wheel choose to favor?** Janina Loh offers a drive-through of the neighborhood.

■ This interview was conducted by our editor, Tim Cole.

Janina Loh teaches philosophy at the University of Vienna. Together with her husband, she recently contributed an essay on digital ethics to Patrick Lin's anthology *Robot Ethics 2.0* (Oxford University Press, 2017)

Will autonomous vehicles represent a step toward greater safety or are they an added risk?

Since 90% of all traffic accidents are due to human error, chances are that self-driving cars will reduce the current number of pileups. But even the best autonomous vehicles will eventually be involved in serious incidents. Today, the driver makes decisions spontaneously and reacts by reflex because of the lack of time and information required to make informed ethical decisions before it's too late.

Essentially, the same will be true with self-driving cars but their decisions will be largely based on automation, so it will actually be the algorithms used and their programming that decide what actions to take. That's why we need to make sure certain ethical principles are built into our technical systems.

So in the worst case, machines will have to decide over life and death, won't they?

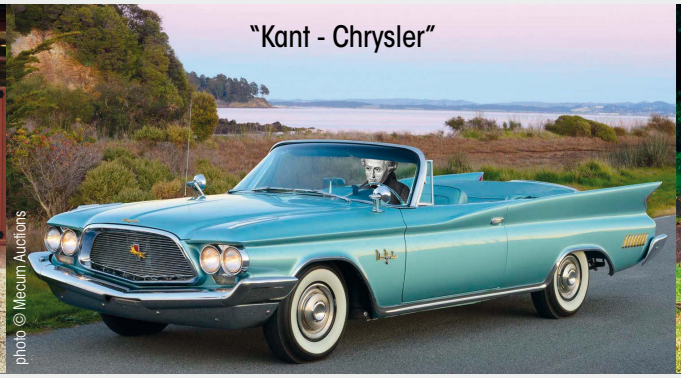
It will be hard to program autonomous vehicles to include every conceivable scenario that could occur in traffic. That's why we need to make sure certain moral principles are being followed. A car programmed to protect its own passengers at the cost of everyone else would be just as socially unacceptable as one that willingly sacrifices its occupants to save others.

So to which rules should a self-driving car adhere?

Let's consider the classic case. A car is driving through a residential area when a group of small children run out from behind a parked car. To avoid them the car would have to pull to the left, but by doing so it would hit an 80-year-old man approaching on his bicycle.

In your opinion, what should the car decide to do?

That depends on which school of ethics you choose to follow. The utilitarian school of thought, founded



by Jeremy Bentham in the early 19th century, states that the best action is the one that maximizes utility. According to Bentham's Greatest Happiness Principle, we should be governed by the credo "the greatest happiness of the greatest number." This means the old man must die because his usefulness to society is probably less than that of the children, one of whom might grow up to become the next Einstein.

However, according to the school of deontological ethics, prescribed by Immanuel Kant, assigning different values to different human lives is completely unethical because human dignity is absolute, and you can't compare absolutes. In fact, human dignity is the bedrock of most legal systems in liberal democracies today.

Sounds like there is no real ethical solution after all?

Philippa Foot, a famous British philosopher and ethicist, called this kind of situational dilemma a "trolley problem" [based on a similar dilemma as described above using a trolley bus rather than a car and adding further complications].

Philosophers often engage in thought experiments such as these, where they describe hypothetical situations, sometimes realistic and sometimes theoretical, designed to investigate our "moral intuitions" when dealing with dilemmas. There is no right or wrong answer to a trolley problem, which means we don't need to solve some kind of puzzle but can choose wisely before we let autonomous vehicles loose on mankind.

So which school of ethics should carmakers follow?

The automotive industry is focused on making sure accidents don't happen in the first place. Driver assistance systems are programmed to react defensively, meaning that when in doubt they will slow down or stop and ask questions later. If an accident becomes unavoidable, the European Ethics Commission has laid down that under no circumstances may a vehicle be programmed to choose between potential human victims. Instead, the steering systems must be programmed to seek to avoid an accident by all means, or at least to reduce speed (and thus collateral damage) as much as possible.

And if worst comes to worst, who is considered liable?

It's certainly not the car itself, since algorithms cannot be held legally accountable.

Do we need some kind of Digital Road Traffic Act?

The European Parliament suggested that autonomous driver assistance systems should be considered to be legal entities – a kind of electronic persona. After all, companies can be taken to court so why not an algorithm? This is especially true for self-learning artificial intelligence (AI) systems, which would need to be issued a digital legal personality of some kind. Of course, this also means they would have to be registered with the authorities and would need to be provided with assets with which to pay compensation, or at the very least they would require liability insurance. We need to think long and hard about what this kind of "digital personhood" means in practice, because we are heading towards a future in which autonomous and self-learning machines will play an increasingly important role.

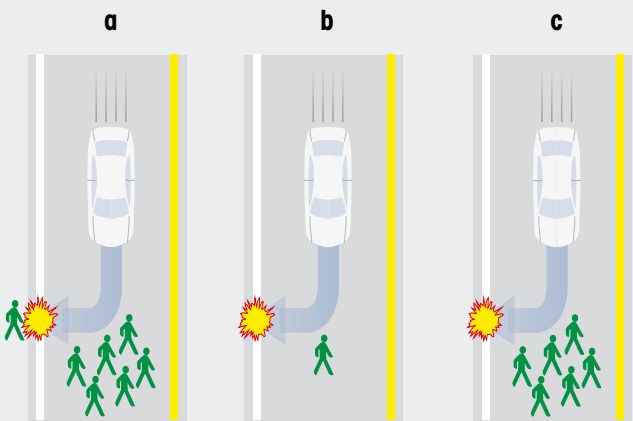
> It will be hard to program autonomous vehicles to include every conceivable scenario that could occur in traffic

Couldn't the creators of such systems conceivably argue that, since they are self-learning, it wasn't they who taught the machine to do what it does, but that it actually taught itself?

It's certainly true that the damage done by a self-learning system can't easily be traced back directly to the programmer. In order to act in a virtue-ethical sense, an autonomous driver assistance system will need to be capable of a far greater degree of self-learning than a simple "Kant Car" or "Bentham Porsche." It would not be inconceivable to imagine a kind of "Aristotlemobile" that would require owners to drive themselves around at first in order for the car to learn to drive the way they do.

Vital decisions

Autonomous vehicles will one day be forced to make life-or-death choices in an instant



practices and recommendations for all players. It includes advice on how manufacturers can:

- Improve cybersecurity in smart cars
- Improve information sharing between industry actors
- Improve exchanges with security researchers and third parties

Another challenge relates to vehicle-to-vehicle (V2V) communication for which a dedicated short-range communications (DSRC) standard is proposed, based on the IEEE 802.11p standard working in the 5.9GHz ITS spectrum. In addition, communication with networks and pedestrians will also be needed for everything to function seamlessly; something that is hardly guaranteed given today's patchy GSM and LTE coverage. For this reason, many observers think acceptance of autonomous vehicles will depend on the rollout of 5G networks, which is not expected until 2020 at the earliest. Regulation for legal aspects is needed, preferably sooner rather than later. Who is liable in the case where technology fails? Germany was the first to add relevant paragraphs to its traffic laws in early 2017. In most other countries the regulators still need to come to grips with the situation.

Meanwhile, the auto industry is stepping on the gas. During September 2016 in Germany, Audi, BMW, Daimler, Ericsson, Huawei, Intel, Nokia, and Qualcomm came together to form the 5G Automotive Association (5GAA). In March 2017, 5GAA announced it had signed a memorandum of understanding with the European Automotive Telecom Alliance (EATA). The stated aim of this partnership is to "foster cooperation in the field of connected and autonomous driving solutions as well as standardization, spectrum and related use cases."

Private and public field tests begin

The first German public test field was inaugurated in November 2015 on the A9 highway between Munich and Nuremberg with a total length of 160 km. In February 2017 the first cross-border test field was set up ➔

Smart Roads
PAVING THE WAY

Forget for a moment the headline-grabbing testing of autonomous vehicles by Google and other high-tech companies and think instead about a more down-to-earth innovation: **a smart highway that demonstrates the near-term potential to improve road transportation.**

By Alan R Earls

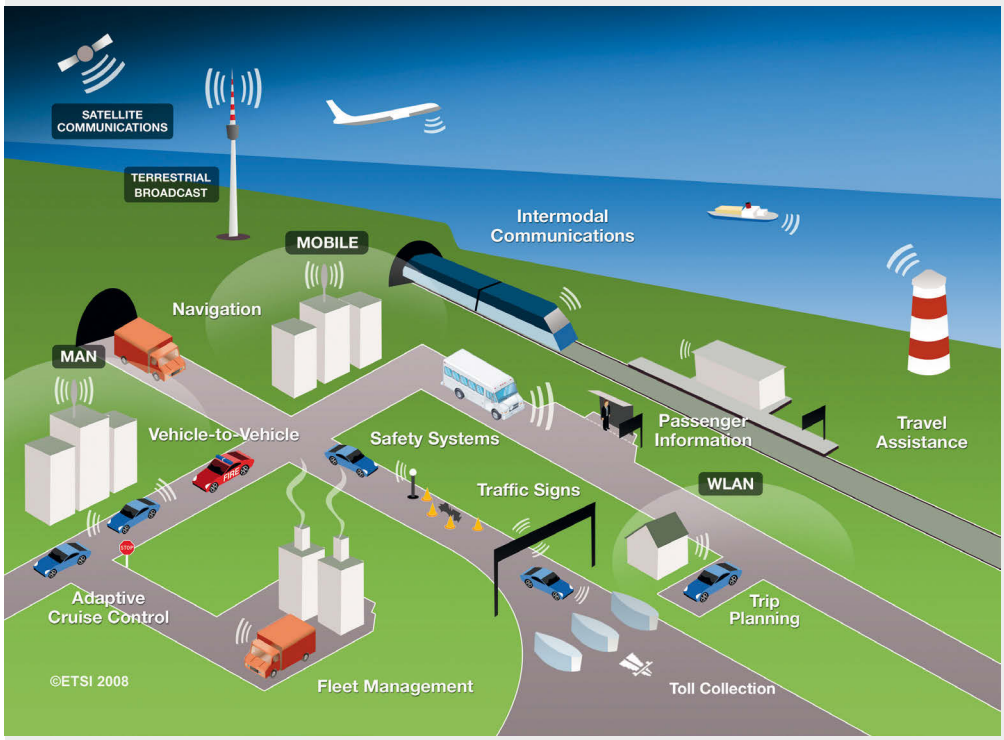


photo © ETSI

Vital systems
The real revolution in road transportation will come through the application of IoT principles

In 2013, the Austrian, German, and Dutch transport ministries agreed to work cooperatively to create a long highway corridor spanning the three nations – from Rotterdam to Vienna – that would test and implement cutting-edge safety and traffic management technologies.

The first results came in during 2016 and 2017, showing promise in the smoothing of traffic flows and the reduction of holdups, among other things.

Best of all, the technologies provide travel benefits whether the driver is a sophisticated computer system or a human being.

The Cooperative Intelligent Transport Systems (C-ITS) Corridor, Joint Deployment has the potential to increase transport efficiency, improve road safety, and provide environmentally friendly mobility. Its supporters also believe it will create additional services and new business models.

The system uses a set of international specifications that provide the technical basis for the deployment to bring benefits for any vehicle using the road,

not just the specially equipped vehicles used to demonstrate more advanced features of the scheme.

The C-ITS project shows autonomous, self-driving vehicles may have garnered most of the attention but the real revolution in road transportation may come from making the underlying road infrastructure and the wider environment smarter through applied IoT principles. For example, roadways that are aware of issues, such as traffic conditions, icy surfaces, or the presence of wildlife, can help individual vehicles to travel more safely and smoothly while providing system-wide management to ensure optimal routing and efficiency for all.

Infrastructure must be part of the conversation

Autonomous vehicles benefit, too, not only because of the additional situational awareness smart roads can provide but also because self-driving vehicles with no connection to local traffic information can't contribute to the improved efficiency that most roads badly need.

"With autonomous vehicle development, much of the attention has been given to how clever and independent the vehicle can be," notes Ian Hughes, senior analyst for the Internet of Things at 451 Research in the UK. However, each vehicle is part of a wider network of links involving both vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications.

"If an autonomous driving system was being built 'greenfield,' without any reference to existing systems, everything would be designed to interact for efficiency and safety. As we transition to autonomous [vehicles] certain hubs of infrastructure will upgrade, while others lag and require vehicles to be independent," says Hughes.

Just as toll roads offer a better service for a price, we may see some of this infrastructure appear for premium use. For example, a motorway might accept autonomous vehicles using specific protocols to keep them all informed and traveling safely at speed until they break away to their destination, he explains.

"Smart cars will become more integrated with national intelligent transport infrastructures and systems such as satnavs in cars, traffic signal control systems; parking information, weather reports, bridge de-icing, container management systems; variable message signs; automatic number plate recognition; or speed cameras to monitor applications, such as security CCTV systems and similar," predicts Kevin Curran, a senior member of the IEEE and professor of cybersecurity at Ulster University. He explains that ultimately the road beneath us would become more communicative with smart cars via embedded road sensors which could be turned on during preventive road construction maintenance or in emergency conditions, alerting every vehicle to the need to reduce speed or halt. "With such a technological advantage, we can expect the end of roadside cones demarking construction and traffic flow," he says.

Other glimpses of future intelligent infrastructures beyond the C-ITS example can be seen in initiatives such as one in Birmingham in the UK, where IBM is helping with the use of Big Data analytics to understand parking patterns in order to manage congestion better. In the Birmingham system, IBM has deployed ultra-low-power wireless sensors in roads and provided an accompanying app for drivers to get real-time availability and prices for parking. Common input sources for managing traffic include road sensors, video cameras, and GPS updates from public transport.

Huawei recently demonstrated smart technologies employing coordinated vehicle grouping, vehicle-intersection management, and lane-change regulation. Curran warns that the Internet of Vehicles (IoV) poses stricter latency and reliability requirements for the era of 5G networks.

"On motorways a latency of one millisecond equals an approximate driving distance of three centimeters and only fast networks, such as 5G networks, can support millisecond-level latencies, thus ensuring safe driving," he argues.

> Smart cars will become more integrated with national intelligent transport infrastructures
>
> **Ian Hughes**
> senior analyst for the Internet of Things at 451 Research

The general approach of automotive OEMs so far has been to march ahead with technology enabling vehicles to talk to other vehicles (V2V) but without incorporating connectivity to the cities and their infrastructure (V2I), notes Mark Zannoni, research director for smart cities and transportation at IDC Government Insights. "You don't see carmakers coordinating with governments; they are just going along on their own," he says.

The autonomous vehicle outlook

If you have a city-based smart infrastructure more of the benefits of autonomous vehicle developments will become evident, such as the improvements in safety.

Right now, autonomous vehicles can sense other cars around them and when a car ahead applies its brakes yours will, too, Zannoni says. That improves safety because it is estimated that 95% of vehicle accidents result from driver error. However, the case of a child darting into the road unexpectedly may result in an autonomous vehicle applying its brakes quicker than a human would but it may still hit the child. In other words, it is not a big change from the status quo.

"If you had city-based and road-based smart infrastructure, not simply technology in the car, it would sense the presence of the child, calculate the child's possible path, and communicate that to the vehicle, helping ➔

between Merzig in Germany and Metz in France, and was recently extended to Luxemburg.

In March 2017, 29 European countries signed a Letter of Intent to intensify cooperation on testing of automated road transport in cross-border test sites. An additional test field was added in September 2017 connecting Rotterdam and Eindhoven in the Netherlands, Antwerp in Belgium, Porto and Evora in Portugal, Vigo and Merida in Spain, Tromsø in Norway, and Oulu in Finland.

Another initiative, called the Nordic Way, is a pilot project that seeks to enable cars to share safety-hazard alerts through cellular networks on a road corridor through Finland, Norway, Sweden, and Denmark.

Agriculture is another hot candidate for self-driving vehicles. It is expected that a fully automatic tractor will be available in 2018. Austrian vendor Lindner demonstrated the necessary technology during Agritechnica in Hannover in November 2017.

According to the McKinsey report *Smart Moves Required – The Road Towards Artificial Intelligence in Mobility,* robo-taxis could represent the future. These self-driving taxis could disrupt the auto industry.

But it doesn't end there. For some services the road may be abandoned completely. A fully auto-piloted air-taxi service based on Chinese-made E-Hang 184 aircraft has been flying passengers on selected routes within Dubai since October 2017.

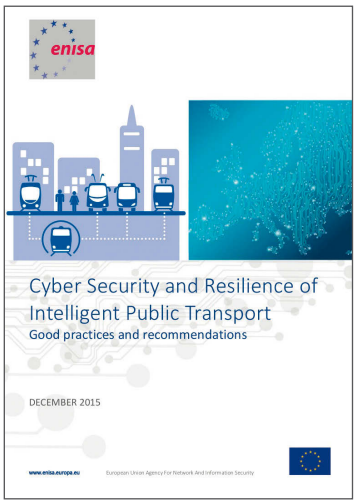



photo © Ertico

Road smarts
Traffic infrastructures will eventually need to be in constant communication with autonomous vehicles

to avoid an accident," Zannoni adds – and that kind of development would have a profound safety benefit.

Along more rural roads data relating to parameters such as atmospheric temperature or the temperature of a bridge deck would also improve safety and some of that could come from V2V communication.

"If a vehicle hits a patch of ice it can share that data through edge computing or the cloud to warn other cars or send a message to maintenance crews," says Zannoni.

Of all the key technologies needed to aid the progress of autonomy, getting accurate vehicle location information is perhaps the most important. GPS in cities isn't accurate enough, according to Zannoni, due to "urban canyoning," the blocking of GPS signals in built-up areas. To try to overcome this, peer-to-peer sensors were set up in New York's Manhattan district, with funding from the US Department of Transportation, and the result was improved locational accuracy to a tolerance of two centimeters; much better than with traditional GPS.

Zannoni says that, while autonomous technology is already a reality, it will be a while before we see a society of autonomous cars. "A car can operate by itself but, when you put it around other cars or involve traffic police or pedestrians, its performance has problems," he says.

The challenge therefore is to get it to work successfully in society. Zannoni explains: "That's why I think it's vital to have infrastructure that can communicate with autonomous vehicles and deal with congestion."

The smart money is on infrastructure

The infrastructure will become a key element in the operation of autonomous vehicles, agrees Walter Sullivan, who is head of the innovation lab at Elektrobit, a maker of embedded and connected technology for the automotive sector, based in Erlangen, Germany. The potential for smart infrastructure is tremendous, he believes – from efficient distribution of traffic through the road network, to optimized, automatic notification of breakdown service vehicles, to improved response times from first-responder services. With the help of smart infrastructure, for example, paths and roadways can be cleared and roadways can be coordinated with public transit.

"The scenarios are bounded only by imagination and ability to invest," says Sullivan, adding that making the

transition to more capable mobility services in urban planning means the infrastructure we currently put aside for parking of vehicles can be reconsidered and perhaps reduced.

A key issue will be cost-effectiveness. "Infrastructure which is meant to cooperate, or interact, with autonomous vehicles will naturally be built out where autonomous vehicles are concentrated – and that is unlikely to be in rural areas," he says. "It really comes down to utilization and cost-benefit."

Street cab named desire could be the key

Given the role of smart infrastructure in powering the future of road transportation, what is the realistic outlook for autonomy?

"We probably have a similar view to commercialization as many others do. Autonomy has the opportunity to be introduced into targeted vehicle fleets operating in geographically restricted areas at first," Sullivan replies.

The kinds of fleets he believes will be targets for autonomy would typically be operated by mobility, cargo, or transportation companies, and have relatively high utilization rates. That, in turn, provides more justification for the costs needed to implement an autonomous system, which will take us into the first half of the 2020s and will include L4 and L5 levels of autonomy, he predicts.

"In parallel [with targeted vehicle fleets], we'll see increasing L2 and L3 implementations reaching commercialization in traditional passenger vehicles," Sullivan says.

As we progress through the decade more people will have access to fully autonomous vehicles through different mobility services that they might use, such as rental vehicles or even taxi services like Uber or Lyft. Along the way, consumers will gradually develop confidence and comfort in the vehicles' capabilities, he says.

In the second half of the 2020s and early 2030s, Sullivan predicts we will see L4 autonomy introduced into cars which are more in the mainstream of those vehicles consumers can buy. "There may be early versions of L4 systems introduced into high-end vehicles in the latter half of the 2020s but they are not likely affordable for the typical car buyer. The industry still has some tough challenges to overcome, however at this time the focus and progress of the industry are rather promising," he says.

Deployment of self-driving vehicles does have risks. "We are still working on perfecting some of the foundational technology, from the sensors to be used, to the algorithms, and AI that will act on the data our sensors give us," explains Sullivan. As an automotive industry software company helping carmakers to scale up from traditional driver assistance to L4 and L5 autonomy, Elektrobit is, in general, optimistic about the future.

"I believe that from a technology perspective, we will solve those challenges and the risks therefore will be more related to acceptance, regulation, security, and demonstrated safety improvements," predicts Sullivan.

Safety first for self-driving breakthrough

Is the public really interested in autonomous vehicles or do they just want safer ones? Sullivan reckons the answer probably depends on how the products are presented. If people can have point-to-point transportation which is safer, cheaper, and more convenient than driving their own car, then the value proposition would be compelling, he believes.

The experience for most people in the first years of autonomy will be through ride-hailing and sharing. Sullivan's view for those attracted to a ride hailing service is that it will be a safer and probably cheaper alternative offering the same or a better quality of service.

Ken Philmus, senior director for global business development at Conduent Transportation, agrees. "I'm confident that autonomous vehicles are inevitable but full integration is clearly not in the near future as there is a tremendous amount of work to be done to gain consumer acceptance," he says.

There are over 40 US companies testing different prototypes of autonomous vehicles yet standards to allow them to work with one another are just beginning to be developed at the federal level. According to Philmus, "as integration moves forward there may initially be separate lanes for autonomous vehicles or even a focus on autonomous freight movement."

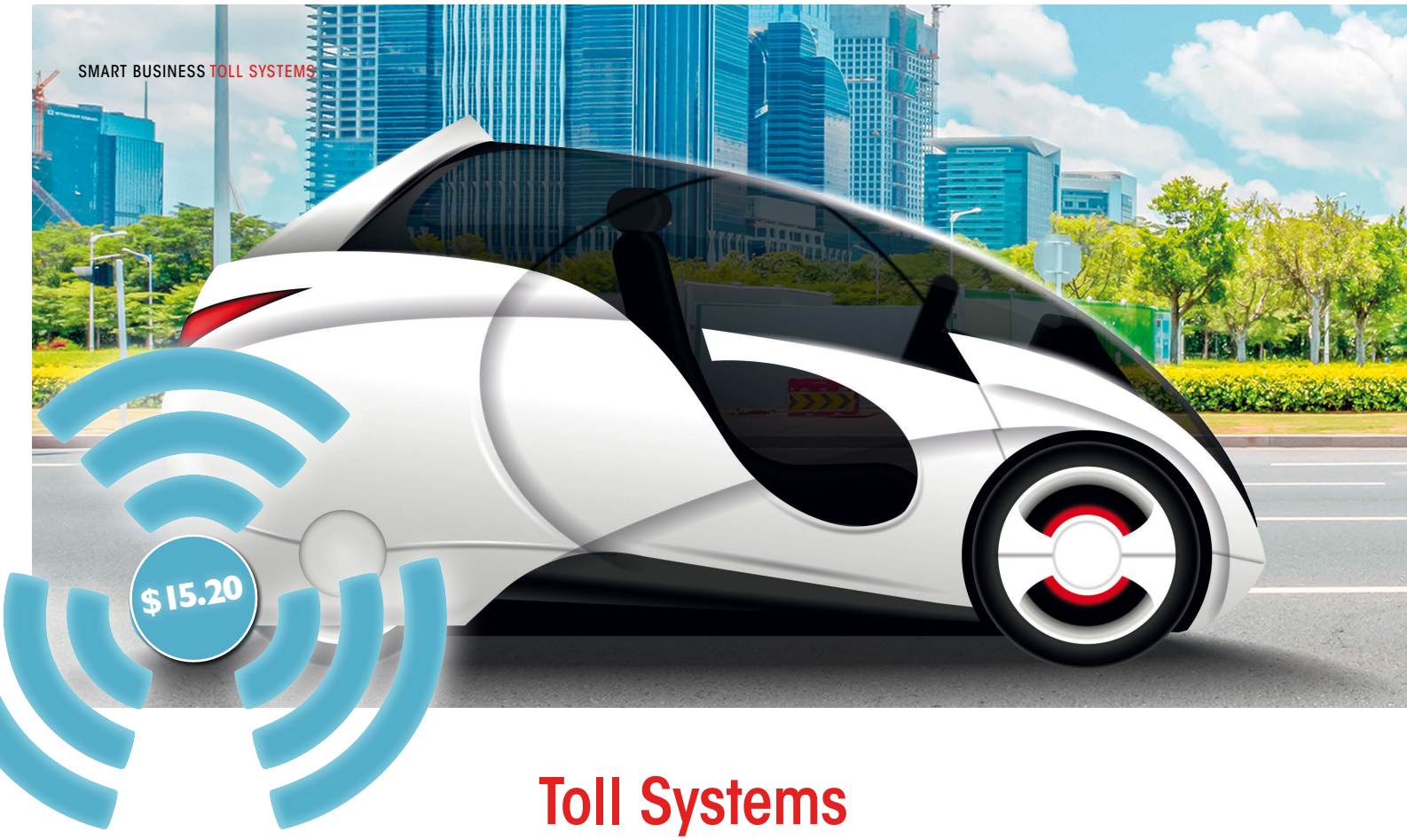
> You don't see carmakers coordinating with government; they are just going along on their own
>
> **Mark Zannoni**
> research director for smart cities and transportation at IDC Government Insight

Smoke without fire is the main obstacle

Full autonomous vehicle implementation can't be achieved without the ability to obtain information about road and traffic conditions. Along the way, traffic management as we know it today will be very different. For example, traffic management centers will become communication centers that not only share information with each other but also with vehicles in "absolute real time," according to Philmus. This will require massive infrastructure changes.

Although the technical challenges can be mastered, drivers will be the greatest hurdle. "People who simply enjoy driving (…) will see autonomous vehicles as taking away their personal freedom," he says.

Drawing an analogy between driving and cigarette smoking, Philmus adds: "Despite all the clear evidence that not smoking will prevent illness and death, millions still do and seemingly will always continue to smoke. I'm confident that we will see the same types of resistance at the various implementation stages of autonomous vehicles."



Toll Systems

WHAT PRICE THE ROAD?

Toll systems in use around the world are hopelessly stuck in the analog age. By using **intelligent IoT-based metering** governments might be able to keep pace with rising numbers of vehicles as ride-sharing and electric cars take off.

■ By Tim Cole*

Toll roads go back a long way and have existed for at least the last 2,700 years. Records show that tolls had to be paid by travelers using the Susa–Babylon highway under the Assyrian regime of King Ashurbanipal, who reigned in the 7th century BC.

In 14th-century England, some of the most heavily used roads were repaired with money raised from pavage grants, a toll for maintenance or improvement of a road.

In early US history, many individual citizens would maintain nearby stretches of road and collect fees from travelers. Eventually, the toll leviers formed companies to build, improve, and maintain a particular section of roadway, and tolls were collected to finance the enterprise.

> Road pricing is more efficient than the typical indirect ways drivers pay for imposing costs on others, such as through taxes on fuel and on car ownership

These private "turnpikes" were soon owned by business corporations that built and maintained new roads for the right to collect fees from travelers. Turnpikes often left an important social and political imprint on the communities that created and supported them, but they seldom turned a profit.

There were three important phases of toll road construction in the US: the turnpike era of the eastern states from 1792 to 1845, the plank road boom of 1847 to 1853, and the Far West toll roads between 1850 and 1902.

Political sentiment eventually turned against them, and the Federal Road Act of 1916 prevented the use of tolls on highways from receiving government money.

The prominence of the tollway model increased further with the rise of the automobile, and many modern toll roads all over the world charge fees for motor vehicles exclusively.

Money for jam

In recent years, tolls have been used as a way to ease traffic jams in inner cities. In 2003 Ken Livingstone, then London's mayor, introduced a system called the Congestion Charge Zone (CCZ). Motorists pay at least £11.50 a day ($15.56) to drive into the center of town. At first, the system seemed to work wonderfully: the number of cars entering Central London fell by almost a quarter but, since about 2012, the numbers started to creep up again. One reason is that delivery trucks and taxis are clocking up more

*Tim Cole is the editor of *Smart Industry*.

miles within the zone. Another is the spread of bus lanes reserved for public transport – especially the famous red London double-deckers. Today, more time is being lost to gridlock than before the introduction of the CCZ. According to a report in the business magazine *The Economist,* the average vehicle speed within the zone fell from 32 kph in 2013 to 28.5 kph in 2016.

As a result, London is currently searching for a more radical solution for congestion control. In January the London Assembly, the city's governing body, called for municipal authorities to develop a new system of road pricing that varies according to when, where, and for how long a motorist drives in the city.

The idea of selling time on the streets isn't really new: Singapore already has the world's most comprehensive road-pricing system which is camera-based. It plans to introduce a new GPS-based one in 2020. The system will use built-in global positioning systems in cars as well as smartphone signals to charge motorists more precisely. The Singapore experiment is being carefully watched by other authorities all over the world, with California and Oregon in the US already in trials of similar setups.

As *The Economist* notes, it's not just about frayed nerves and lost time on the way home. "Using prices to ration a scarce resource, such as space on busy roads at busy times, makes sense," remarked the authors of a recent article on congestion avoidance (*Jam Every Day*, August 2017). Those who consume goods should pay for them, they argue. And they believe that road pricing is more efficient than the typical indirect ways drivers pay for imposing costs on others, such as through taxes on car ownership and on fuel.

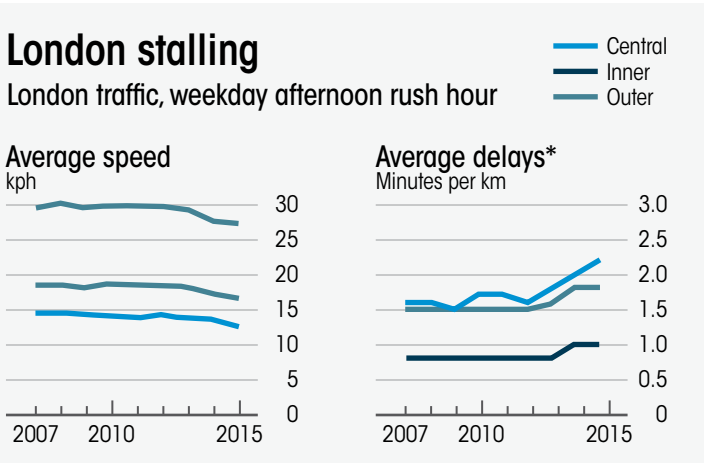
Taxing cars or fuel doesn't discourage motorists from causing congestion, which increases pollution and crimps productivity by delaying workers and deliveries, disrupting supply chains.

Although congestion zones can help, they are blunt instruments. Road use pricing could be adjusted to penalize traffic flows during rush hours and offer incentives to drive during off times instead – and the systems could be made to work in real time. Taxes are unpopular, no matter what purpose they serve. Drivers would much rather "pay" by queuing than through road pricing. The Netherlands hoped to run a 60,000-vehicle trial of road pricing in 2011, on the way to rolling out a national scheme, but opposing politicians supported by motoring organizations fought so hard that the plans were dropped.

Governments need to bring their systems into the digital age anyway, because a major reason congestion in inner cities is growing is the huge success of ride-hailing and ride-sharing models spawned by the Internet and IoT. Drivers for Uber and their ilk can ride all day inside London's CCZ picking up fares, but are only charged once. On the other hand, typical commuters usually ➔

London stalling

London traffic, weekday afternoon rush hour



*Extra time it takes to travel 1km at rush hour versus at night

source: Transport for London

Inner-city traffic problems

Despite the introduction of congestion charges, London's traffic slows to a horse and buggy crawl at the height of the ironically named rush hour

Stop&Go in Singapore
Singapore has the world's most comprehensive road-pricing system which is camera-based. It plans to introduce a new GPS-based one in 2020

only use their cars twice a day: once to get to work in the morning and again in the evenings to drive home.

Things are going from bad to worse in a hurry

London is a good indicator of what lies in store for other urban areas. The number of private-hire vehicles that entered the CCZ at least once rose from 50,000 in March 2013 to 85,000 in November 2016. The number of licensed drivers rose from 67,000 to 115,500 over the same period.

It can only get worse. Self-driving cars are set to join the stream of vehicles moving in, out, and around the most congested areas in the next couple of years. Most scenarios forecast a noticeable decline in direct car ownership as a result, with people preferring to call up a driverless car from Uber or others, which means that the number of car owners to tax will probably decrease as well. Even today, private-hire vehicles make up 38% of car traffic in Central London, almost double the share of traditional black taxicabs.

Economists point out that electric vehicles of the future will lower all governments' tax revenues further. Owners pay no fuel taxes and, at least today, are often granted generous government subsidies. On the other hand, the call is out for authorities to help finance the basic infrastructure for e-mobiles, such as on-street charging stations.

A growing number of experts are calling for a way to pay the costs of car use that would be fairer than taxing fuel and ownership. Instead, they argue, governments should institute general road-usage taxes for all: a per-kilometer charge that would vary depending on the vehicle's weight and how much pollution it emits. Owners of big, gas-guzzling SUVs, for instance, would pay proportionately more than someone with a lowly Fiat Panda. Charges could also be adjusted so vehicle owners in densely populated areas pay more than suburb dwellers.

Technology will play a central role in the introduction of road pricing. As in any area of technology, prices will fall as systems mature and become more commonplace.

> Thousands of self-driving cars are set to join the stream of vehicles moving in, out and around the most congested areas in a few years

Smartphones are ubiquitous today even in countries like Bangladesh or Brazil, where traffic congestion already reaches nightmarish levels and can only get worse. As automobiles and trucks increasingly connect to the Internet, it will become increasingly easy to track them, especially in conjunction with GPS satnav systems.

Singapore is showing the rest of the world the way here. It introduced paper permits to control access to its central zone way back in 1975. In 2008, the city-state went electronic. Every three months, the toll fees are adjusted to account for average speeds, so if traffic slows down, tolls go up automatically.

Pay-as-you-go, only now in real time

In 2020, Singapore plans to roll out a completely new system that relies on GPS signals. It will adjust the amount drivers pay depending on distance, time, location, and vehicle. It is hoped that this will reduce the need for camera-bearing gantries that spot vehicles driving in and out of the downtown area. It will invoice drivers in real time, sending notifications about the amount deducted from their bank account or credit card as well as traffic information and tips on how gridlocked areas of the city can be avoided.

In the United States, there are at least two major road-pricing schemes being implemented currently. By far the most ambitious is Orego in Oregon, which kicked off in 2015 and now has around 1,500 subscribers. Drivers have devices fitted in their cars that take data from their engines' computers. The gadgets record the distance driven and the amount of fuel used, and transmit the data via mobile networks. Motorists are charged based on how far they drive, with each mile costing 1.5 cents. This amount is then deducted from the state fuel tax each driver has paid and refunds are credited directly.

As governments increasingly start to track vehicles, and the citizens inside them, concerns about data privacy are growing in leaps and bounds. Tech firms and carmakers are also competing to gain access to the mountains of data the drivers create. This can be used to upsell additional services based on the location of the vehicle, its condition (by using sensors to suggest when it's time to head for the next garage), or how it's driven. The latter will play a key role in creating the algorithms that will steer driverless cars in the future.

In the US, the American Civil Liberties Union (ACLU) has voiced concerns in the past about the Oregon project, and others. They worry about data being leaked or stolen. In Europe, EU Commissioner Günther Oettinger pointed out in an interview with *Smart Industry* (see SI 01/16) that in Europe, as well as in the States, it is far from clear to whom data generated by smart cars actually belongs – the car's owner or its manufacturer?

Clearing this up is conceivable. *The Economist* explains: "Once motorists have become used to the idea of paying for the road space they take up, rates could be tweaked to account for the noise, pollution and the risk of collisions in each location."

Time will tell.

MACRONIX

Smart Industry

Long Term Memory Support
for Your Design

What does it take to provide real long term support for Memory products ?
Longevity of course, but also a requirement for High Quality and a diverse product offering. This is what Macronix provides its customers.

Nowadays, everything needs to be connected either wired or wirelessly and this is no different within the Smart Factory. The trend is unsurprisingly to higher densities but one thing won't change, once the design has been set, the long term supply needs to be assured, and this is what Macronix provides.

While most of the competition is defocusing from legacy NOR and NAND flash towards managed, higher density devices , Macronix continues to provide NOR flash from 512kb to 2Gb and SLC NAND from 512 Mb to 8Gb.

With its product range, Macronix enables not only connectivity like wired, wireless and OTA but also support for other demanding applications, for instance high resolution video, instant ON, fast boot, etc.

But most important is the quality and reliability of memory supply. Macronix has been doing exactly this for more than 25 years now, providing up to 10 years guaranteed supply of high quality Flash Memory and can continue to support your design today and tomorrow.

Macronix owns 3 Fabs, has full control about the development and manufacturing and hence is able to provide a real Product Longevity Program. Knowing that the technological market place is evolving at a fast pace to even higher densities and lower technology nodes, Macronix decided to further develop suitable new products but also strongly maintain supply to its customer base with existing products.

MACRONIX
MPLP
Product Longevity Program

Longevity
As Macronix own its own 3 Fabs,its longevity program can ensure developers a period of 10 years worry free supply.

High Quality
Industry leading low RMA and PPM numbers.

Diversity
With a broad Non-Volatile Memory portfolio of NOR 512kb to 2Gb, NAND 512Mb to 8Gb and MCP in Industrial Grade (extended temperature on request).

VCC	Density	Temperature Range
Serial NOR Flash		
1.8V / 3V	512kb-2Gb	-40°C to +125°C
Parallel NOR Flash		
1.8V	4Mb-8Mb / 32Mb-128Mb	-40°C to +85°C
3V	4Mb-2Gb	-40°C to +105°C
SLC NAND Flash		
1.8V	1Gb-4Gb	-40°C to +85°C
3V	512Mb-8Gb	-40°C to +105°C
MCP NOR Flash		
1.8V	64-128Mb Serial NOR Flash 32-64Mb pSRAM	-40°C to +85°C
1.8V / 3V	64-128Mb Parallel NOR Flash 32Mb pSRAM	-40°C to +85°C
MCP NAND Flash		
1.8V	1-4Gb SLC NAND Flash 512Mb-2Gb LPDDR1/2	-40°C to +85°C

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Interview with Kevin Ashton, the "Inventor of IoT"

IOT IS DRIVEN BY THE USERS

Kevin Ashton is sometimes called the "Inventor of IoT" since he first used the term in 1999 to describe a system where the **Internet is connected to the physical world via ubiquitous sensors**. He is a serial entrepreneur and co-founded the Auto-ID Center at MIT*

You coined the term the "Internet of Things" in 1999, but what did it mean then and is the definition still valid?

It meant using the Internet to empower computers to sense the world for themselves. It still does.

Did you believe then that IoT would actually change the world?

It wasn't hard to believe that to enable computers to sense the world would change the world. It was a little harder to believe it might be possible.

It is difficult to imagine today, but there was a lot of skepticism back then, and plenty of "experts" were eager to explain why it was an impossible idea. Some of those objections seem especially hilarious today. People thought all that data would crash the Internet; that the laws of physics meant the type of radio communication we needed was impossible; that silicon chips could never cost less than a dollar; that the internet was a fad; that there was not enough silicon in the world; that we already had all the data we needed. And when I say "people" I mean serious people, like academic specialists with tenure.

Many of my early presentations were met with open hostility. In the late 1990s and early 2000s, there were so few people who believed in this idea that we all knew each other personally and could get lunch together. They helped me to keep believing – when a lot of people think you're crazy, you often wonder if they're right.

Is IoT just another buzzword?

Yes and no. Buzzword means something people say frequently but don't understand. There are a lot of people doing that with the Internet of Things, and many of them work for those big IT companies who didn't understand the Internet of Things in the beginning. Their customers are talking about it, so they are talking about it – even though they don't know what it is. That's how you get all this crap, like the "Internet of Everything," the "Industrial Internet," and so on.

> When a lot of people think you're crazy, you often wonder if they are right

People get "IoT" added to their job title and are assigned the task of selling old products to new customers – not actually Internet of Things products, just cloud services, reporting systems, routers, or whatever, that now have an IoT sticker on the box. In all those cases, IoT is a buzzword, devoid of any real meaning, not adding any real value. But that is not a problem with the concept, it's a problem with the people and companies that are desperately trying to hop onto the bandwagon without bothering to understand the paradigm shift going on all around them. That's always going to happen when something is successful.

So what is it?

The actual concept of the Internet of Things is real, powerful, and not a buzzword at all. And the people and companies that understand it fully do amazing things.

A lot of those companies don't use the term IoT very much at all, by

*https://en.wikipedia.org/wiki/Auto-ID_Center

the way. Uber, Nest, Tesla, Amazon, Google, Facebook, and Samsung, for example, all use the Internet of Things in various ways, but they don't mention it any more than they mention, say, being an Internet company or a computer business. They focus instead on the benefits using the Internet of Things brings to their customers – and that's the way it should be.

How can companies win with IoT?

The first thing to know is that it was not the IT industry that drove the early development of the Internet of Things, but end users.

In the late 1990s, the IT industry was preoccupied with the World Wide Web and did not understand the Internet of Things at all. They didn't even pay lip service to it back then.

But big companies like Procter & Gamble (where I worked), Gillette (now part of Procter & Gamble, but still a separate company back then), Wal-Mart, Tesco, Canon, Coca-Cola, and government organizations like the Department of Defense and the United States Postal Service, had all figured out that their supply chains could reap massive benefits from the Internet of Things.

They all started to invest in our research, and eventually some of the IT companies, like Sun Microsystems and Accenture, followed.

That's important, because the Internet of Things is not a solution looking for a problem: it's a solution to a big, real problem – the problem of knowing everything you need to know about the physical world. That could be where things are, or where customers are, or whether things need maintenance, or something else.

The way to win is to figure out what you need to know about the physical world to make your business the best it can possibly be for your customer, then figure out how to get and use that information. This is not as easy as it sounds: most businesses have become so used to the information they have that they can't see the information they don't have – and how much their ignorance is hurting them.

Any good examples?

Here's an easy one: why didn't any taxicab services, anywhere in the world, think to create an app that matched passenger GPS information to driver GPS information to make getting a ride more efficient? Why did it take new entrants like Uber and Lyft to do that? With hindsight, it's an obvious improvement to calling for a taxi, or standing on a street corner, sticking your hand out and hoping. But it was not obvious at all, because incumbent taxi businesses were so accustomed to not knowing where passengers and drivers were, that they didn't see the opportunity. There's an information gap like that in every business. Finding it and filling it is the way companies win with IoT.

What's the next big thing after IoT?

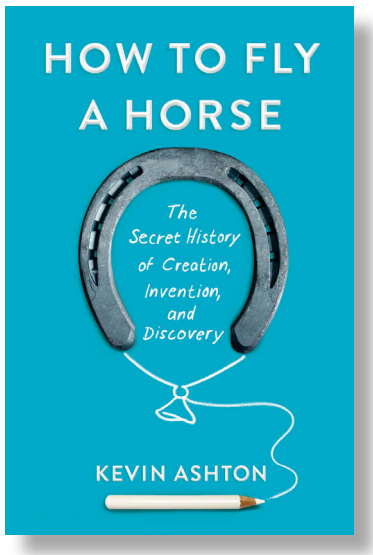
It's convenient and useful to divide technological progress into parts like chapters in a book, but, just like chapters, what comes next builds on what's gone before, making technology a continuous story, not a series of discrete episodes. The Internet of Things builds on the Internet, which builds on computing, and so on. There's no hard edge where one thing stops, and another starts, so "before" and "after" is very subjective.

What big things will build on the Internet of Things? One is "messy automation" – systems that can cope with the randomness and complexity of the real world. We are starting to see that now with the emergence of self-driving cars and robots that can sew clothes. Previously, automated systems needed everything to be precisely controlled and repeated, within very small tolerances and with little margin for error. Think of robotic arms painting cars on production lines. Those robots were just repeating the same movements again and again, very precisely, with very little sensory input or ability to understand the world around them.

As IoT becomes more sophisticated, robotic systems will get better at interpreting the world around them and making good choices in unexpected, non-deterministic situations. That will remove a fundamental constraint on automation, and opens a whole new world of applications to explore – for example washing machines that don't just clean your clothes, but sorts them from the laundry basket, folds them, and puts them back in your closet once they are clean; or robots that can perform surgery without human operators; or machines that sort trash and remove high-quality materials for recycling and reuse; or vehicles that can rescue people from dangerous environments like fires and floods.

To create is human

In his book *How to Fly a Horse* (Penguin, 2015), Kevin Ashton draws on examples from Mozart to the Muppets to reveal the hidden secrets of human creativity



> What big things will build on the Internet of Things? One is "messy automation" – systems that can cope with the randomness and complexity of the real world

Legacy Systems

SMARTER THAN YOU THINK

A world of opportunity opens if IoT is implemented in a way that makes business sense. Taking advantage of existing infrastructure is an efficient way to transform your enterprise.

By Jason Kay*

The Internet of Things (IoT) is taking the world by storm, with most analysts predicting huge things for the uptake of the technology, particularly across the enterprise. Persistence Market Research forecasts the worldwide IoT market will be worth more than $260bn by 2025, highlighting that IoT is showing no signs of slowing.

Despite the huge business opportunity IoT presents, recent research from Cisco illustrates how decision makers must ensure they remain objectives-focused when joining the movement. It revealed that 60% of IoT initiatives stall at the proof of concept (PoC) stage and only 26% of companies have an IoT initiative they consider a complete success.

It doesn't help that many of those looking to reap the rewards of IoT believe ripping out and replacing legacy infrastructure is the way forward. Although there is clearly a case for infrastructure investment, the need to disrupt need not be tantamount to huge expenditure. If the IoT solution under consideration for a business requires any kind of rip and replace, it's worth thinking twice before taking the plunge as the existing infrastructure may be smarter than you think.

> Ripping out supposedly outdated systems and replacing them with new facilities won't do the business any favors

IoT short-fallings?

The reported IoT failures in PoCs could appear to make worrying reading. IoT technology was conceived with the idea of increasing business efficiency and driving value for adopters, yet research seems to indicate that the intention of improvement is not yet being fully realized by all. If IoT deployments are failing to provide businesses with the value they set out to gain, the growth rate of IoT is surely at risk as enterprises become increasingly wary of investing in it as a result.

The reality is that businesses should not fear IoT investment. It remains firmly at the heart of many digital transformation strategies – streamlining the processes and improving efficiency. Yet, for those looking to reap the rewards of IoT, ripping out supposedly outdated systems and replacing them with new, state-of-the-art facilities won't do the business any favors. Not only will this exercise add huge costs to the project, it will also remove the infrastructure that's already there – an infrastructure that holds a mountain of data that could be put to work improving the business.

Legacy advantage

The potential business benefits of the Internet of Things are truly transformational; not only to increase productivity and save money, but also to generate more by adding value to the business's core purpose. This is fantastic in principle, but how many are willing to explore this potential if there's a huge initial investment attached to it?

Take refrigeration and cooling in the food retail industry as an example. It seems unlikely that replacing the refrigeration estate is going to appeal

*Jason Kay is CCO of IMS Evolve

to a multiple retailer whose core business focus is selling produce, as cost will far outweigh the immediate benefits. For businesses undergoing digital transformation, rather than investing in brand-new equipment they should see if the answer lies in the existing infrastructure. The data that is an increasingly vital part of many enterprises' digital strategies is already being generated – businesses simply need to find how to extract it, understand it, and release its value.

Using an IoT layer, the food retailer could tap into the available data locked within legacy machines. By integrating it with supply chain and merchandising systems, as well as with the fridge control systems in real time, the temperature of each fridge could be automatically managed to suit its specific contents. As a result, not only is the energy consumption reduced, but a higher quality product can be achieved, resulting in a better customer experience.

Likewise, within the food manufacturing industry, IoT technology at the edge can provide necessary insights to monitor each stage of the process when creating food in batches. Consistency both of ingredients' quantities and environmental factors can be regulated and the available data from each stage of the process united to ensure the highest quality, most profitable end product every time.

When venturing into the world of IoT, it is critical that businesses and their technology vendor partners take the right approach to ensure the long-term success of their project. This means taking a "business-first" stance, rather than following the "technology-first" path.

Changing the mindset

There is a requirement for a mindset shift across the entire IoT industry that makes "Why?" the first and most important question when defining an IoT deployment. Too often the purpose of an IoT project is defined by the capabilities of the technology, but just because a business can achieve something with the solution doesn't necessarily mean it should.

For industries such as food retail there is the opportunity to reap significant benefits and efficiencies from adopting IoT, but for fast-moving environments with low-margin consumer goods and high infrastructure costs, a rip and replace solution to extracting data is simply not tenable.

Closing stores or the suspending of operations runs the risk of jeopardizing customer experience, customer loyalty, and brand image, undermining the potential business value of the solution. As demonstrated by the Cisco findings, the value of IoT must be apparent quickly and with minimal downtime, or the project will quickly fall by the wayside.

This ability to release value quickly is fundamental to taking a business-first approach and accelerating the transition into digitization with low capital investment and a high return on investment.

Instead of asking the question: "This is the technology, what problems can it address?", the various stakeholders should instead be considering: "This is the greatest issue, how can technology help?"

Businesses continuously face multiple challenges, but it takes real insight and understanding of the organization and the industry to understand which solution when applied to which area will have the biggest impact on core purpose and, if addressed, offers the greatest reward.

Set to explode

It is predicted that the IoT market will explode over the next ten years, but for the industry to remain on this trajectory, a "business-first" approach is necessary and legacy equipment should not be a setback to its fruition – it should be at the heart of it. Many enterprises have all the data needed to modernize sitting unused in their current systems, and now is the time to unlock it.

Vendors must work with businesses to deliver sustainable, truly valuable IoT deployments that offer scalability, rapid deployment, and quick ROI.

There is a world of opportunity available through the Internet of Things when it is implemented in a way that makes business sense, and by taking full advantage of the existing legacy infrastructure with an IoT layer, an enterprise can efficiently and effectively transform its organization in a way that both supports and enhances its core business purpose.

Food for thought

Food retail is a good example of an industry with the opportunity to reap huge benefits by adopting IoT, but replacing existing infrastructure is simply not an option for most

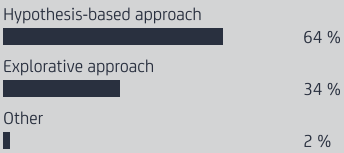
Microsoft

JOURNEY TOWARDS SUCCESSFUL IOT SOLUTIONS

1 Business Case Development

Initiate the IoT project by developing the goal/vision and ROI model

How companies start their IoT projects?



Takeaway: It is most common to start with a business model hypothesis but some just explore the technology to find value

Common mistakes

- Not starting the organizational change effort on day 1 — starting early is crucial!
- Underestimating the required time, budget, and complexity

Best practices

- Employ modern project management philosophies like design thinking and agile development
- Map the IoT skills gap to understand the kind of expertise that needs to be brought in from the outside

2 Build vs. Buy Decision

Understand the engineering requirements, the capabilities of key vendors, and eventually choose suitable vendor(s)

How do leading IoT vendors compare? (Excerpt)

Components			
Device Management	●	●	○
Operating System	●	○	●
Edge Analytics	●	○	○
Storage / Database	●	●	●
Augmented / Virtual Reality	●	○	○
Modules and Drivers	●	●	○

17 Components — 8 leading IoT vendors

● = Offering available

See the guide for a complete comparison.

Common mistakes

- Putting too much trust into one vendor's in-house capabilities to build a scalable solution instead of working with partners

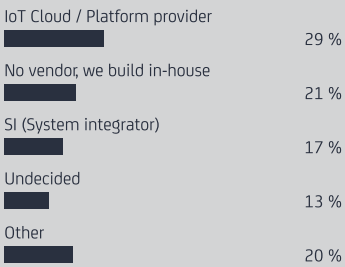
Best practices

- Map the engineering requirements across the technology stack
- Understand the ecosystem and its capabilities for the vendor in the lead

3 Proof of Concept (PoC)

Try out a number of use cases in a small but real setting and quickly assess the solution feasibility.

Which vendor is primarily in the lead to coordinate your IoT solution development?



Takeaway: IoT Cloud / Platforms are leading the way in coordinating the IoT Solution Development

Best practices

- Perform PoCs with several vendors to benchmark their capabilities
- Map the attack surface of the IoT solution and work with the "security by design" philosophy

IOT ANALYTICS
MARKET INSIGHTS FOR THE INTERNET OF THINGS

4

Initial Pilot Rollout

Work with a pilot product or a customer to implement the technology in a small but real setting

What does the technology stack look like?

APPLICATION
CLOUD SERVICES
COMMUNICATIONS
DEVICE
SECURITY

See the guide for a complete comparison.

Common mistakes

- Not building IoT systems in a modular manner
- Not building the IoT Solution on top of existing standards

Best practices

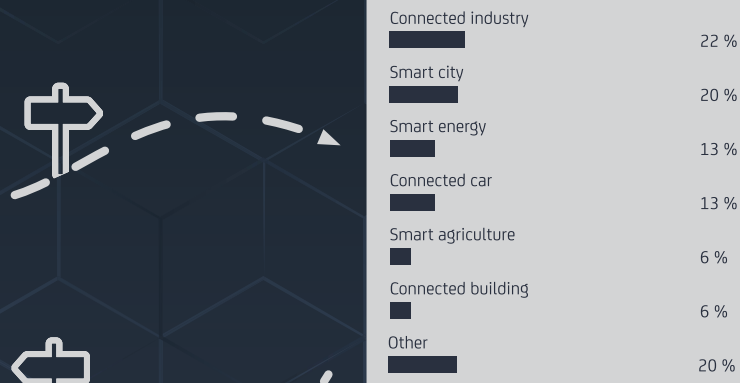
- Implement security mechanisms such as secure booting, TPM or TLS
- List adjacent IoT systems for potential future integration

5

Commercial Deployment

Roll out the solution to other products / customers / regions.

Where are most IoT projects currently being realized?



Takeaway: Most IoT projects are currently implemented in industrial settings and cities

Common mistakes

- Individual system components are initially not designed to scale to thousands of devices – requiring major redesign efforts

SUCCESS

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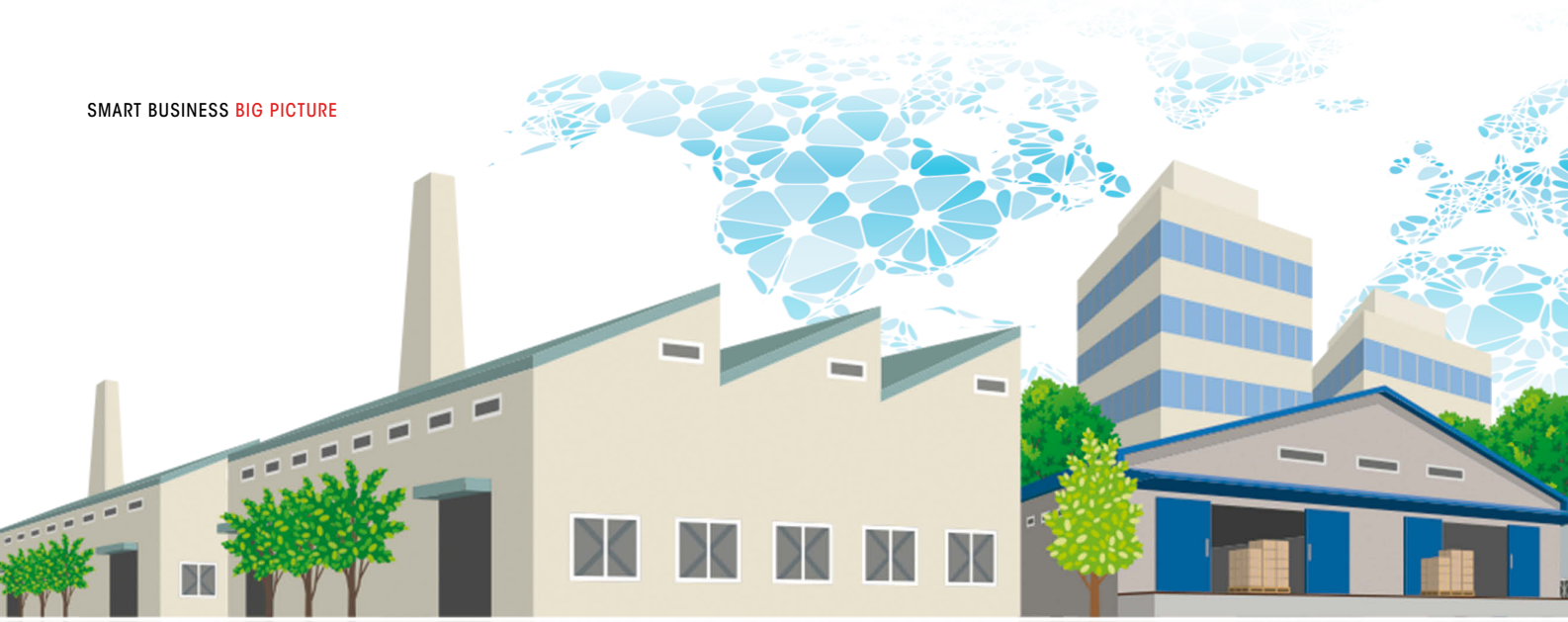
OTHER SOURCES:

INDUSTRIAL ANALYTICS REPORT 2016 / 17
https://iot-analytics.com/product/industrial-analytics-report-201617/

LIST OF 640+ ENTERPRISE IOT PROJECTS
https://iot-analytics.com/product/list-of-640-iot-projects/

Developed in partnership with Microsoft



Big Data and Manufacturing

THE BIG PICTURE ON THE BIG PICTURE

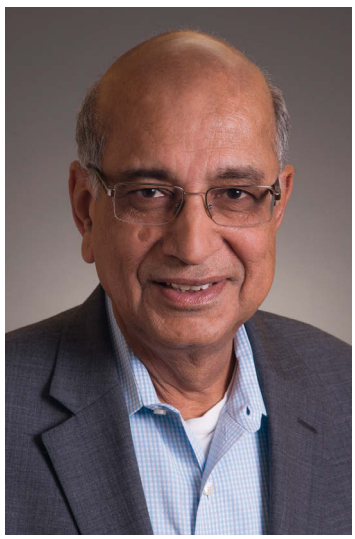
Reflections on the manufacturing landscape of America in 2018.

By Arun Jain

Remaining competitive has many meanings, depending on your location, but here are some thoughts on how manufacturers can do it better today. By the time you finish reading this another bright entrepreneur will have figured out a way to make it happen for their company.

Time-to-market reduction remains as critical today as ever. Shorter innovation cycles, resulting from new product life-cycle management software and services available to companies both big and small, mean savvy product companies can take their concept and make it fly in just a fraction of the time spent in the past – and by "past" I mean compared to about ten years ago.

With the recent rapid expansion of application-specific integrated circuit (ASIC) capability, more functionality can be built into a product today and this means the manufacturing community must become even more flexible and responsive than ever before, not merely reactive.



Arun Jain
is vice-president of Siemens Industry's Motion Control Business

With the Big Data impact that has resulted from the above scenario, the manufacturer is challenged in many ways, not the least of which is the daunting task of deciphering the important or exceptional from the merely nominal. A quality enterprise resource planning (ERP) or manufacturing execution system (MES) can tell you what you need to know, but the key elements are the determining factors that make up the inputs to these systems and how their basic priorities are set.

In the motion control world customers task us with the control, generation, or application of movement on everything from a machine tool to a packaging line; from a chemical processing plant to a printing plant. From that perspective, I see a great variety of needs among OEMs as well as end users in these various segments.

All of them require flexibility and often highly customized solutions to their manufacturing or processing challenges. In addition, maintaining high productivity on ageing equipment is a constant concern for every American company. Do they need to retrofit their existing machine or

> The really daunting task is deciphering the important or exceptional from the merely nominal

invest in a new one? Are enhanced robotics and transfer mechanisms or more personnel required on the line? Should the focus be on better asset management or on an entirely new business model, when companies are thinking about their factories or processing facilities?

Today, as the digital factory emerges in all industries, we find ourselves providing answers to these questions, not only based upon product but also in software, communications, bus protocol, and other sectors of manufacturing expertise.

The answer to a simple question from the past, such as how much motor horsepower to use, is now expanded through the availability of variable-frequency drives that can impact the choices made, depending upon the applications involved.

Tie the shop floor to the top floor

It's now a popular saying that data drives utilization. Using data smartly, however, requires an educated workforce who can take product design and turn it into viable and profitable production, regardless of the widget, chemistry, or product being made. In a world dictated by product life-cycle management needs, the correlation between design, production planning, output, and delivery, plus the monitoring of usage and returns in the field, has never been more important but also never more manageable, given the new tools available in the market today from both product and service providers. With IT as the link, today's digital factory will, as they say, tie the shop floor to the top floor.

Technology is key, but trust is even more important

A word about security. The involvement of your suppliers, especially as it pertains to the cybersecurity of Big Data, is a critical factor today. While technology may be key, so is the old-fashioned but highly underrated notion of trust.

Companies are at their most productive when they can trust their suppliers, especially those who promote a defense in depth approach to cybersecurity.

Garbage in, garbage out

ERP or MES can tell you what you need to know, but what are the factors that determine what goes into the system?

That value can often come in unseen ways, such as the access provided to your workforce for prompt, effective answers to questions. Perhaps it's a 24-hour hotline, maybe it's an on-board technical manual within the machine controller with on-screen troubleshooting capabilities, or it could be a supplier-provided training webinar that will expand the way your production teams and maintenance personnel use their machines. Taking advantage of these services will improve the productivity of your factory floor. You hear about total cost of ownership (TCO) and this is one of those subtle but very real factors driving that calculation.

Focus on smart energy management

Another key factor in remaining competitive is the cost of energy. The more a machine can do using less energy, the more efficient and profitable it becomes. That is the obvious part. How to get there can take many forms. For example, the simple notion of regenerative energy, a concept in the electrical world since Sprague's regenerative braking motor in 1886, can be manipulated and monitored by today's drives, putting power back onto the grid or using it to drive other equipment. Simply by implementing smart motors, drives, and other equipment, manufacturers can improve their productivity and boost the bottom line – a win-win, to be sure.

Lastly, safety must be paramount, not only as it protects the workforce, but because it contributes to overall efficiency and the profit picture. Fewer accidents result when there is a reduction in the mean time to repair (MTTR) and equipment is replaced before it malfunctions and possibly injures someone. This requires the implementation of both preventive and predictive maintenance protocols at your company – but it really does work, every time.

When all of the above are considered and acted upon, a business, if not an industry, can return to higher growth levels, once again.

SMART COMPANIES

London: Starship Technologies

The pizza robot is on its way

Janus Friis
Robot delivery in congested urban areas can be tricky

Ahti Heinla
Autonomous deliveries will take on sooner than many expect

Your next home-delivery pizza may very well come to your doorstep by robot. Starship Technologies aims to make on-demand delivery more efficient by having robots complete deliveries in congested urban areas, where driving can be challenging. The company claims its autonomous couriers can finish deliveries in as little as 15 to 30 minutes, traversing the streets of Silicon Valley with ease.

Founded in 2014 by Ahti Heinla and Janus Friis, two of the original investors in Skype, the London- and Tallinn-based startup has built the delivery robot to navigate busy sidewalks.

Sounds crazy? While drones need to fight new regulations (and gravity), Starship has been running tests in 16 countries, partnering with the likes of Just Eat and Domino's Pizza, and raised £13.4m (€15.1m) in funding.

Tests in Hamburg, Germany, started last summer using what Starship calls its "personal delivery devices," the six-wheeled autonomous vehicles that speed along at 6 kph and can carry loads of up to 18 kg.

Simple as pie
Customers can open the robotic storage bin by entering a code and pressing a button

Retailers and restaurants in many countries are still unsure how robot delivery technology will pan out. In the US, legal requirements are still under discussion in many states but Virginia and Idaho have leaped ahead with their own set of rules. Some countries only allow self-driving delivery on an exemption basis.

While Starship's microvan deliveries may currently be seen as a marketing gimmick for the likes of Domino's, autonomous deliveries could start to motor a lot sooner than many industry pundits expect.

starship.xyz

Chicago: Uptake

Assisting the elderly

Most of America's old industrial base is decrepit and decaying, or so many believe. What it needs is a shot in the arm, preferably youth serum – which is exactly what Uptake intends to provide, namely a way to improve some of the nation's oldest industries.

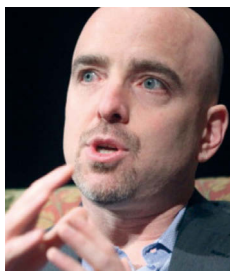
Based in Chicago, Illinois, Uptake uses analytics and predictive software to increase safety and enhance performance for companies in industries like construction, rail, aviation, and mining, according to *Forbes*.

Uptake was started by Brad Keywell, one of the original founders of the collective buying platform Groupon. He believes that the rise of connected technology, commoditized sensors, massive storage capacity, and growing processing power means every asset in every industry can generate extremely valuable data at incredible scale. This key information can answer the most critical questions across an operation and open the door to unprecedented business advantages, but he says he feels that companies are not making effective use of this wealth of data.

"Do you know that, according to [the consultancy] McKinsey, less than one percent of industrial data is being used today?" he asks.

Keywell set himself the goal of creating purpose-built products to ingest and analyze sensor and enterprise data, transforming it into actionable insights and immediate outcomes. This, he believes, can generate real business value and set new standards for productive, secure, safe, and reliable operations. "Machines don't *have* to break," Keywell maintains.

With its focus initially on safety and allowing construction, transportation, and manufacturing to use data to enhance performance, the company is well on its way to achieving its goal. The construction industry machinery behemoth Caterpillar has become a backer and Uptake is growing quickly. Formal recognition by some august institutions followed quickly. The World Economic Forum's Technology Pioneers community hailed Uptake as a leader in its field in 2016, inviting it to participate in the Forum's events, activities, and initiatives alongside larger companies like Airbnb, Google, Kaggle, Kickstarter, Scribd, Spotify, Twitter, and Wikimedia.



Brad Keywell
Creating real business value with the help of sensors and data

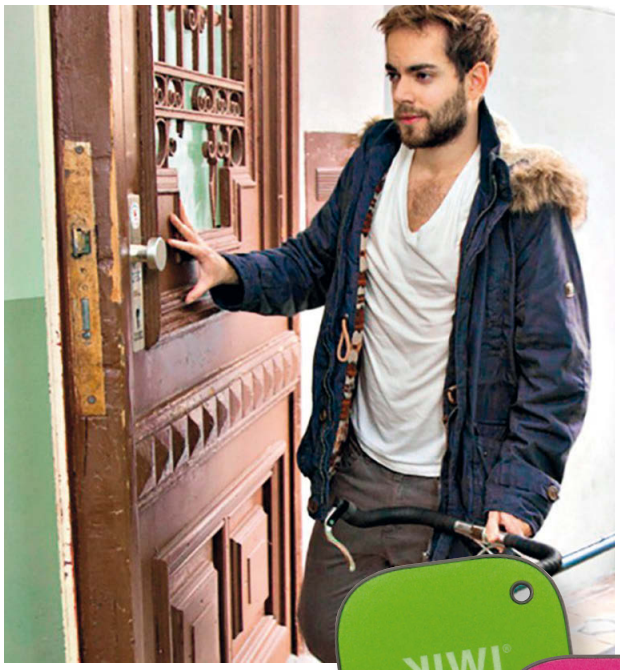
Operating hospitals is one area where Uptake has been making headway by increasing efficiency with better data usage. Keywell explains that hospital fluid delivery infusion pumps often sit idle in hospital back rooms waiting to be used, and MRI machines are often sidelined for days awaiting replacement parts. These are just two common examples of the inefficient use of medical equipment.

According to *Becker's Hospital CFO Report 2016*, hospitals spend $93bn on life-cycle costs for medical equipment, yet they have almost no insight into how medical equipment is being used and how much value it drives. With limited visibility into existing assets, hospitals are losing money, wasting resources, and putting security at risk, he believes.

Some of the symptoms of today's broken processes in many areas of industry and business include the problem of only being able to report issues after they have occurred. By understanding how individual assets are used, engineers and administrators can gain insights into asset equipment availability and performance, and dive much deeper into providing the value opportunities that surface.

The best way to avoid downtime is to create clear visibility into equipment. Enterprises must be able to collect data directly from existing hardware and incorporate it into a centralized asset management system, he says. Over time, progressive, data-driven organizations with robust equipment visibility will be rewarded handsomely with massive cost savings from reduced downtime and optimized operations, he concludes.

www.uptake.com



Berlin: KIWI

Opening doors for IoT

The story starts in 2007 when Claudia Nagel, a doctor in industrial engineering, was standing outside the door to her apartment building in pouring rain. Her baby was screaming. She was carrying heavy shopping bags in one hand and with the other she was frantically searching in her pockets and handbag for her keys.

A few weeks later, she told the story to her friend Christian Bogatu, an engineer with a background in hardware startups and IT security who she knew from her time with the consultancy firm McKinsey. Together, they dreamt up KIWI – a way of retrofitting doors to buildings for IoT by putting RFID sensors in buzzer systems to unlock doors.

Their system has two components: the "Ki," a key fob users carry around to pick up the signal locally from a transponder in the door; and the "Wi" (wireless) smartphone app to enable users to release the lock remotely.

The two young entrepreneurs want to open doors all across Europe, no less. Based in Berlin, the tiny company that aims at replacing our keyrings with nifty wireless technology has already garnered funding and partnerships – and customers, too.

In order to make sure no one is left standing in the rain, so to speak, KIWI is focusing primarily on the home market by forging relationships with service companies. At last count, the KIWI technology had been installed in 1,500 buildings, which amounts to about 15,000 apartments.

Conrad Electronics, the biggest mail-order seller of electronic consumer goods in Germany, is one of KIWI's prime partners. Another is Deutsche Post, which is interested in providing its postal workers with easy access to apartment blocks. Today, mail carriers often tote massive bunches of keys, one for every building.

"You have service providers like the post and the trash removal people, gardeners, and cleaning personnel," says Bogatu. "All of these need to open doors to do their job. All of this is a big efficiency and management problem, not to mention security."

KIWI also works with local emergency services, like fire departments and ambulance operators. "Once KIWI is installed, the firemen or medical team can get inside fast," says Bogatu. This means the technology provided by KIWI could potentially save lives one day.

Claudia Nagel
Domestic trauma unlocked a business opportunity

Christian Bogatu
We're now in a good position to get our foot in the door

What would happen if a user lost their electronic key fob or had their smartphone stolen? For these eventualities KIWI provides an app and a website where users can log in and cancel their Ki code immediately.

The company claims the KIWI system is secure and hack-proof, so nobody – neither hackers nor, for that matter, nosy landlords – can track or record information about who might walk through the door.

Bogatu and his development team are looking at other technologies that could be integrated into the keyless systems. Bluetooth would obviously be an attractive option but limited battery lifetimes have proven an obstacle until now – although some competitors, like UniKey in the United States, claim to have overcome these problems and Bluetooth Low Energy may one day prove to be an alternative solution.

For now, KIWI's focus is on conquering additional European markets, and Bogatu has secured more than €4m in funding for this purpose.

"We're now in a very good position to get our foot in the door," Bogatu says confidently.

kiwi.ki

Bucharest: DeviceHub

Enabling the IoT ecosystem

Ionut Cotoi is a man on a mission: "Digital transformation is a stunning opportunity into increased productivity and lower costs for any business, regardless of the industry, size, and location," he proclaims.

As CEO, Cotoi founded the company with two friends in 2013 to offer an integrated platform as a service (PaaS) for IoT solutions.

With an €80,000 investment boost from Deutsche Telekom, DeviceHub is targeting smart metering, fleet management, home automation, IoT makers, and the wearables market. The company has a community of over 2,000 active developers contributing to the platform.

Customers can build mission-critical, secure, and customizable IoT applications running in a centralized, decentralized, or hybrid manner. Blockchain encryption protects communications over a highly fault-tolerant backbone. DeviceHub continually collects data to help customers to analyze, optimize, and innovate their services.

www.devicehub.net

Hannover: PEAT

A growing concern

From Hannover to South America, to India via Berlin, and back again, agricultural tech startup Progressive Environmental and Agricultural Technologies (PEAT) has come a long way in its quest to tackle crop damage, a problem faced by farmers across the globe.

The idea is to let the farmer take a picture of a damaged plant using a phone and send it to

PEAT's experts to determine the cause and advise on treatment and prevention remotely.

PEAT was formed in 2015 and built an app called Plantix which now has over 100,000 users. One of the seven co-founders Pierre Munzel says the company receives between 2,000 and 5,000 images every day – many of them from India, where PEAT is working with 30,000 farmers for whom life is especially hard. With pests, monsoons, and chemical use that can render a farm useless, there are just so many negative elements at play a bit of expert help can be a livelihood-saver.

The success story has attracted the attention of investors, and PEAT recently closed on a seven-figure seed-funding round allowing the company to look into other markets. After all, growth is what PEAT is about.

peat.technology

Tel Aviv: Airobotics

Up, up and away!

Drones are taking off everywhere but especially in industry. Israeli startup Airobotics, a specialist in enterprise sector drones that don't require human involvement in any aspect of their operation, has picked up $32.5m in funding from Microsoft Ventures to expand its business into defense and homeland security, and to further increase its business globally.

Founded in 2014 by Meir Kliner and Ran Krauss, Airobotics has built an early lead in building autonomous quadcopters for industrial inspection, mapping, and security. Its drones operate from a toolshed-sized box

for charging and maintenance, and clients pay a monthly fee for their use.

Krauss argues the benefits of autonomous drones as being cost and precision. Drone operators are expensive to hire, when you can find one, and, on a daily basis, a human cannot fly a mission accurately ten times but a computer can. Drones also don't mind working in remote, rural areas.

airobotics.co.il

Wellington: Ubicquia

A moment of inspiration

Ubicquia is making cities smarter with Kairo, a customizable router that takes advantage of a city's infrastructure of street lighting.

Inspiration for Kairo came when Ubicquia's co-founder Tre Zimmerman was working on an IoT project in Rome, involving IP cameras and smart water grids. The cost of providing power was an obstacle to keeping the data recording devices on all day – then he saw a street light was still on outside his son's room in Florida at 2 p.m.

"There's a light pole every 120 feet in every major city in the world. Do the math. That's 255 million street lights just waiting to be connected," Zimmerman observes.

By using existing street lights, Kairo claims it could make cities smart overnight. Sao Paulo suffers from major air pollution but simply plugging Kairo into its light poles would instantly provide a sensor network.

Deploying Kairo meant finding a partner to help guide the product through the design process to market, which is where Avnet entered the picture. "We help customers optimize the cost profile of their product. We also help them source the right components. We help them find the right manufacturing partners. And we help them take the product to market," says Chuck Loomis, the Avnet FAE (field application engineer) who worked with Ubicquia.

"Avnet does a fantastic job in supplying its customers with FAEs to come and sit in our lab with us while we source these components," explains Zimmerman. "Then they cross-reference them from their line card to check availability and quantity, which really speeds up our process of decision-making."

Zimmerman was also impressed with Avnet's global scale and distribution, which was something he said a small startup like his could "only dream of."

www.ubicquia.com

IoT Readiness

IS EUROPE UP TO IT?

The race is on but how does Europe measure up? We look for the winners and losers to see if the Old World can take a lead in the new world of IoT.

By Alan R. Earls

The Internet of Things is inexorably reshaping the world – and Europe. From the western shores of Ireland to the Russian border, connective technology, smart devices, and analytics are coming together, offering new options to consumers and potentially revolutionary developments in agriculture, commerce, and industry. While beginnings can be detected almost everywhere, only a few countries have yet advanced far on the IoT journey.

Prospects, challenges

The Internet of Things, that potent combination of mind and matter that is threatening to upend industries and even patterns of consumption, has received a lot of attention and hype. Pundits like Gartner routinely issue pronouncements about the billions of connected devices that will soon be joining humans on the Internet.

Of course, not all the predictions will come true but it seems likely that many will – and soon. Quite simply, IoT has the potential to be as consequential as the whole age of information up to this point.

For Europe, IoT is both an opportunity and a threat. It is an opportunity for leading sectors of the European economy to stay ahead, and for others it's a fresh chance to lead.

How big is the rapidly evolving world of IoT? According to Marta Muñoz Méndez-Villamil, research director and IoT practice lead at IDC EMEA in Madrid, her firm expects market spending on IoT in Western Europe to grow from approximately $147bn in 2017 to over $274bn in 2021.

IoT activities in the manufacturing sector, one of the largest sectors for IoT investments, will reach almost $26bn in 2017 across Western Europe. That spending will be primarily driven by IoT investments to improve two main areas: manufacturing operations and production asset management. "The main objective here is to use IoT sensors to improve factory performance in the plant, as well as improving supply chain orchestration," explains Méndez-Villamil.

"According to our research, Germany undoubtedly leads the way, due to the large presence of manufacturing companies in the country and the large contribution of manufacturing to the country´s GDP," she adds.

For Germans, the focus is around cost control and efficiency gains, which are the two primary drivers of IoT investments in this sector. This not only includes large German manufacturers, but also smaller ones with innovative approaches to circumvent budgetary limitations and scalability restrictions, and the creation of multiple industry alliances to test IoT use cases, like the ADAMOS (Adaptive Manufacturing Open Solutions) alliance, she says.

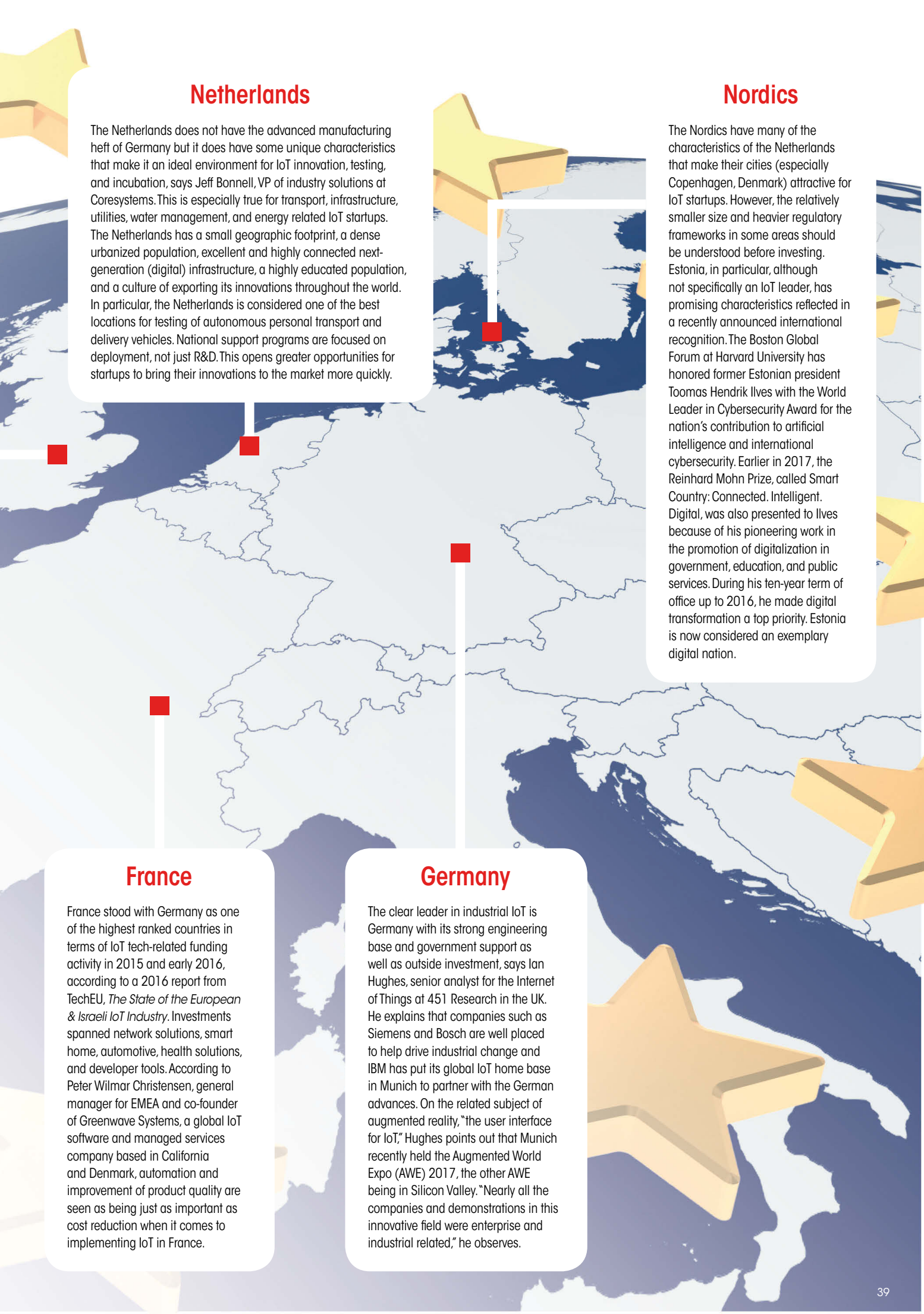
According to Software AG, an ADAMOS member along with DMG Mori, Dürr, Zeiss, and ASM PT, the organizations have established the strategic alliance for the advancement of Industry 4.0 and the Industrial Internet of Things (IIoT). ADAMOS is customized to meet the specific needs of machine and plant builders and their customers. It is a non-proprietary platform that brings together up-to-date IT technology and industry knowledge. The alliance hopes to attract other machine builders to become partners and establish ADAMOS as a global standard for the industry.

Other markets where IDC expects to see rapid growth in IIoT-related activity are Italy, France, and the UK. The opportunity in this sector is sufficiently important to have attracted players like Apple, with its recent partnership announcement with GE, says Méndez-Villamil.

In general, the infrastructures and political willingness of Europeans will dictate how the Internet of Things develops in the near future, notes Peter Wilmar Christensen, co-founder and general manager, EMEA, at Greenwave Systems, a software and managed services company based in California and Birkeroed, Denmark. ➔

United Kingdom

The UK has a track record for inventing IoT-related technologies, such as the MQTT protocol which came out of the IBM Hursley Labs in Hampshire and is now an open-source standard. The UK also has a significant startup scene and many maker spaces dotted around the country. Furthermore, there were several UK companies speaking and exhibiting at Augmented World Expo (AWE) 2017 in Munich.



Netherlands

The Netherlands does not have the advanced manufacturing heft of Germany but it does have some unique characteristics that make it an ideal environment for IoT innovation, testing, and incubation, says Jeff Bonnell, VP of industry solutions at Coresystems. This is especially true for transport, infrastructure, utilities, water management, and energy related IoT startups. The Netherlands has a small geographic footprint, a dense urbanized population, excellent and highly connected next-generation (digital) infrastructure, a highly educated population, and a culture of exporting its innovations throughout the world. In particular, the Netherlands is considered one of the best locations for testing of autonomous personal transport and delivery vehicles. National support programs are focused on deployment, not just R&D. This opens greater opportunities for startups to bring their innovations to the market more quickly.

Nordics

The Nordics have many of the characteristics of the Netherlands that make their cities (especially Copenhagen, Denmark) attractive for IoT startups. However, the relatively smaller size and heavier regulatory frameworks in some areas should be understood before investing. Estonia, in particular, although not specifically an IoT leader, has promising characteristics reflected in a recently announced international recognition. The Boston Global Forum at Harvard University has honored former Estonian president Toomas Hendrik Ilves with the World Leader in Cybersecurity Award for the nation's contribution to artificial intelligence and international cybersecurity. Earlier in 2017, the Reinhard Mohn Prize, called Smart Country: Connected. Intelligent. Digital, was also presented to Ilves because of his pioneering work in the promotion of digitalization in government, education, and public services. During his ten-year term of office up to 2016, he made digital transformation a top priority. Estonia is now considered an exemplary digital nation.

France

France stood with Germany as one of the highest ranked countries in terms of IoT tech-related funding activity in 2015 and early 2016, according to a 2016 report from TechEU, *The State of the European & Israeli IoT Industry*. Investments spanned network solutions, smart home, automotive, health solutions, and developer tools. According to Peter Wilmar Christensen, general manager for EMEA and co-founder of Greenwave Systems, a global IoT software and managed services company based in California and Denmark, automation and improvement of product quality are seen as being just as important as cost reduction when it comes to implementing IoT in France.

Germany

The clear leader in industrial IoT is Germany with its strong engineering base and government support as well as outside investment, says Ian Hughes, senior analyst for the Internet of Things at 451 Research in the UK. He explains that companies such as Siemens and Bosch are well placed to help drive industrial change and IBM has put its global IoT home base in Munich to partner with the German advances. On the related subject of augmented reality, "the user interface for IoT," Hughes points out that Munich recently held the Augmented World Expo (AWE) 2017, the other AWE being in Silicon Valley. "Nearly all the companies and demonstrations in this innovative field were enterprise and industrial related," he observes.

Citing a report from the CXP Group, Christensen says it shows there is a strong appetite for IoT technology across the continent. He believes the majority of European companies are already involved in IoT initiatives, with cost reduction being the major driver.
"The same report revealed most companies will also increase their spending on IoT over the next three years, and between 10% and 30% will increase it by more than 30%," he says.
Although major concerns around privacy and data security remain, and the General Data Protection Regulation (GDPR) is slowing down implementation, IoT is advancing quickly in certain markets. According to IDC, manufacturing is among the leading industries in terms of market share, followed by utilities and transportation.
"The industries that will see the fastest spending growth are consumer, insurance, and retail," Christensen adds.

Regional divergences

There are also variations between different countries. In Germany and the UK there is a great focus on IoT and a willingness to invest. There are technology hubs in Berlin, Dresden, and Munich, while the UK also has several projects dedicated to decentralizing its IoT development. Mobile phone provider O2 recently became the first British telco to announce it will trial 3GPP-compliant IoT connectivity tech in the UK later this year.
Meanwhile, companies across Italy see the improvement of supply chain management as the biggest driver for implementing IoT. But, when it comes to the most advanced region for IoT adoption, the Nordics lead the way with cost reduction and the development of connected products being the main motivators, Christensen says.
This landscape is creating a positive investment climate, with low interest rates and recent economic growth meaning that companies are generally willing to invest in optimization – and that is where Christensen reckons the IIoT comes into play.
"IIoT is not only big in transportation and logistics, but also in production and machinery," he explains. For example, car and truck tracking, where mobile connections link to GPS devices in fleets, has been used for many years and is now very much the norm, but going forward mobile asset tracking will be the new standard in supply chain use cases. Christensen explains: "Starting with assets with most value, they will have low-cost Long-Term Evolution (LTE) high-speed wireless communication devices – with long battery lifetime – attached to them, with assets of lower value also getting connected as the cost of the devices and services goes down."

> The main objective is to use IoT sensors to improve factory performance, as well as improving supply chain orchestration
>
> **Marta Muñoz Méndez-Villamil,** Research director and IoT practice lead at IDC EMEA in Madrid

Analytics at the edge

He adds that this trend will continue "until mobile asset tracking becomes as normal as barcodes are today."
The simplest of these devices will solely report location and build on current GPS and Wi-Fi solutions but more advanced solutions will include connected sensors to relay light levels, temperature, smoke, and the like.
"Some will even have edge analytics, so they can react to data input without needing to send it back to a data center for analysis," he notes. "While these sorts of solutions may seem a long way off, the willingness of companies to invest in such systems is high and the infrastructure is ready."
LTE can provide the connectivity these products need until NarrowBand IoT (NB-IoT), a low-power, wide-area network (LPWAN) wireless standard, become widely implemented, which is expected to be by 2020.
"When it comes to consumer IoT, we don't expect these solutions to be adopted quite as rapidly due to the price point being a major influencer on end-user trends," Christiansen says.
However, this could happen as soon as 2018, with things like bikes, handbags, suitcases, children, and dogs being among the "assets" consumers might want to connect to keep secure.
UK business consultancy Logicalis is a provider of global IT solutions and managed services. Its European chief technologist for IoT, Richard Simmons, comments: "I think it is fair to say that IoT is one of the key options and strategic goals that most customers are looking at across all verticals." He adds that they want to know how to use different IoT devices to get better connections to what they do. While there is a lot of interest, it's still a technology looking for a use case that would actually drive value, he believes.
Manufacturing has been one area of success, especially with things like predictive maintenance. IoT helps ensure better maintenance and, from an adoption standpoint, it represents a fairly controlled and well understood environment – namely the internal workings of a production machine or an appliance.
"In that world, you already have people familiar with operational tech and they know how that can be better controlled," Simmons explains.

Rocky foundations

The biggest challenge to further IoT adoption is that most customers don't have the foundation to adopt it.
Simmons says that's because large-scale IoT implementations include not only devices and sensors but also connectivity, management platforms, analytics, machine learning, and user interfaces – all of which must be wrapped in comprehensive security. It is a frustrating reality.
Simmons has talked to construction firms about the potential to automate air conditioner maintenance through IoT, a potential that generates excitement and interest. When he then asks about the details, things come to pieces.
"Do you have AC units with sensors?" No. "Connectivity?" No. "Network management?" No. "Do you have the data platform for storing data?" No. "Do you have analytics?" No.

"For most companies, it would be a huge investment to provide that foundation and in the case of that construction company the actual ROI wasn't supported – the investment was simply too big," he explains.

On the other hand, some customers may have more compelling use cases. "We work with a car manufacturer that handles 30 chassis per hour. If that line went down for 30 minutes, the costs would be tremendous, so an IoT investment is worthwhile," he says.

If the network or some other part of an IT infrastructure is coming to the end of its life, a refresh means nominal additional investments can be made to build a foundation for IoT. Then everything is ready for these use cases further down the road.

Missing links

Another impediment to adoption is that in much of Europe there are huge challenges with connectivity. That gap between connectivity need and connectivity capability represents a major barrier, according to Simmons. Where connectivity is available, creative IoT solutions emerge readily.

As an example, he outlines a smart city project his company recently completed that incorporated the monitoring of trash bins. The bins can signal when they are full enough to warrant pickup but this information is combined with weather monitoring in accordance with what analytics revealed about consumer habits. In Spain, where rain is relatively infrequent, people neglect to put their bins out for pickup when it's wet. In the UK, on the other hand, where it rains more often, people don't change their routines and bins are put out for collection at the same rate as under dry conditions.

Logicalis was also involved in a flood prevention project that used smart manholes. Service companies would typically charge about €10 for each manhole they cleaned out, regardless of whether there was actually any debris to be removed.

"We can detect which ones need cleaning, which has led to a reduction in flooding as well as operational savings from not sending people out to needlessly clean out manholes," says Simmons.

While pundits focus on the amazing things that can be accomplished by IoT, especially with the coming of 5G, there remain huge areas of Europe without 4G, or even 3G – and access is often expensive. "In many cases we have to put in Wi-Fi to allow devices to talk," he says.

The situation is no better with other potential communications protocols. Sigfox, a French company founded in 2009, builds wireless networks that connect "things" such as electricity meters but the problem is that there isn't the coverage for Sigfox networks yet in Europe, Simmons says.

The evolution of IoT

There are several things that will determine the evolution of IoT in Europe and the most important are competitiveness, innovation, standardization, and security, comments Christensen from Greenwave: "Innovation, a willingness to invest, and competitiveness are crucial for European companies if they are to keep pace with Asia. Innovation in particular makes it possible to move up in the value chain to offer more advanced products and services."

This has to be balanced with the main concerns about IoT for most companies: data security and privacy. "These elements should not be an afterthought that is sprinkled on top ➔

> While these sorts of solutions may seem a long way off, the willingness of companies to invest in such systems is high and the infrastructure is ready
>
> **Peter Wilmar Christensen**
> Co-founder and general manager for EMEA at Greenwave Systems

Germany and Industry 4.0

How to count the ways

The Industrial Internet of Things is a cumbersome term at best, so why not come up with something better? That may not have been the intent but it gave rise to "Industry 4.0." The name was first proposed by the German Federal Government's High Tech Strategy team in 2011 at the Hannover Fair. Within a couple more years, a formal planning effort emerged and the term was officially adopted by the government. But why 4.0?

The thinking is as follows:

- The first phase of industry was mechanization (1.0)
- The second phase was electrification (2.0)
- The third phase was digitization (3.0)
- The fourth phase adds intelligence, connectivity, and ubiquitous computing (4.0)

All of this was embodied in *Recommendations for Implementing the Strategic Initiative Industrie 4.0* from the Ministry of Education and Research in 2013. The report predicts: "In the future, businesses will establish global networks that incorporate their machinery, warehousing systems and production facilities in the shape of Cyber-Physical Systems (CPS). In the manufacturing environment, these cyber-physical systems comprise smart machines, storage systems and production facilities capable of autonomously exchanging information, triggering actions and controlling each other independently. This facilitates fundamental improvements to the industrial processes involved in manufacturing, engineering, material usage and supply chain and life cycle management."

of new solutions, but should be baked-in from the beginning," says Christensen.

When innovating, developers should also be aware of regulations and the level of digital culture in specific companies, because these two factors can potentially slow down implementations. Likewise, the value of data analytics shouldn't be underestimated because being able to understand and react to what is happening instantly is incredibly important for companies, especially those with mission-critical operations. Here, "implementing edge analytics can yield great results," he says.

In industry, the number of connected devices is likely to multiply five times. Today, automobiles are the big driver and holder of "most connections" but in five years, assets will also be connected, as well as all critical production equipment. "Taking all of this into account, we expect to see a pretty massive build-up of services and devices both in industrial and consumer IoT applications," Christensen says.

"We are seeing more adoptions of IoT in some areas but it is very task specific," says Simmons at Logicalis. "What we are not finding is repeatability. Instead, we find that every organization and situation is different and must be engineered differently."

Adoption and innovation also have a geographic component. According to Bonnell from Coresystems, the question should really be which cities are best positioned to benefit from IoT.

> What we are not finding is repeatability. Instead, we find that every organization and situation is different and must be engineered differently
>
> **Richard Simmons**
> European chief technologist for IoT at Logicalis UK

World of opportunities

Across Europe, important innovation hubs are emerging in cities such as London, Barcelona, Berlin, Munich, Copenhagen, Amsterdam and Zurich. "What is happening in these innovation hubs is not always mirrored across the entire country – especially those with large rural populations," explains Bonnell. For startups focused on IIoT, cities like Berlin and Amsterdam should be high on their list. "Both these cities are highly desirable for tech talent, with strong and increasingly well-funded tech ecosystems and close access to real-world testing and incubation opportunities, partners, and customers that will improve chances for commercial success," he says.

Europe offers a wealth of opportunity for companies expanding their footprint in the IIoT market and they would be wise to determine which cities make the most sense as their base, rather than deciding at the country level.

Of course, it's not possible to talk about the state of IoT in Europe without putting things into a global context – but it can be uncomfortable to do so.

"Asia is ahead of Europe and moving forward fast," warns Hughes. "China is prioritizing advanced automation [robotics] and wants to be world leader in precision manufacturing in 2050."

He considers the US to trail Europe, with Boston Consulting Group placing Germany ahead of the US when it comes to implementing or planning digital solutions in their factories.

"We expect the new wave of IIoT to offer cloud-based services which are cheap and easy to implement in existing infrastructures – and can, therefore, spread with very low financial and technology barriers," says Christensen. "For this reason, we don't expect those countries that are currently behind on IoT to stay that way for long, with all three regions poised for high-speed IoT growth in the near future."

Avoiding Babel

Plenty of initiative

While Germany has carved out a prominent vision that incorporates the concepts of IIoT in its Industry 4.0, this isn't the only alternative initiative on the continent. Indeed, the European Commission has identified numerous strategies and has proposed taking steps to align them.

In 2016, the European Commission proposed building upon and complementing the many national digitization initiatives beyond Industry 4.0, such as Smart Industry in the Netherlands and in Slovakia, Fabbrica Intelligente in Italy, and Nouvelle France Industrielle (Industrie du Futur) in France. Currently there are more than 30 national and regional initiatives.

The Commission says it plans to use its policy instruments, financial support, coordination, and legislative powers to trigger further investments in all industrial sectors, including working with member states to focus investment in public–private partnerships. The Commission hopes to encourage pooling of resources for further developments in digital technologies and platforms, including high-performance cloud infrastructure for science and innovation as well as large-scale test-beds to accelerate standards setting.

Significantly, the Commission says it will monitor the commitment by the private sector to invest on average three to four times as much as the EU investments in the public–private partnerships.

In particular, the Commission says it strongly encourages the use of the opportunities offered under the Investment Plan's European Fund for Strategic Investments (EFSI) and through the European Structural and Investment Funds.

The Commission predicts further digitization of industry could create an additional €110bn of revenue for industry per year in Europe over the next five years, citing studies by consultancies PwC and the Boston Consulting Group.

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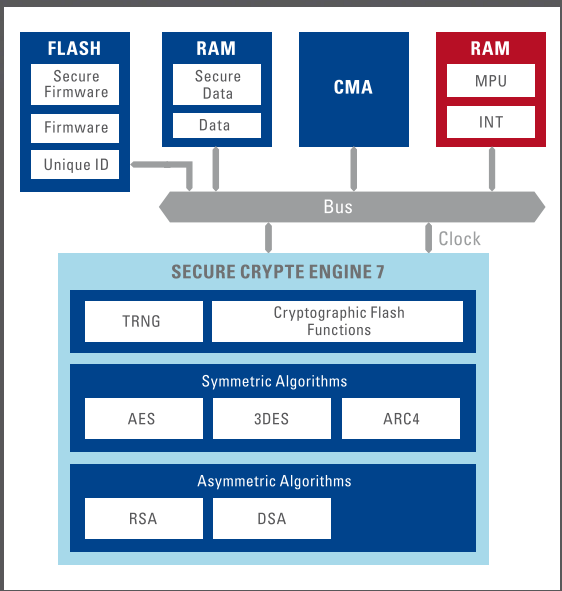

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4th Industrial Revolution: According to PwC, 85% of all companies will have implemented Industry 4.0 in most key areas by 2020.

Industrial IoT Security: WHY AND HOW?

Few enterprises are prepared to deal with the new cyber risks in the IoT world. Without a secured IT infrastructure that supports connectivity across the value chain, attempts to create the smart factory of the future will fail

By Steve Hanna

Steve Hanna
Senior Principal Technical Marketing at Infineon Technologies AG

The manufacturing sector is undergoing a transformation so exciting and promising it is often referred to as the Fourth Industrial Revolution or Industry 4.0.

Broadly defined, for a manufacturing system to be described as a smart factory, it needs to have its industrial control mechanisms connected to cloud intelligence, managed by cyber-physical control systems.

The automotive sector has always been at the forefront of innovation, and it still leads in Industry 4.0, but the move to smart factories also applies to all other manufacturing sectors. That includes industries that employ discrete or continuous production to manufacture, produce, or process items or materials, such as in power generation, oil refining, or chemical production.

The manufacturing sector knows that embracing Industry 4.0 is the only way to survive, and that the use and analysis of real-time data provides the competitive edge to work more efficiently. According to a study by PwC, 85% of the companies questioned will have implemented Industry 4.0 in most key areas by 2020. As industrial control systems become more responsive, open to external devices, and interconnected to the Internet, these systems are exposed to cyber risks which have been shown to lead to defective products, equipment damage, stalled production, safety risks – or even business-ending events.

The need and demand for industrial security

A frightening example of such an incident is the hacking of Ukraine's power grid, in December 2015, which left large sections of the population without power.

A truly smart factory needs a secured IT infrastructure that supports

connectivity right through the value chain. Manufacturers need to have plant-wide connectivity in order to link devices and share operational data with IT systems within their site, and with their suppliers, enabling automated analysis and optimization. This connectivity is of great benefit for businesses, partners, customers, and suppliers because it enables production to be adjusted to match demand, and for maintenance needs to be predicted and scheduled to maximize profits. It can also support many other novel inventions and business models. However, the integrity of sensitive equipment and confidentiality of secret designs and formulations must be protected.

Security is of critical importance in an isolated production plant but even more so in an interconnected industrial value chain.

The *2016 IBM X-Force Cyber Security Intelligence Index* ranks manufacturing as the second most attacked industry of 2015, after health care. The most targeted manufacturing sub-industry was automotive (30%), followed closely by chemical manufacturing.

According to a 2017 study by Deloitte, *Industry 4.0 and Cyber Risk: Security in an age of connected production*, the manufacturing sector is "woefully unprepared" to meet cyber threats. For manufacturing leaders, therefore, defending against these attacks should be high on the agenda.

There are signs that businesses are focusing more attention on cybersecurity. A recent IDG study predicts that, by 2020, global organizations will be spending $101.6bn annually on security hardware, software, and services, compared to $73.7bn in 2016.

The nervous system of Industry 4.0

If servers at plant level act as the brain of an Industry 4.0 "nervous system," programmable logic controllers (PLCs) equate to the nerves that control the muscles – the motors and valves.

The technology used for the different levels within the architecture differs: At the lowest level of field and control there is a lot of embedded hardware, such as sensing elements, electronic circuits, PLCs, and microprocessors. At the supervisory level, devices tend to include industrial PCs and network devices, gateways, and routers with a strong data storage and processing capability. Data streams are funneled from the whole process up to the supervisory control level.

As information flows upwards, the measurements collected by sensors at the field level are aggregated and passed to the supervisory level. Throughout this data flow between the levels, the data and the devices must be protected.

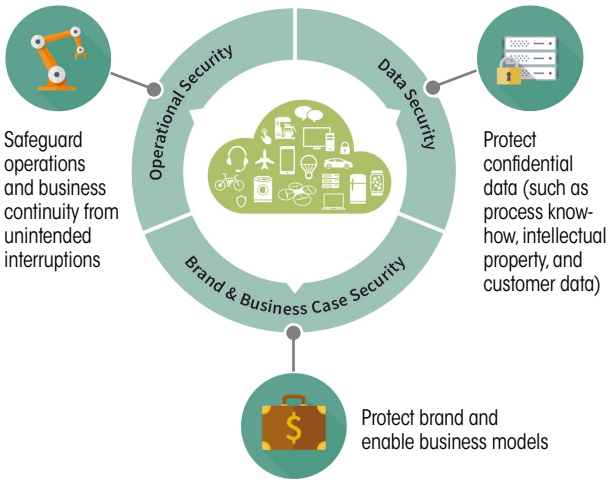
The design of an industrial control system often lacks basic security controls, such as authentication and encryption, which means that attackers can read and modify this data at will once the network is breached. They can even gain access to industrial controllers like the PLCs, alter their configuration, and corrupt the process from the control level.

As the PLCs within industrial control systems define the process flow and safety settings, an attack at this level can cause immense disruption and damage but can stay undetected. The scope of the damage is multiplied if the production site is no longer a stand-alone facility but an interconnected, smart-factory environment.

How to protect a smart factory

How can a smart factory be protected? A defense in depth approach is best. Relying on software alone to protect your industrial control system would be like trying to protect yourself from a heavy downpour with only rain boots. By far the smartest way to completely secure a process is by using strong hardware solutions and software applications together – a raincoat and rain boots strategy.

Security products are designed and tested not just on a functional level but also to resist many kinds of security attacks. Infineon supplies hardware solutions to safeguard automated industrial systems by protecting data streams and device integrity across all levels of the industrial architecture. Together with the company's network of international partners, Infineon's security controller portfolio has been designed to grow and maintain secure uninterrupted operations.



Security technologies

Manufacturers need powerful, reliable security technologies to secure communication between devices and machines within heavily networked infrastructures

Hardware security products protect industrial control systems by ensuring integrity is maintained and enabling authentication processes. Already, meeting today's industry standards usually requires the introduction of hardware security within industrial systems to comprehensively protect the most security-sensitive processes and applications.

Intelligently implementing hardware security to protect the entire manufacturing environment enables any organization to successfully protect its whole production process.

When fully integrated into an overall security strategy, reliable hardware-based protection helps industry by neutralizing the effects of cyber attacks, using proven and tested technology to protect the manufacturing process across all control levels.

In Industry 4.0

everything is nothing without security

AR and VR in Manufacturing

BEING THERE

Virtual reality is not exactly new – VR goggles have been around since the '90s – **but now virtual reality is poised to arrive on the shop floor**, along with augmented reality, both of which promise to revolutionize how things are made.

By Rainer Claassen

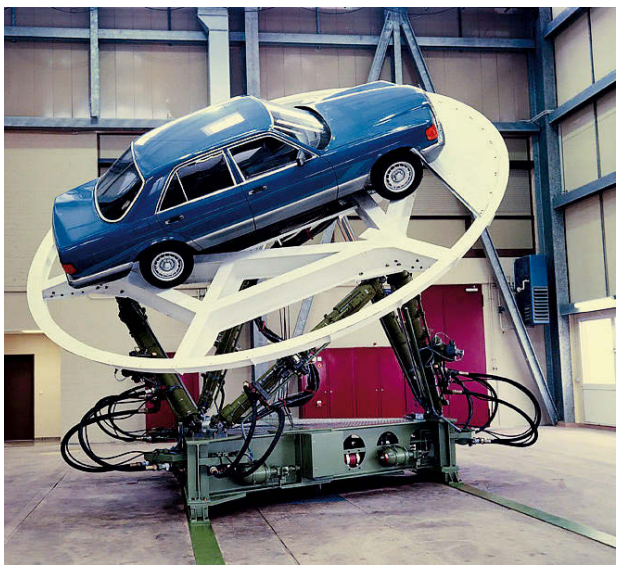
In 1985 Mercedes-Benz introduced the world's first virtual driving simulator in Berlin. A whole car could be placed on a moving platform and projectors turned the surrounding walls into a computer-generated landscape. With this device, the research and development (R&D) department was able to analyze a driver's behavior in difficult or dangerous situations, without the risk of anyone getting hurt. Back then, this called for a seven-figure investment, but today, 30 years later, kids are exploring virtual environments, wearing simple VR sets that cost less than their smartphones. Entertainment has been one of the driving forces behind the development of the technology, but it's very likely to bring big changes in the world of industry.

Virtual reality (VR) and augmented reality (AR) are similar in many ways but distinct in both their underlying technologies and the way they are used. A VR computer generates a 3D image of a desired setting which can then be experienced via a screen, a smartphone display, or VR goggles – a headset containing monitor screens that provides a truly immersive, "real-life" experience. The headsets are usually equipped with gyro sensors that precisely catch the user's every motion, allowing the displayed image to adapt to the wearer's movement. This creates the illusion of actually "being there."

More sophisticated headsets have two dedicated displays mounted inside, one for each eye. The unit is attached to a workstation that provides two high-resolution video images displayed at a rate of 90 frames per second. These systems – like Oculus Rift by a spin-off from Facebook, or HTC's Vive – also come with handheld controllers to allow interaction and surround-sound headphones to make the illusion even more realistic.

Augmented reality, on the other hand, doesn't cut users off from the world around them. Instead, by superimposing visuals and text over a camera image of a real scene, additional information is supplied which is intended to enrich the viewer's perception of reality. Smartphones are one way of doing this. When the phone's camera is pointed at something, the AR app recognizes the image and displays relevant bits of information or superimposed images into the display.

Dedicated devices like Microsoft's HoloLens are more sophisticated and allow more thorough integration. It looks like a normal pair of spectacles. Objects or textual elements are displayed in the viewing field of the user – for example a calendar from a computer could be displayed and would look like it was hanging on an empty wall. By tracking the user's



Early days
1985: the virtual driving simulator at Daimler-Benz cost a small fortune

movements, the virtual overlays always seem to stay tethered to the correct place. In combination with handheld controllers, interactions with virtual parts of the scene are possible.

Though this technology is just beginning to spread, the outlook is fantastic, with estimates predicting spending on AR technology will hit €60bn by the year 2020.

A learning process

R&D is the typical use case for both technologies but AR and VR are being adopted increasingly in production environments. Ford Motor Company uses touchscreen devices to train its assembly line workers when new processes are introduced. A model of a work space on the assembly line is displayed on the screen. In the first step, the actions the worker has to do are demonstrated. As the learning process advances, the demo becomes more sophisticated in four steps. In the last one, the user has to choose all the tools correctly and use them in the right way. This system allows workers to learn new skills without disrupting work at the assembly line – and without the need to withdraw an experienced worker.

VR can also be useful before production even begins. It takes architects to fully understand blueprint plans of structures, and it takes engineers to read details of a construction plan. With VR technology it is now possible to take the data from the two components and put them together to build a 3D model of a finished construction site before the first brick has been laid.

Now that it no longer takes expert training to understand and judge these models, the CEO of a corporation can wander through the virtual building and get a vivid impression of the current status of the work just as clearly as a worker who lives with the construction every day.

Mistakes in planning that would not have been apparent before the building was completed can now become glaringly obvious much earlier.

To make this possible, it's necessary to "translate" construction data from different sources into formats suitable for visualization – a task that is not always easy but, as the demand is growing, solutions are developing.

Engineering software developer and consultancy Salt & Pepper, located in Osnabrück, Germany, specializes in data transfer and visualization.

CAD and 3D models can be transformed through its Forestage tool for virtual reality displays on HTC Vive, Oculus Rift, or Google Cardboard. This can be done in seconds and the software is more or less intuitive, say Timo Seggelmann and Fabian Scharmann of Salt & Pepper. Clients include companies like Claas, a producer of farm machinery, and carmaker Daimler.

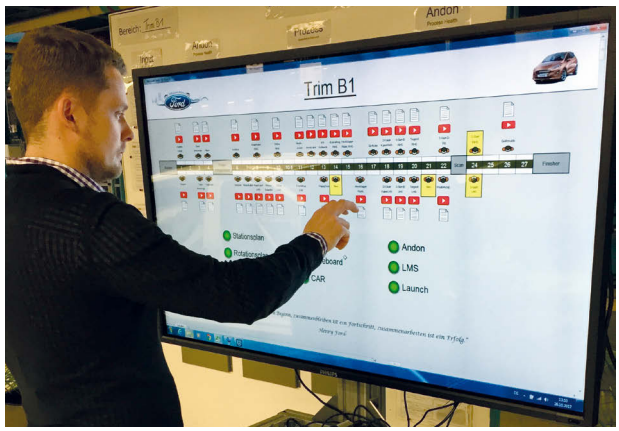
When using tools like Vive users are not limited to just watching the virtual surroundings – they can also interact with them. Forestage is able to import metadata from construction plans – so moveable parts can actually be "picked up" in the virtual world with a handheld controller as the user moves within the virtual surroundings to view things from different angles.

Augmented workplace

On the shop floor, scenarios for augmented reality are somewhat different. Service companies like Munich-based Reflekt focus mostly on themes such as service and maintenance operations and training. Similar to the earlier examples, Reflekt's tools can also be used with construction data.

One of the typical use cases for AR lies in maintenance where technicians can be guided through inspection procedures, and benefit from features like screenshots, displays of relevant measurements and values, as well as automated creation of inspection reports. Recurring repair procedures can be simplified and the frequency of errors reduced drastically when an AR guide is used instead of traditional printed descriptions.

Similar to the example from Ford, training the workforce can also be made a lot more efficient with AR. Italian mixed reality company Inglobe Technologies has developed a post-installation checking solution for the Huawei SUN2000-25KTL inverter – a piece of equipment employed in large industrial solar power applications.



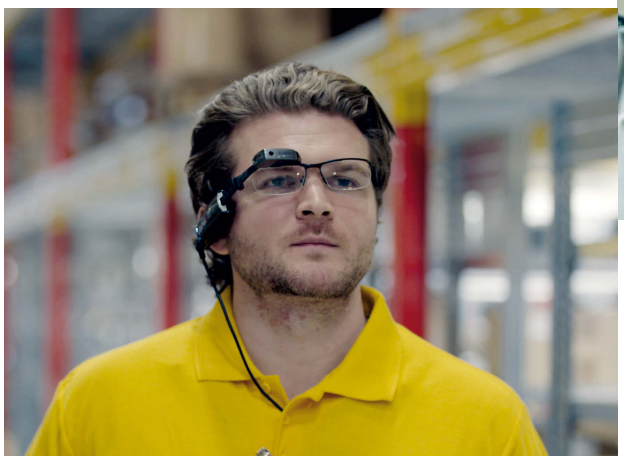
The right choice
Workers at Ford can learn without disrupting the assembly line

> Spending on AR technology is predicted to hit $60bn by the year 2020

Technicians can follow step-by-step instructions with augmented reality graphic elements and animations to perform assembly and wiring operations, quickly and easily locating the access points on the equipment and performing technical assignments. During the process, the technician is aided in choosing the most suitable tools for executing individual tasks.

AR technology has other benefits. In the production facilities of Bergolin, a medium-sized paint manufacturer in Northern Germany, the HoloLens has become an important part of the production work. Production staff are required to wear heavy chemical-resistant gloves and had to remove them before entering feedback into the company's terminals, which are located in specific places. With the introduction of HoloLens, the facility is now equipped with virtual mobile terminals and 3D touchpoints, which can be virtually displayed anywhere in the room and can even move along with the user. Simple hand gestures allow the recording of all job data in real time, so the entered information is available immediately – and fewer errors occur when entering the data. Not only is the cost of providing ➔

VR pioneers
Timo Seggelmann and Fabian Scharmann of Salt & Pepper convert CAD data into virtual reality with the help of their Forestage tool



Look, no hands!
Hands-free pickup at DHL can actually be fun

the interface low, additional savings have been made by Bergolin because the old terminals' buttons, switches, and dials are no longer needed.

AR completely changes the way user interfaces work. Virtual control panels can be superimposed directly on a machine, which can then be operated by hand gestures and voice commands. Workers wearing smart glasses are able to walk along a line of factory machines, see their performance parameters, and adjust each machine without physically touching it. Maintenance can also be done with the help of remote experts, who can almost literally see things through the eyes of the operator.

At its engine plant in Győr, Hungary, Audi has done some AR testing in the area for assembly of original parts, where engines are built by hand in accordance with customers' specifications. The production process takes several hours and some shelves in the engine assembly area have up to 200 compartments for small parts, many of which look very similar.

With a plant pass and a QR code, assembly workers check into their workplace and individual assembly orders are loaded from a central server into the Google Glass spectacles each worker wears. The individual steps of the assembly process for the given engine version are shown over the worker's right eye in a picture and text presentation. Although Google stalled the development of Glass as a gadget for private use, this project shows how AR can be of great benefit in production facilities.

> Workers can adjust each machine without physically touching it

No more science fiction

As in the Salt & Pepper VR application mentioned earlier, AR can similarly help in planning production facilities. A virtualized model of a construction machine can be positioned on the ground, created using actual planning data. Engineers and workers can walk around it, or even go inside, to gain a full appreciation of the sight lines and ergonomics of the design at full scale in its intended setting.

Does all this sound like science fiction or something restricted to big players with huge budgets? Companies, like CMC Engineers in Hülben near Stuttgart, are starting to address SMEs who are doing specialized engineering work, such as CMC's ViewR VR software. The SMEs offer complete solutions that can be operated by clients without long training processes – and the investment does not have to be in the five-digit area.

Gloves on
Paintshop workers at Bergolin can leave their protective gloves on when operating a virtual computer terminal

While shop floors are just beginning to make use of AR, larger steps have already been made in logistics firms. DHL Supply Chain, a contract logistics specialist within the Deutsche Post DHL Group, has completed global AR pilots for its Vision Picking system and is now expanding its use to warehouses around the globe.

The smart glasses used provide visual displays of order-picking instructions along with information on where items are located and where they need to be placed on a cart. This frees the pickers from having to collect and carry paper instructions and allows them to work more efficiently and comfortably. The trials have shown an average improvement in productivity of 15%, along with higher accuracy rates. The user-friendly and intuitive solution has also halved onboarding and training times.

DHL's employees have been enthusiastic about being able to use state-of-the-art technology. They are happy with the comfortable smart glasses and now actually enjoy the process of hands-free picking. VR and AR environments seem bound to make production more efficient and transparent while reducing mistakes – but they also make work a lot more fun.

Mixed reality
At Huawei, VR assists in assembly and wiring of solar power inverters

Step by step
Workers at Audi's Győr plant in Hungary are shown how to assemble engines by hand

VR and AR headsets that are available in the market

Though both of them are most popular among gamers, Oculus Rift **(1)** and HTC Vive **(2)** VR headsets can also be used in industrial settings. One of the first AR products for the public was Google Glass **(3)**, which was removed from the market in 2015. In summer 2017, X Company in California started promoting Glass Enterprise Edition especially for industrial and business use. Probably the best known AR headset is Microsoft's HoloLens **(4)**, but there are competitors like Meta's Meta 2 **(5)**. As an alternative to transparent glasses are headsets with integrated cameras, like HP Windows Mixed Reality **(6)**

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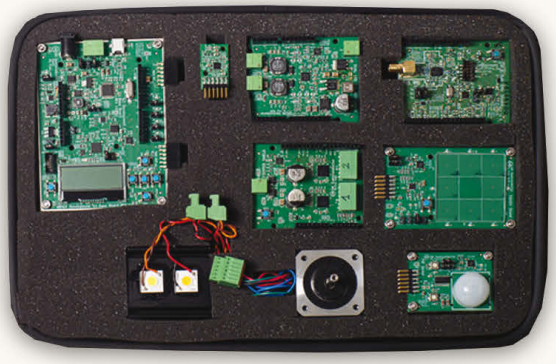

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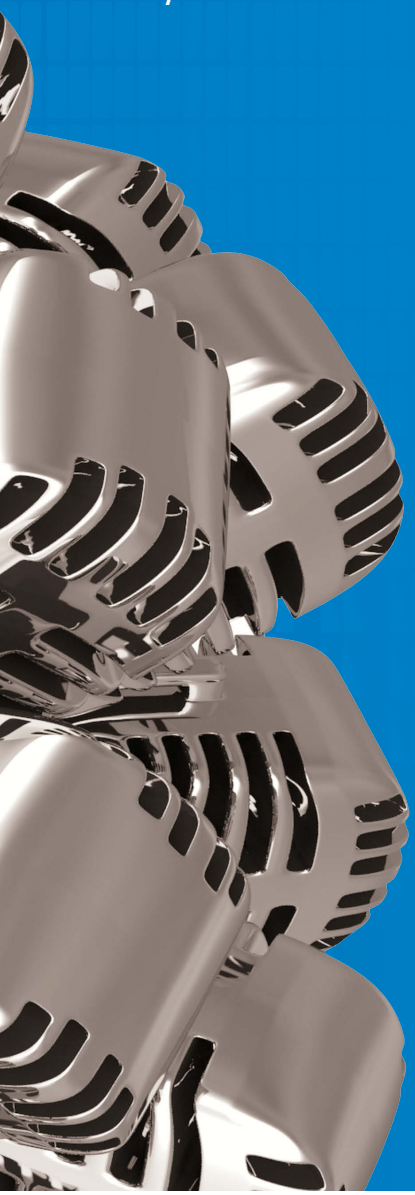
Interface Design

THE VOICES OF IOT

Voice is the next big platform and it may very well deliver the smart home hub everyone is waiting for. How does this new interface model fit in with the rest of the digital world? And what does the voice market look like today?

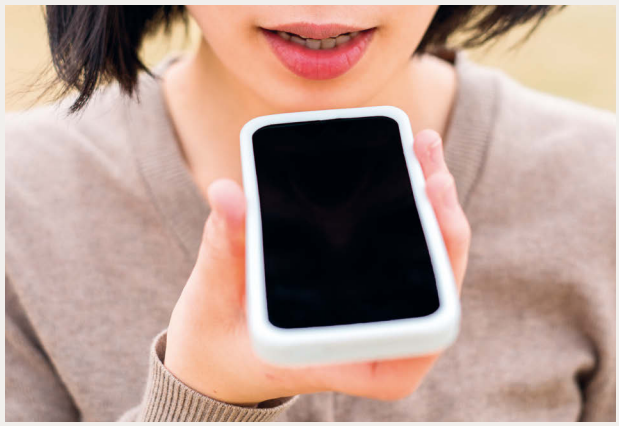
By Marcel Weiss



The Amazon Fire Phone was a spectacular flop and, in hindsight, one of the best things that could have happened to Amazon. Instead of perhaps gaining a comfortable third place in mobile, Amazon was delegated to remain as "just another app" on someone else's platform. While Apple and Google were hard at work dividing up the gargantuan mobile market between them and crushing former operating systems giant Microsoft, Amazon could look elsewhere.

Unencumbered by mobile, Amazon built and released the first version of a new kind of standalone gadget in late 2014. Thus Echo, the leading contender as winner of the "next big thing™" was born and it took Google until 2016 and Apple until 2017 to bring their own smart speakers to market. Though Apple and Google continue to dominate mobile, Amazon seems poised to rule in the home. This is a big deal for the Internet of Things. IoT is often seen as the next big thing after mobile and, in the end-consumer market, the biggest missing piece of this puzzle has always been the actual glue that holds it all together: the essential platform and, with it, the front-end interface.

Let's take a step back. Is voice the next big thing? Will voice finally be the harbinger of a truly smart home? Will voice be the natural interface for smart homes? Or, more precisely, will smart speakers turn into the smart home hubs holding it all together?



Talk to me!

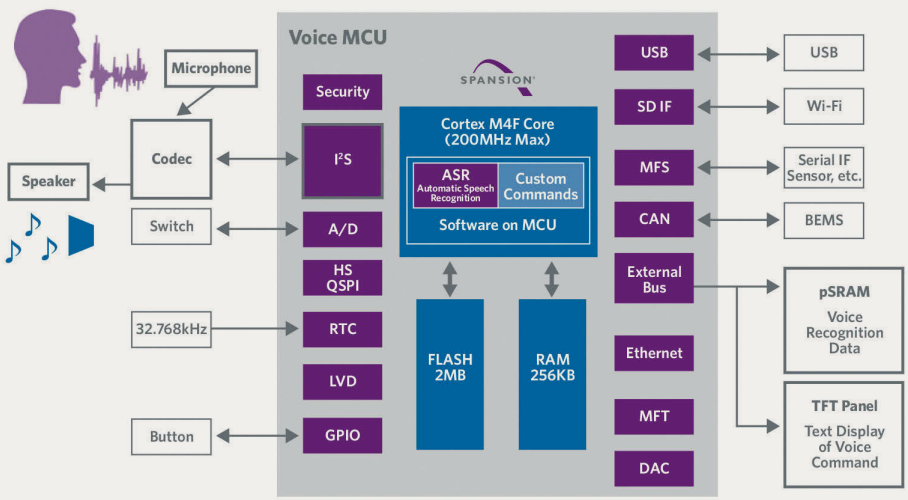
Voice is a natural way to interact with our technology, but constraints remain

Voice is a more natural way of interacting, or "communicating," with devices than using a graphical user interface (GUI).

On the other hand, voice is also very much constrained. Using voice is not the best way to do something that consists of several steps, or is overly complex, because it requires a lot of data points or options. This lays bare the fact that pure voice as an interface, meaning no screens, is more akin to a terminal than it is to a GUI within the larger interface family.

We are entering the age of additive interfaces

Which brings us to another trend in interfaces. Think about their future, which is more than "just another ➔



Not that easy

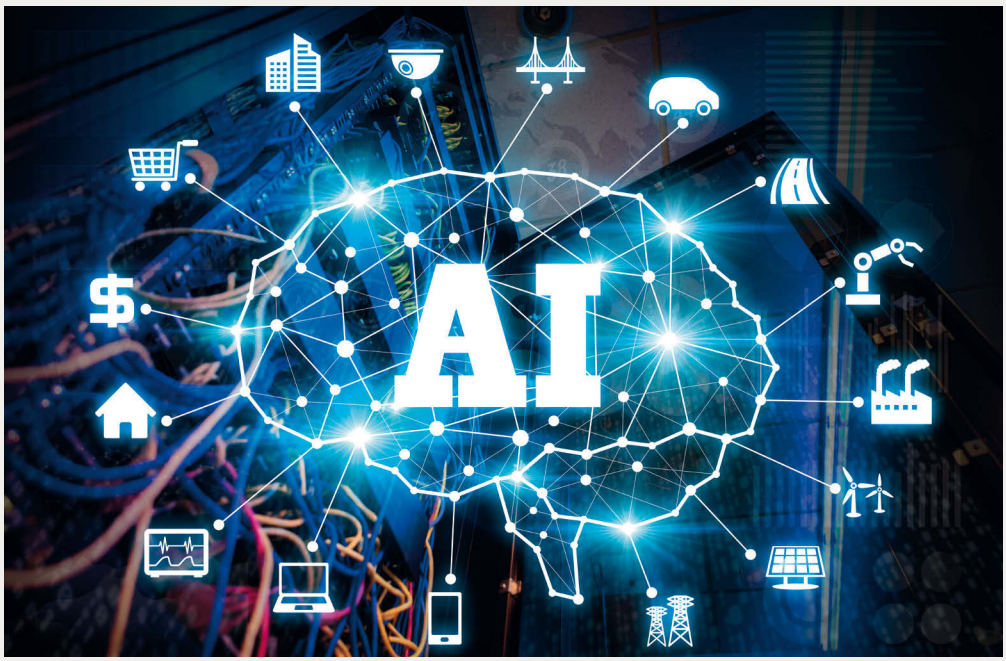
Multipoint Control Units (MCUs) play a crucial role within complex voice server systems

photo ©: Spansion

aspect" of the future of technology. We have to do away with a rather dominant assumption: one type of interface replaces another type of interface. This is not true. After the big, and ongoing, switch from mouse plus keyboard to multi-touch (plus keyboard), we are entering the age of additive interfaces. Smartphones and multi-touch are not going anywhere, they're here to stay. But now they've got company. Voice is clearly an additive interface. Voice makes some interactions easier but is not better suited than a GUI for others. And a new additive interface is rising – augmented reality.

Showstopper
Alexa has been the secret star of CES for two years in a row

What uses are more suited to voice? Broadly speaking, you can split user interactions with smart devices into two segments: the initial setup phase, and day-to-day usage. Setup, at the very least, requires the authentication of yourself, or the services and the networks which connect to the device. Even if everything is kept in the default state, this often proves more complex for users than the second phase, the actual use. A GUI makes more sense for this first phase and that's why every voice system is accompanied by an app for setting things up. The second phase involves repeated actions and this creates space for voice. Think about it in the context of the smart home: turn on your lights by voice, trigger predefined "scenes" by voice (turn lights off and turn TV on, for example), control connected kitchen appliances by voice while cooking, and so on.



Under control
Voice allows interaction with all kinds of smart devices and apps

Voice is only a subset of conversational interfaces

A new catchphrase, conversational commerce, emerged in 2016. Broadly speaking, this is regular e-commerce performed in a "chatty" way using a conversational interface. The voice interface may be incorporated in a mobile chat app using text con-

version or voice through a smart speaker. The interesting aspect from a developer's perspective is that once you have built your bot/AI, it doesn't matter much whether your customers engage through text or audio. Considering voice as a subset of conversational interfaces immediately increases its usefulness.

Conversational commerce is where Amazon is making money with Alexa. Voice is perfect when reordering consumables, for example – simple, repeated actions. Amazon has now built a more convenient way to buy consumables and other products by connecting Alexa with Prime – and it is the biggest player in standalone voice gadgets through the company's growing Echo speaker family.

Voice is still an open field, especially for non-English-speaking markets. While Apple's Siri can support 21 languages (localized for 36 countries), only eight are supported by Microsoft's Cortana, four delivered in Google Assistant, and currently Amazon's Alexa has only two (English and German). Amazon Echo has three years of experience; Google Home, the first to follow, was released two years later in 2016; last summer, Alibaba released its Echo-like speaker Tmall Genie; and, barring any further delays, Apple's Homepod should be hitting the first homes around the time you're reading this.

While there are, by far, more phones with Siri or Assistant onboard, making the potential customer base for those smart assistants bigger, it is the far smaller, smart-speaker market that matters. This is especially true for the Internet of Things. A dedicated communal voice-based device can become a smart home hub but a smartphone, which is personal, cannot.

Amazon is building its own operating system

Alexa is the best example to study because, first, voice is not bound to screenless speakers and, secondly, Amazon is a fierce platform company determined not to lose out to any rival consumer-centric platform plays.

Amazon has introduced Echo Look, an Echo with a cloud and AI-connected Style Check camera, and Echo Show, the first Echo with a screen. More importantly, Alexa has been the "secret" star at the influential CES show for two years in a row.

Through 2016 and 2017, numerous companies announced Alexa-enabled gadgets. Amazon is effectively making its own operating system – in the cloud, voice-based. And many of the other big companies are joining in – no one wants to miss out. Facebook may use Messenger and WhatsApp to build its own voice platform. Samsung is now trying to push Bixby (formerly Viv) from the people behind Siri, but with mixed results – the dedicated Bixby buttons on the Galaxy S8 and Note 8 are universally hated by users. In our previous issue, we showed how even a former giant like Nokia is getting in on the action: *Corporate Comeback with IoT: Reinventing Nokia... Again.*

The application level is even more interesting than the OS/platform level. What do the emerging voice markets mean for current and new brands and manufacturers?

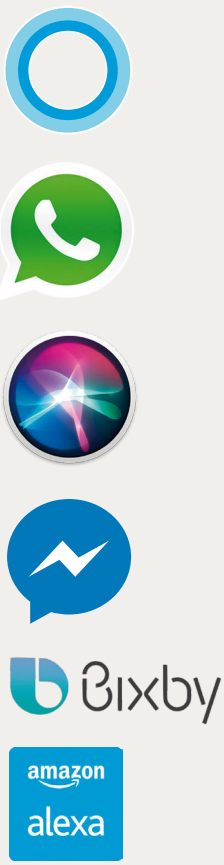
Premium speaker brand Sonos is the first example pointing to where we are heading in the voice space. Sonos One supports Alexa right out of the gate and will add Google Assistant in 2018. Sonos' implicit modus operandi is: we'll build the best speakers and will support all major voice platforms that allow integration.

Homeware company Ikea is doing something similar with its first smart home product family. Its Tradfri smart lighting system supports Alexa and Apple HomeKit, and can connect with Philips Hue gateway. What Sonos and Ikea are doing is referred to by economists as "multi-homing" because they support several platforms simultaneously and thereby slightly decrease the market power of those platforms.

In the sci-fi TV series Extant, Halle Berry plays a near-future astronaut. Anyone interested in interfaces, the Internet of Things and where things are heading in the consumer space should take a look, at least at the pilot episode. It provides a well thought-through picture of where we are heading: a world where voice tech is everywhere and any surface can be an interface, invisibly connected and equally invisibly user-authenticated – FaceID, anyone?

That world is approaching fast.

Northern lights
Ikea's Tradfri home lighting system can be voice controlled via Alexa or Apple HomeKit



Mixed results
Samsung's Bixby is struggling to catch up with Amazon's Alexa

Robot 2020

JOIN THE CONVERSATION

Robots have hands and feet, arms and legs, a torso of some sort or another, and a kind of head sitting on top, maybe with bulging, fly-like faceted eyes, or camera lenses that stare back at its human master. If that's what you think robots of the future will look like, think again. Chances are **robots in 2020 and beyond will look more like a can of sardines**.

By Tim Cole


source: hanson robotics | photo © Andrew Lipovsky/NBC@fallon.tonight

A star is born
Robot Sophia makes a guest appearance and meets Jimmy Fallon on NBC's Tonight Show

In recent years we have seen a host of machines that perform household tasks like vacuuming the floor, carrying out the trash, or mixing a cocktail in the evening. As always, appearances are often deceptive and in reality robots will probably simply talk to us, answer our questions, remind us of appointments, and just generally be there when we want them.

Yes, they will perform tasks for us, but these will be more in the nature of knowledge work: finding flights and booking a ticket, contacting a favorite restaurant to see if there is a table free, scheduling a doctor's appointment, or whistling up a cab. We need to rethink our notions of what a robot really is.

The preconceived idea of a humanoid mechanical servant that will constantly be at our beck and call harks back to the days of butlers and housemaids (or, worse, to human slavery). That is not what robots are destined to become, says Nicholas Carr, author of numerous bestsellers such as *Utopia Is Creepy: And Other Provocations*, *The Shallows: What the Internet Is Doing to Our Brains,* and *Does IT Matter?*

Carr has proven uncannily accurate at predicting important future trends in technology and in a recent opinion piece for *The New York Times* he mused about the future role, and appearance, of robots, writing that "a robot invasion of our homes is underway, but the machines – so-called smart speakers like Amazon Echo, Google Home and the forthcoming Apple HomePod – look nothing like what we expected. Small, squat and stationary, they resemble vases or cat food tins more than they do people."

Marketed as smart speakers, these devices are powered by chatbots.

> Smart speakers are oracles of the countertop. They may not be able to speak for the gods but they can deliver reports on news, traffic, and weather
>
> **Nicholas Carr**
> author of numerous bestsellers

Apple's Siri and Amazon's Alexa have already become household names in America, but acceptance is widening almost daily. In China, Xiaoice has become a digital friend to millions since being introduced by Microsoft in 2014.

One reason the tech giants are fixating on chatbots is that there is a widespread feeling today's technological limitations will soon be overcome. Anyone who has interacted with a digital assistant knows how frustrating it can be. Chatbots are often overwhelmed the minute a conversation goes beyond very basic requests.

Conversation creates huge amounts of data

Recent advances in artificial intelligence (AI), especially in self-learning algorithms, have opened the door to much more sophisticated chatbots. Microsoft, for instance, designed its Cortana chatbot from the beginning to get smarter with every use, both by learning about the world and the people with whom it interacts, fine-tuning itself to anticipate the wishes of individual consumers. Every use of these AI-powered conversational interfaces is building huge amounts of data which, over time, will make these systems even more useful.

Another reason for the sudden hype wave about chatbots is down to the customers themselves and their changing habits. In 2015 the number of active users each month on ➔

China calling
WeChat claimed to have more than 760 million users in 2016

messaging apps quickly surpassed the number of active social network users, according to a report from news website *Business Intelligence*. One year later, WhatsApp reached the one billion user mark, meaning roughly one in seven people on the planet use the Facebook-owned platform. WeChat, its Chinese competitor, claims to have 768 million users logged in daily, as of September 2016.

In tandem with smart speakers, chatbots, essentially talking computers, have been quietly entering homes around the world. According to the market research company eMarketer, there were more than 35 million of them in American homes in mid-2017 – more than twice as many as just a year ago. McKinsey, an analysis company, predicts that three quarters of US households will own at least one of the gadgets by 2020.

"It's not hard to understand the attraction," Carr says. "Smart speakers are oracles of the countertop. They may not be able to speak for the gods but they can deliver reports on news, traffic, and weather. And they have other talents that their Delphic ancestor couldn't even dream of: they can serve as DJ. They can diagnose ailments and soothe anxieties. They can read bedtime stories. They can even bark like a watchdog to scare off burglars. And they promise to be the major-domos of home automation, adjusting lights, controlling appliances, and issuing orders to specialized robots like the Roomba vacuum cleaner."

Building a humanoid robot is tricky. Illah Nourbakhsh, a Carnegie Mellon University professor who specializes in robot design and is author of the book *Robot Futures*, reminds us that it requires advances not only in artificial intelligence but also in the complex hardware systems required to enable movement, perception, and dexterity.

"The human nervous system is a marvel of physical control, able to sense and respond fluidly to an ever-changing environment," Nourbakhsh maintains. Achieving such agility with silicon and steel lies well beyond the reach of today's engineers, he argues.

Building a chatbot and channeling it through a set of smart speakers, on the other hand, is child's play for the big tech companies such as GAFA (Google, Apple, Facebook, Amazon) and their peers. After all, messaging has become a major way for people to interact with their smartphones, so companies want chatbots to literally become a part of the conversation. For example, a group of friends could be discussing evening plans and a chatbot would seamlessly order movie tickets. Oracle recently surveyed major companies around the world and found 80% plan to use chatbots for customer interactions by 2020 and 36% have already started implementing them.

As the dominant player in the field of messaging services, Facebook with its Messenger platform and ownership of WhatsApp is poised to take the lead. Facebook has 1.2 billion people using Messenger currently and over 100,000 active bots monthly.

Mark Zuckerberg recently showcased an AI-powered virtual assistant, code-named "M," to a handful of tech journalists. When M faces a question it can't answer, it calls on human backup. Each time an intervention is required, M learns from what its human helpmate does. It can parse conversations, either locally through smart speakers or online, for certain keywords and contexts. Let's say you need some money or want to take a trip, M can suggest ways to transfer money or hail a ride-share service. Users can tell M to share music, order food, or split a restaurant bill without leaving the conversation.

> The human nervous system is a marvel of physical control, able to sense and respond fluidly to an ever-changing environment
>
> **Illah Nourbakhsh**
> is professor at Carnegie Mellon University, specializing in robot design

The next big way to use computers

Microsoft CEO Satya Nadella believes chat-based interfaces will eventually become the primary way people use the Internet, replacing the graphical user interface, the mouse, and touch-screens as the next big way to interact with computers.

"Intelligence will be infused into all of your interactions. That's the rich platform that we have," Nadella told the audience at Build 2016 in San Francisco, where he unveiled his company's grand vision of "Conversation as a Platform" – making bots that understand natural language the next big way to use computers. Conversation as a Platform, he believes, will "funda-

mentally revolutionize how computing is experienced by everybody," in a paradigm shift comparable to the development of the web browser.

Microsoft showcased how this might work using Skype, which it acquired in 2011 for $8.5bn, demonstrating how Cortana can team up with various bots to plan a holiday – all without leaving the chat window. The company also unveiled what it calls the Microsoft Bot Framework: a toolkit of code and machine learning programs to enable anyone to build their own chatbot.

Amazon has been following Microsoft and Facebook's lead by creating Lex, a powerful conversation interface tool that uses the same technology as their Alexa chatbot. The company allows developers to create conversational apps or chatbots for chat services, IoT devices, or messaging services using a simple set of tools. In Amazon's shareholder letter in 2017, Jeff Bezos told investors to "watch this space. Much more to come." Analysts believe Amazon's focus will be on bringing AI to companies via Lex, with attention on personal assistants for shopping.

With over 10 million Echo devices sold, Amazon has its feet firmly placed in the smart speaker market; it is now looking for technologies that would allow it to continue to dominate retail commerce in the long term.

As with every new technology, there are fears that chatbots and smart speakers, the new robots, will not only have benign effects. Nicholas Carr worries that "whenever you chat with a smart speaker, you're disclosing valuable information about your routines and proclivities."

Smart speakers, he argues, not only provide a powerful complement to smartphones but, equipped with sensitive microphones, they will also serve as in-home listening devices that greatly extend the ability of their makers to monitor consumer habits. Big Brother, he fears, will not be watching us surreptitiously; he will be sitting right there on all our living room tables.

Changing the way people use technology

However that may pan out, smart speakers and AI chatbots appear to be here for the long run. The main reason will probably be convenience, says tech writer Jon Walker, who has been following the "Big 4" technology firms and their chatbot plans for years. "You just ask and it happens," he says.

His view of the future is optimistic: "Based on Facebook's experiment with an AI assistant that has human back-up, it seems that if people have access to a really great assistant program they will use it frequently." In the meantime, big companies like Microsoft, Amazon, and Facebook are investing heavily in the technology behind this generation of stationary robots and personal assistants, and betting they will soon become smart enough to change the way people use technology. At the moment, using a smartphone or accessing dozens of apps requires users to take dozens of different actions. That may soon become a thing of the past. Interacting with our machines may soon seem like sitting around and shooting the breeze with a few friends.

> Conversation as a Platform will fundamentally revolutionize how computing is experienced by everybody
>
> **Satya Nadella**
> Microsoft CEO

Public Transport

THE INTERNET OF BIKES

Bike-sharing is growing with breathtaking speed all over the world. **Thanks to IoT technology, the systems are improving just as rapidly,** bringing dramatic changes to urban mobility.

By Rainer Claassen

In 2004, I had a really remarkable experience. I had a six-hour layover at Copenhagen Airport during an international trip, so I decided to have a look at the city instead of the tax-free shops at the airport.

As I came out of the subway that had taken me downtown, I noticed some bicycle stands with lots of colorful bikes attached to them by chains. By inserting a coin, they could be unlocked, taken for a ride and returned at any of the many stands spread across the city, where you could get your deposit coin back.

Taking the bike gave me a chance to see the opera house, the castle, and, of course, the famous statue of the Little Mermaid – without even paying a dime. For me, on a sunny day there is no better way to get around a city than by bike. Back then, a system like this would only have been feasible in a peaceful and prosperous country like Denmark.

A worldwide megatrend

What was a pioneering project in this Scandinavian metropolis has since become a worldwide megatrend where growing companies are competing to lead the market. Who would have imagined that in 2017 there would be about 600 bike-share operators worldwide, or that the industry would be expected to grow at about 20% per year, on track to be a $5.8bn market by 2020?

One of the reasons for this might be the trend toward a sharing economy. Probably more important is the ability to run an intelligent management system for public bicycles by using location sensors, wireless technology, and mobile phones.

When the success story of bike-sharing began to take off around 2010, the systems were not very flexible and were rather inconvenient for users. Companies installed stations, where a finite number of bicycles could be racked, all over the big cities.

Often the investors were players in public transport – in Hamburg for example, StadtRAD operated by German railway Deutsche Bahn.

In the early days, to be able to rent a bike, you first had to subscribe with the company, allowing it to withdraw fees from your bank account or your credit card. To rent a bike, you had to use a terminal screen at the rental station and go through a rather complicated process to get hold of the bike. When you wanted to return it, you had to find another rental station, where you had to endure another process to check the bike in again.

Even though fees for riding were quite low, these inconveniences kept many users from sticking with their subscriptions and discouraged potential users from trying it out. It could be quite a hassle to go through the process, especially when traveling.

Over the next few years, many providers developed smartphone apps that made the process of enlisting to rent a bike much quicker and easier.

Even with the improvements in the rental experience itself, bike-share growth stayed rather moderate due to several factors: it takes time to secure government and corporate sponsorships and get support from local authorities to cover the cost of installing the expensive docking stations, as well as having to set up credit card payment systems.

In Europe, some rather unexpected joint ventures have been formed to help overcome these hurdles. Deutsche Bahn is cooperating with car manufacturer Ford in Cologne and Düsseldorf (www.fordpass-bike.de) and with the Lidl supermarket chain in Berlin (www.lidl-bike.de).

Development in the US has been quite similar to Europe and, lately, bike-sharing has exploded seemingly overnight in China, due to an influx of venture capital and a model that eschews docks, making expansion cheaper and easier.

That's how it started:
A shared bike the author used in 2004 in Copenhagen

> The new bike-share operators scatter bikes around a city and customers use an app to unlock them

Docking station of StadtRAD
The service is operated by the German railway in Hamburg, Germany

The new bike-share operators scatter bikes around a city, and customers use an app or scan a code to unlock them. The bikes can be left near a bike rack, on a sidewalk, or in a park within the range of the system. Without the need for docks, these start-ups can launch in a city in a matter of weeks without government help because they are subsidized with venture capital.

Britain's YoBike instructions shows how easy bike rental has become:

1. Download the app. Open the Google Play or iTunes App Store app on your smartphone and search for YoBike. Launch the app and follow the registration process; it shouldn't take more than about two minutes to get set up.

2. Find your closest YoBike. You can locate bikes near you from the home page of the YoBike app. Once you've found a bike, scan the QR code on the rear of the bike's frame. YoBike will unlock, then 60 minutes of hassle-free cycling starts! You can also enter the bike number manually.

3. Finished your ride? Two things before you go: Check the in-app map to park your YoBike next to one of the allocated parking spaces across your region. Close YoBike's lock on the rear wheel and mark your trip as completed within the YoBike app.

Mobike and Ofo are two of the most successful Chinese companies in ➔

this market and both operators have already started to expand their operations into other countries.

Companies learn quickly these days: American market leader LimeBike has successfully copied the scheme. After launching with a $12m seed round, the dockless bike-sharing startup announced in October 2017 that it had secured $50m to expand nationwide. LimeBike provides citrus-colored bikes that can be parked and picked up from anywhere using their dockless stations.

Expanding in all directions

In the first six months since its launch in March 2017, LimeBike claims to have logged over half a million trips and currently counts 250,000 registered users. With the new funds, it is planning to increase the size of the current deployed fleet tenfold by the end of the year.

The company is also expanding in other directions with an initiative called Lime Business Network, which allows local businesses to offer memberships to employees as a perk.

Among the competitors in the space are Velos and Nextbike in Europe, Mobike and Bluegogo in Asia, and Spin and CycleHop in the US.

Tandem ventures
Deutsche Bahn and Ford cooperate on bike-sharing in Cologne. In Berlin, the partner is the Lidl supermarket chain

Cooperation with public transport will also draw additional customers to bike-sharing. A hybrid scheme comprising 900 smart bikes has been set up in Cologne by Nextbike, where public transport users can use their e-tickets to access the bicycles. In some parts of the city, there are "free-floating zones" where you can leave the bicycles at any road intersection, whereas in other areas rent-and-return is only possible at official docking stations. Additionally, users get a free 30-minute ride without a separate registration with Nextbike.

Find YoBike
No docking station needed: leave the YoBike wherever you want

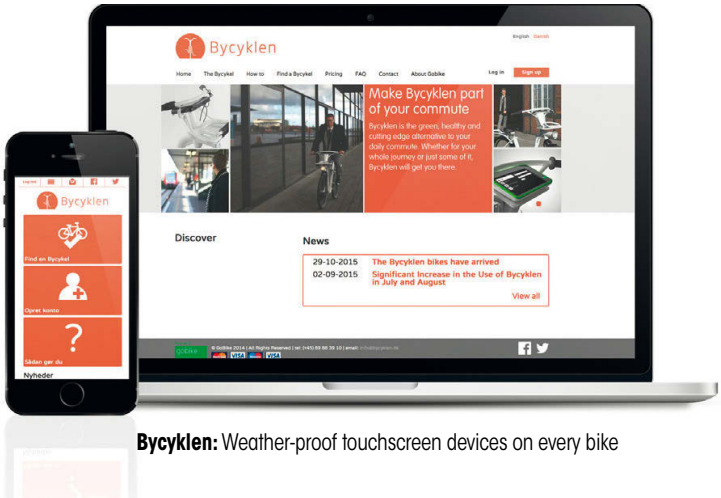
An integrated computer makes it easy to access a bike by holding the KVB transport e-ticket over the card reader. This shows how integration among different public transport modes using a wireless near-field communication (NFC) smart card can offer significant advantages.

What is the attraction of investing huge amounts of venture capital in this market? It's easy to guess when you see one of the development partners of Mobike in China is the contract electronics manufacturer Foxconn. From the more than 20 million rides on their bikes each day, five terabytes of data are generated: usage, movement patterns, duration, and destination.

This can help authorities in planning bus stations and parking lots. Of course, IT firms are also interested. Tencent, the producer of WeChat (a Chinese app similar to WhatsApp), has also teamed up with Mobike; Alibaba is working closely with Mobike competitor Ofo – which has also announced a global partnership with the payments platform Adyen. The collaboration will allow customers around the world to pay using local currencies and payment methods. We can expect similar collaboration and cooperation on other continents.

Too many bicycles

With the growing number of dockless shared bicycles, a new problem has turned up: there are too many of them. After the Singapore-based oBike started a dockless service in Melbourne last summer, with plans to provide 10,000 bikes around the city, the bikes kept turning up in places where nobody wanted them. They cluttered up busy footpaths; some were even hung up in trees, and others were dumped in the Yarra River. The reaction of Lord Mayor Robert Doyle was harsh: "We work hard to keep the city free of clutter. They are clutter and that must be fixed." Hopefully, the dialogue with oBikes' head of marketing Chethan Rangaswamy will be successful and can be used as a model for fixing similar problems in other places.



Bycyklen: Weather-proof touchscreen devices on every bike

What has happened in Copenhagen since my first encounter with public bike-sharing?

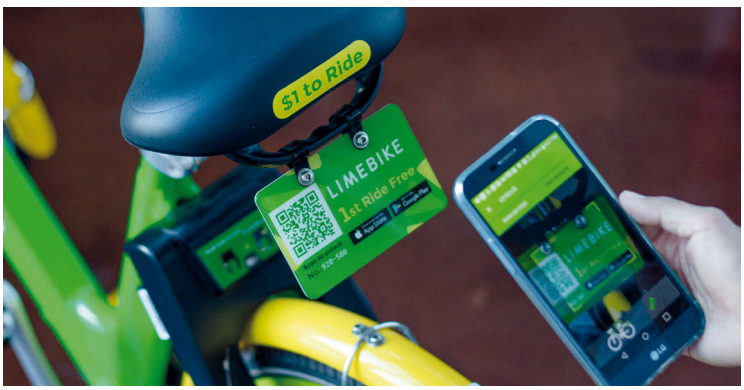
In 2014, a highly advanced electric bike-sharing program was launched. Bycyklen provides a way for Danish commuters to use the bikes for their whole commute or to use them for the first or last mile in combination with mass transit. The program also appeals to tourists with the slogan: "See Copenhagen like the locals do. Get on Bycyklen and experience the wonderful sights of Copenhagen like a Dane – on two wheels."

The Bycyklen e-bike with a front-hub electric motor is built by GoBike and features a touchscreen tablet computer on the handlebars with built-in GPS for finding docking stations, public transit, and tourists spots, such as museums, restaurants, hotels, and parks.

The touchscreens are weather- and tamper-resistant. In addition, the bikes are driven by a Gates Carbon belt drive to reduce maintenance and eliminate dirty, oily bike chains.

The new program has hundreds of GoBikes at 20 docking stations in Copenhagen and Frederiksberg, with one station at City Hall for politicians and government workers to use.

How does a rental system work?



Customers register and choose a payment method – credit card billing is still the most common

In most cases, users have to provide their address or a deposit as a guarantee against theft of the bikes. Once registered, users can select a bike using a map in their smartphone app. Bikes are equipped with GPS modules and can be located by the management software. Once a user has found a bike, they may scan a QR code or enter its ID in the app. The app then sends the user a code, which is typed into the special wheel lock on the rear of the bike – or opens the lock automatically. The user can then begin their journey. When finished, the rider parks the bike, clicks the lock back in place, and the user's online wallet is automatically charged. Some bikes are "geo-fenced," limiting where they can be used.

Everybody's doing it
Successful bike-sharing companies worldwide

MOBIKE

Beijing Mobike Technology. Founded in 2015 in Beijing, China. Mobike operates in over 160 cities in China and has started to expand internationally. In Europe, it has bikes in London and Manchester in the UK, and in Florence and Milan in Italy. In September 2017, It opened its first service in the US in Washington, DC.

OFO

Founded in 2014 in Beijing, China. Ofo claims to operate over 10 million yellow bicycles in 250 cities and 20 countries. In the US, Seattle was the first city where Ofo bikes were offered and in the UK it is competing with Mobike and a local-government-sponsored scheme in the heart of London.

LIMEBIKE

LimeBike was in January 2017 in San Mateo, California, and raised $12m in funding led by Andreessen Horowitz in March 2017. In October they operated in 11 cities in the US and additionally on four college campuses. The service is gaining custom at the cost of its Chinese competitors.

BYCYKLEN

From Copenhagen, Denmark, Bycyklen the first bikesharing company that has brought e-bikes to the public. They currently have over 100 stations located all over the city.

IoT in Agriculture

BETTING THE FARM

When thinking about applications for automation, robots, and connected sensors, their industrial uses immediately come to mind, but taking a closer look at developments in agriculture unearths a number of surprises. There are so many striking examples that could easily fill a whole magazine. Instead, we have picked out some that seem especially stunning.

By Rainer Claassen

IoT, the oyster said

Can mollusks save the planet?

Oysters are filter feeders, which means they often absorb contaminants as well as food from their environment, substances that may be harmful to humans. Oyster harvesting is usually controlled by public authorities and collections are suspended temporarily if there is cause for alarm. Rainwater washes contaminants from the land and into the waterways where the oysters grow, so farmers depend heavily on precise meteorological data to determine the right time for harvesting. If the harvest is stopped unnecessarily, it can cost the oyster farmers a great deal of money in lost sales.

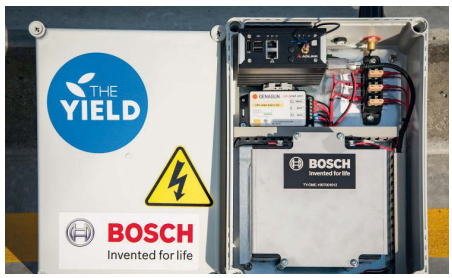
Just off the Australian island of Tasmania, measuring stations using the Bosch ProSyst IoT platform have been installed in the immediate vicinity of oyster beds. These measure the depth and salinity of the water, as well as temperature and atmospheric pressure. Algorithms developed by local startup The Yield AgTec Solutions record and analyze the data, allowing farmers to check their computers or smartphones for the ideal time to harvest. Bosch has developed the system in cooperation with The Yield and supplies the hardware, software, and real-time data management.

As Jesse Reader, a Bosch associate involved in the project, points out, the company's experience in the automotive industry proved to be of great benefit, since this is all about making sensitive technology function reliably in a harsh environment. It all goes to help the oyster farmers optimize their harvests and become more profitable. As a result, it is now possible to reduce unnecessary closures by as much as 30%, which could potentially save the Australian oyster industry several millions of dollars a year. In addition, collected information is supplied free of charge to scientific institutions, where it is used to combat the spread of oyster diseases that could spell financial ruin for farmers and their operations.

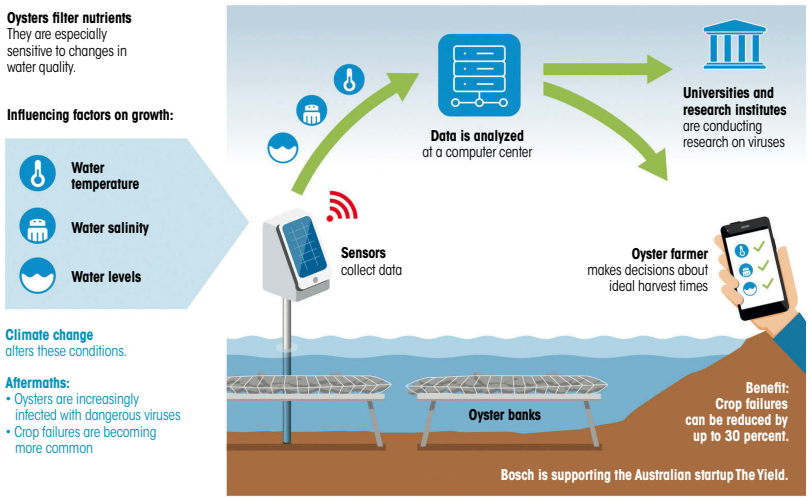
Bosch and The Yield are also teaming up on further applications for smart and more sustainable agriculture, where the focus is on collecting and analyzing microclimatic data.

"If we want to be able to feed the world's population in the future without destroying the planet, intelligent agriculture is the only answer," says Ros Harvey, the founder and managing director of The Yield.

Ros Harvey
founder and managing director of The Yield AgTech Solutions



New IoT solution for oyster farmers



sources: TheYield.com, Bosch

Counting sheep

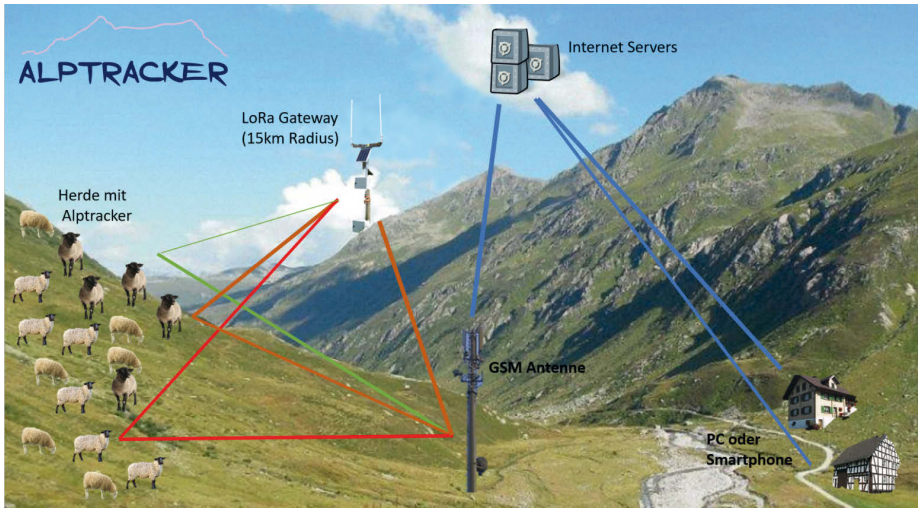
Herds may run, but they can't hide

This summer, Telia Norway launched a first-of-its-kind pilot project where 1,000 sheep were equipped with NarrowBand IoT (NB-IoT) collars and tracked while on summer pasture. NB-IoT is a new cost-efficient communications technology that enables excellent coverage indoors, outdoors, and in the ground. It is ideal for things that run on battery or which only send data occasionally.

Telia Norway and startup Nortrace have fitted the sheep with the modules to allow farmers to monitor each sheep's location and state of well-being while they are on summer pasture in Rogaland on the southern tip of Norway. In the old days, at the end of the summer pasture, ten to12 shepherds would go to gather the sheep – and they usually found about 90% of them. The rest could have become lost or got stuck somewhere in the snowy highlands. With the new system, the farmer receives an alarm on his smartphone if an animal has not moved for a long time and may be in distress, and, at the end of summer, there will be no more problems in finding the missing 10%.

Jon Christian Hillestad
Head of enterprise at Telia Norway

"This is a great example of how IoT and new ➔



technology can help meet real needs," says Jon Christian Hillestad, the head of enterprise at Telia Norway. "Using NB-IoT for tracking purposes is one of the most important areas of IoT and 5G in the future. It can be used pretty much on everything that is mobile: animals, ships, containers, and other means of transportation."

Telia expects to gain valuable experience from the pilot scheme: "With such a big pilot we will get a pretty good picture of how the technology works and how it can be transferred to other applications," Hillestad says. "NB-IoT opens an immense number of opportunities and, with the use of this technology and our platform, we can now connect multiple devices and develop exciting commercial solutions with partners."

The product, originally called Gjeteren (Shepherd), is being marketed under the Shiip brand and will be available early in 2018 at www.shiip.no.

A similar product called Alptracker has been developed in Switzerland for use in the Alps. In the high mountains there is often no access to mobile phone services – and topographic conditions are challenging. Semtech's long-range LoRa low-power wireless system of interlinked antennae, each covering a radius up to 15 km, locates Alptracker collar transmitters, attached to every animal, via GPS every 30 minutes – with an accuracy down to15 meters. The receiving LoRa antenna transmits the data to a base station via the autonomous network.

An Alptracker collar is powered by two AA batteries, allowing continuous deployment of up to 180 days.

A clockwork garden

IoT with a green thumb

Precision farming was high-tech and very expensive when FarmBot creator Rory Aronson had the idea for his solution in 2011. Since then, his company has been working to bring its precision agriculture technology to environmentally conscious individuals at a reasonable price. From February 2017, FarmBot has been shipping its fully automated home gardening set at a price of $2,595.

FarmBot Genesis is a do-it-yourself precision farming kit that almost anyone can use, and the robotic system is constantly being improved by input from an open-source community. Included in the kit is an Arduino Mega 2560 and Raspberry Pi 2 Model B in an unassembled hardware package. Genesis runs on custom-built tracks with a supporting superstructure. The kit also includes open access to the software community's step-by-step assembly instructions and online software platform which is accessed through a web app that looks a bit like the popular Farmville mobile phone game.

The physical FarmBot system is aligned with the crops, as plotted out in a virtual version on the web app, to allow FarmBot to reliably dispense water, fertilizer, and other resources that will keep the plants healthy and thriving. With its universal tool mount, the system can easily be adapted to do many gardening tasks and, as no delicate sensor technology is needed, FarmBot is much cheaper than industrial precision farming equipment. According to the website, Genesis was "designed to be a flexible FarmBot foundation for experimentation, prototyping, and hacking."

It may sound adventurous – but the demonstration video, at www.farmbot.io, is just amazing. It may not be too long before we see offers like this in our local Ikea.

How to monitor grapes

Putting the squeeze on chemicals

One of the greatest goals of modern agriculture is to reduce the excessive use of chemicals – be it fertilizers, pesticides, or fungicides. Precision agricultural practices can be the most effective way to significantly reduce the negative environmental impact of farming due to over-application, while still producing enough food to satisfy a growing demand. The introduction of advanced sensing capabilities allows monitoring at plant level and spotting problems before they spread.

With the help of farming robots, chemicals can be applied with honeybee precision and be used only when needed in the smallest necessary amount. Each field of agriculture has its own difficulties and those of vineyards are being addressed by the Grape project, an acronym of Ground Robot for vineyArd monitoring and ProtEction. It is a collaboration of Spain's Eurecat (Technology Center of Catelonia), Italy's Politecnico di Milano university, and Vitirover, a French company that has already developed a fully autonomous, solar-powered grass mower for vineyards.

The group aims to create the enabling technologies that will provide agricultural service companies and equipment providers with vineyard robots that can increase the cost-effectiveness of their winery products, when compared to traditional practices. The project addresses the biological control market by developing the tools required to execute autonomous vineyard monitoring and farming tasks using unmanned ground vehicles (UGVs), and thereby reducing environmental impacts caused by traditional chemical control. The robots will be able to navigate on rough and sloped terrains with six degrees of freedom, doing 3D mapping and path planning. They will be able to detect plants and perform health monitoring as they perfect their approach maneuvers and develop precision arm control and manipulation.

The project is still developing and a user-friendly interface is being built jointly with the winegrowers. Videos showing prototypes finding their way among the vines are available at www.grape-project.eu.

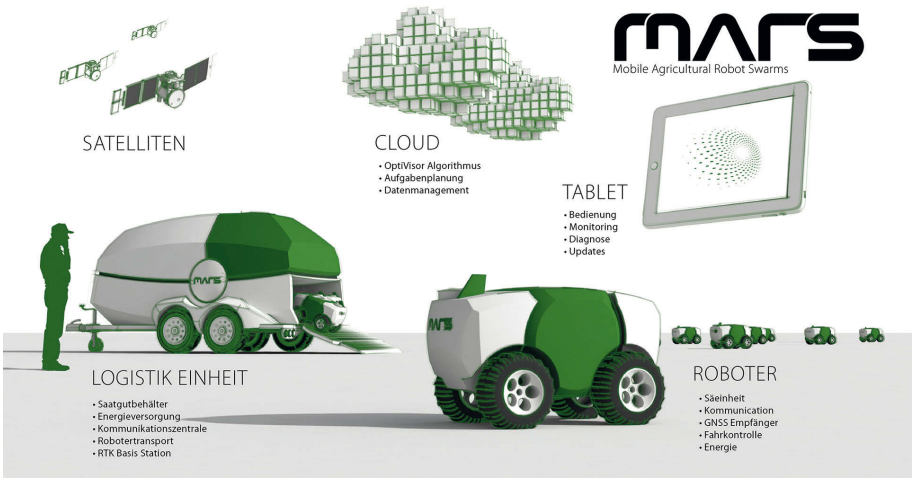
Mission to MARS

Seeding a planet

The idea of small robots doing fieldwork in swarms was started by Agco/Fendt in 2014 under the name of MARS (Mobile Agricultural Robot Swarms). Since then it has been incorporated as a research project supported by the European Union, the first fruit of which is an automated system for the precise seeding of corn, which is now close to shipping.

A MARS system comprises six to 12 Xaver seeding robots which are taken to the field by a special trailer that also serves as a base station. After the robots automatically leave the trailer to do their work, they communicate their progress back through a GSM link. Bad connections can be cushioned by data buffering and redundant communication. The battery-driven Xaver robots each weigh around 50 kg and, as they can work completely autonomously, they are able to seed without breaks 24/7 – even where conventional machines would have to stop due to bad ground conditions.

Compared to a conventional seed drill, energy consumption of this swarm is 70% lower and there is no danger of poisoning the soil by losing fuel or oil. The intelligent management of the robots includes very precise navigation in the field and real-time data collection and documentation in the cloud – down to the precise location and time of seeding for each grain of corn. Should a robot become defective or run out of power, its tasks will automatically be taken over by the rest of the swarm. Future scenarios will allow individual fertilization and protection for each plant.



Currently, potential customers can apply to take test runs with the system but it shouldn't be long until it is available on the open market. Fendt's goal is to bring the product out at a price that's no higher than a conventional seeding machine.

The company recently claimed that customers from different continents are lining up to try the system after its presentation last fall at the Agritechnica 2017 fair in Hannover. More details can be found at www.fendt.com/de/fendt-mars.html.

Smart Airports

IOT IS TAKING OFF

Airports are a massive part of the economy and key players in regional growth and development. They bring many different operators and interest groups together – from airlines, ground handlers, and air traffic management to consumers, retailers and regulators. Among these groups are lots of stakeholders with different perspectives, functions, and goals. **Airports must not just get bigger, they must also get smarter** and examine the infrastructure needed to support a whole new breed of intelligent airports.

By Kelly Allen*

*Kelly Allen is director of transportation in Europe North at ALE

Civil aviation is booming and airports are under constant pressure to maintain or improve their safety levels as passenger numbers continue to grow and the number of routes and flights increase. In order to improve profitability, and because of increased market pressures, airports are being driven towards operational efficiency and cost reductions. But capacity constraints due to lack of space mean it is new technologies that are starting to provide new efficiencies.

The Internet of Things, automation, Big Data, robots, artificial intelligence, and virtual reality are becoming part of the civil aviation ecosystem, along with integrated data collection and better real-time communications channels. To make the most of these technologies, airports need to put in place processes that simplify and speed up collaboration within the aviation communities.

Managing a complex ecosystem

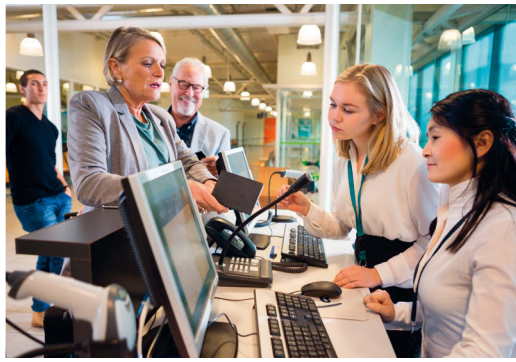
In customer-facing and operational roles, the potential for IoT-enabled assets to streamline processes cannot be understated. There's real-time visibility into the condition of assets or location-based services, and beacons for wayfinding and asset tracking.

Add to those digital marketing and signage, live information sharing, remote sensors for monitoring runway or environmental conditions, and IP cameras linking to facial recognition software, or enabling whole digital control towers. Plus customer services like baggage handling, passenger tracking, and self-check-in – IoT is appearing everywhere.

> IoT will enable better connectivity between people, processes, and smart "things" – and simplify IT management into the bargain

It's a near impossible task to manage all these types of technology if they are rooted to individual subsystems which all need their own management and maintenance. No matter which digital tools, platforms, or systems airports choose to adopt, they will never reach their full potential without the right network or communication building blocks. Further to this, ineffective implementation will increase the potential for these new devices to place a strain on network resources, introduce vulnerabilities, and affect traveler experience.

Yes, aviation industry players need to align but airports in particular need to evolve towards cost-efficient ➔



IP-based solutions. This will immediately enable better connectivity between people, processes, and smart "things" – and simplify IT management into the bargain. This is where the connected airport comes in.

Digital security is a top priority across the board

Whether it's IP security cameras; heating, ventilation, and air conditioning (HVAC) systems; or information boards, running all processes on a single network infrastructure is more cost-effective to manage and maintain and offers much greater visibility on an enterprise-wide scale.

But there are dangers to poorly secured deployments and any compromised device can be a possible backdoor into the network. As more fixed and mobile devices connect to the network edge, it becomes increasingly important that these IoT devices are properly contained.

Making the right connections

Enabling better connectivity between people, processes, and "things" will make airports smarter and more efficient

Using network virtualization techniques, it is possible to create virtual isolated environments on a single infrastructure and make the Internet of Things more manageable. This empowers different departments or teams to maintain their own, dedicated IoT network deployments.

Virtual segmentation on the network can create "IoT containers" to group together, manage, and secure devices and users, and in the event of a breach, they can also stop threats moving across the network.

IoT containment also makes it possible for the different departments to enforce their own customized quality of service (QoS) policies on the general network to optimize specific operational processes.

In each virtual container it is possible to see and manage all the traffic and users, prioritize applications and devices, reserve or limit bandwidth, blacklist devices, or monitor for suspicious traffic patterns. QoS policy enforcement can ensure that critical operational processes or network assets can always be given access to the resources they need to function properly.

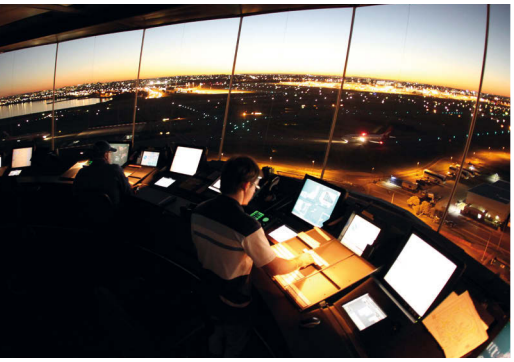
Stakeholder cooperation and collaboration

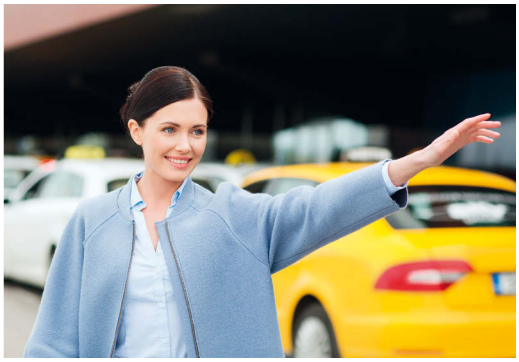
Enterprises are now shifting towards connected platforms where people, processes, and things can connect and collaborate, airports included. The complex community of stakeholders – airport operators, airlines, ground handlers, passengers, authorities, and regulators – can all benefit by removing the barriers to information flow.

Airports can optimize operations, manage passenger movement, and implement better emergency communications. Airlines can provide a hassle-free customer experience by relying on infrastructure elements, such as beacons for automated notifications. Passengers can get real-time updates about estimated waiting time at security lines or locations of specific airline check-in counters, gates, or baggage belts.

Retail concessions and restaurants can use location-based services to promote offers, leading to increased interaction with passengers and a subsequent increase in revenue. Critical passenger or situational information can be shared directly between relevant parties in real time – getting the right information to the right people, exactly when it is needed.

For all this to happen, systems need to be "de-siloed" and communication tools, such as instant messaging, voice, document sharing, video, and alerts, need to be integrated directly into applications and systems. This is possible with open application programming interfaces (APIs) beginning to





come from some of the world's leading communications vendors – giving technology partners and third-party providers the opportunity to make comms and collaboration tools a central feature of digital airport services, not a disconnected afterthought.

Intelligent airports – not just a vision, but a must

To meet these challenges, airports need innovative solutions. Above all, existing infrastructures must be used more intelligently.

Airport operators need to use IoT technology to make the most of their budget and resources, to manage rising volumes of travelers, meet the increasing demands of tech-savvy passengers and the needs of their commercial tenants.

The need for real-time information exchange will see airports around the world adopt new technologies to support the desired free-flow of communications. This requires innovations that integrate smart devices and share information at every point of a passenger's journey. The focus should be on enabling more and better communication between civil aviation stakeholders.

Rolling out the right infrastructure calls for careful planning, an eye on future developments, and a security-first approach – from customer-facing services right down to providing the necessary hardware.

The intelligent airport of tomorrow is more than a vision, it's a must. With the right infrastructure, it has the potential to become a global reality.

Embedded Computing

THE NEXT WAVE OF SMART THINGS

Look inside any of the billions of smart things connected to the IoT and what would you see? Most will have one or more microcontrollers (MCUs) to do some or all of the "thinking" for these connected objects.

By Michele Scarlatella

An MCU takes information it collects locally using sensors and perhaps sends it off to a centralized computer for storage or remote actions. Maybe the MCU combines it with information collected at other nodes in order to do something useful. Consider a simple example: a smart thermometer in the home. With one in every room measuring temperature, these might turn a space heater or window air conditioner (AC) on or off, or they could operate centrally to control a more efficient zone heater or AC.

So far, so good. Now think of a more complex situation in our information-overloaded society where having smart things to think for us can be extraordinarily convenient and efficient. At a municipal level, smart street lights that adapt to cloud cover, sun or moon brightness, and pedestrian traffic; or vehicle-mounted sensors, connected to navigation systems, that identify roadways in need of repair and communicate that information to the appropriate maintenance crew. All of these embedded systems, among thousands of others, are specialized computing platforms that rely on one or more MCUs in each node to provide distributed computing capabilities. All the while, MCUs are evolving to support the next wave of connected objects and their interactions with increasingly complex networks of devices and services. This evolution is traveling along the usual path of providing higher computing capabilities with more storage, better graphics and media processing, and higher-featured, integrated peripherals. Today, there are two additional demands that have not traditionally been associated with microcontrollers – embedded security and artificial intelligence (AI).

> The makers of smart and connected things are getting wise to the need for security in their products

Michele Scarlatella
Communication Director, Microcontrollers & Digital ICs at STMicroelectronics

The makers of smart and connected things are getting wise to the need for security in their products. The type of security required depends on the nature of the "thing" or the value of its knowledge and data, and its potential for harm. Fitness monitors, for example, may not contain very valuable information locally but they could be hacked and used to give backdoor access to a network. You don't want hackers crawling around in the contents of your smartphone, and you certainly don't want them taking control of a car while you, or the person next to you, is driving.

Fortunately, chip vendors like STMicroelectronics are stepping up to meet these demands for rising levels of security. ST provides a flexible security-product portfolio ranging from the integrated security features in its 32-bit microcontrollers to the highest levels of security based on dedicated secure elements. The combination of a general-purpose microcontroller and secure element is a solution that reaches the very highest safeguarding requirements for IoT applications, while at the same time simplifying the product architecture, security validation, and certification. Putting all critical features into a single, highly protected device is much simpler than having security distributed inside a very complex product.

On its STM32 MCUs and in ST's automotive MCUs, the company has begun to embed security using a range of recognized practices, including countermeasures against remote software and board-level attacks, trusted execution environment (TEE) capabilities, self-evaluation solutions, and integrated one-time

programmable (OTP) memory. It also produces embedded hardware security modules (eHSMs) that provide cryptographic processing and can safeguard and manage digital keys for strong authentication.

For even stronger protection, ST has a range of secure elements. The STSAFE family is one of these important building blocks for highly secure applications. STSAFE is a complete ecosystem of independently certified turnkey solutions designed to ensure device identity as well as system and network integrity. Devices from this family are easily linked to general-purpose MCUs to deliver enhanced security or they can be used standalone for authentication or security in consumables covering a wide range of applications and use cases. MCUs in embedded systems aren't only increasing their raw processing power. They are also learning to do things in a smarter way. This is where artificial intelligence comes in. AI is a key part of the evolution of the Internet of Things and is necessary to make many of the IoT services and applications work, as well as being a driver for the kinds of IoT devices that will exist in the future. AI is rapidly gaining ground in a very large number of products and use cases. In some, AI processing is done by powerful processing machines located in the cloud, taking in and operating on vast amounts of data and spitting out answers. But AI processing is also quickly spreading down into the nodes themselves, performing dedicated applications without the transmission-time delays, bringing the advantages of real-time response and lower power requirements that result from on-demand (rather than permanent) connectivity. AI embedded into local devices holds great promise for a wide range of applications like predictive maintenance and real-time object detection, classification, and tracking, among others, where it might be applied in smart factories or in smart vehicles.

STM32 Microcontroller
ST provides a flexible security-product portfolio ranging from the integrated security features in its 32-bit microcontrollers to the highest levels of security based on dedicated secure elements.

Today, general-purpose MCUs, like the STM32 family, can be used to run AI algorithms and neural-network models, using mapping tools that allow these features to be adapted to existing architectures. In the next step specialized hardware will be available to execute these programs more efficiently, allowing AI capabilities to be brought down to the lowest node in the network in an economical and energy-efficient manner.

Building on IoT

THE FUTURE OF CONSTRUCTION CATCHING UP

The building industry is older than the pyramids – and in many ways it has remained unchanged. However, **after years of stagnating productivity and antiquated processes and procedures, construction is slowly awakening** to the fact that, to remain viable, it needs to gamble big on technology in general and IoT in particular.

By Mark McCoy

Construction holds the dubious honor of having the lowest productivity gains of any industry, says a report by McKinsey & Company, a management consulting firm. In the United States, productivity in the construction industry has plunged by half since the late 1960s. UK newspaper *The Economist* called building the "least improved" of all major industrial sectors. Why?

Ask builders and they will complain about the rising costs of materials and increasingly restrictive building codes, along with tighter workplace regulation and many other suffocating bureaucratic strangleholds. Although low inflation in most developed countries has held costs down for the past ten years at least, over the same period productivity in construction in Europe and North America rose by just one percent annually – a piddling rate.

To find an explanation for the anemic state of the building industry, one must search elsewhere, says Luc Luyten of Bain & Company, a consultancy firm based in Boston in the US.

The first reason is that builders have been extremely reluctant to invest in technology because the industry has learned through bitter experience to always prepare for the next recession. Capital-heavy approaches to construction bring high fixed costs that are hard to cut during a downturn. "Workers, in contrast, can be fired," Luyten explains.

As a result, construction relies heavily on brute force – in the struggle of machines versus humans, building workers have the advantage. This applies not only to less developed countries like India or Pakistan, where wages are low, but also to Western nations.

Fragmented market

The second reason construction lags behind other industries is its extreme fragmentation. In the US alone there are more than 730,000 building firms employing over seven million workers. That means the average head count of a construction company is just ten.

The same goes for construction companies in most European countries. There are around 74,000 businesses in Germany employing 780,000 people, or about 10.5 people per company.

The sheer number of firms presents a whole raft of problems, the greatest of which is cut-throat competition. With dozens of companies bidding on each contract, it is relatively easy for developers to drive prices, and margins, down. Even if a single winner emerges, the company will normally need to join forces with many other companies who are signed on as subcontractors, each looking out for its own best interests.

Digitalization, Luyten believes, is the only way out of this mess even though builders are slow to embrace digital technology. Take Building Information Technology (BIM), for example: its 3D-modelling processes introduce efficiencies by allowing architects, engineers, and builders to work as teams, sharing information and harnessing the power of the cloud. In other words, BIM lets partners in a building project – architects, developers, contractors, and subcontractors – share files of information to support decision-making regarding a building or other built assets.

Big BIM vs Little BIM

In the past, builders relied mostly on 2D drawings (plans, elevations, and sections) to share information. Now 3D models provide a feel for the geometry of a building, and BIM makers have been busy adding extra dimensions, like time and cost, to their systems, causing many of them to refer to themselves as 5D BIM or Big BIM. Ideally, such systems go beyond the planning and design phases of the project, extending throughout the building life cycle and supporting processes including cost, construction, and project management as well as facility operation.

Critics have been quick to note BIM can't do everything. For instance, date modelling with BIM takes much longer than something fresh off the drawing board, so more time and effort is required. At least theoretically, this should balance out in the end thanks to reduced costs due to errors and rectifications later. But for the construction company, feeding the necessary data – some of which might not even be available during the early stages of a project – means shifting effort, and investment, forward, with no certainty that anyone will eventually foot the bill or that any major benefits will accrue to the builders themselves.

> Robotics and 3D printing require 30% to 60% less building materials and can be completed between 50% and 80% faster
>
> **Michael Shomberg**
> Global vice-president and general manager for engineering, construction, and real estate at SAP

Due to the fragmented, heterogeneous nature of the industry, widespread use of BIM faces additional hurdles. As a rule, many firms are involved in a project, each with its own software tools and computer-aided design (CAD) systems, and each with its own proprietary data format. BIM could solve the latter problem, but only if the functionality has been installed, and paid for, beforehand. In addition, many architects consider design as their own personal intellectual property and are highly reluctant to share data with others, even if they are all supposedly on the same team.

Digitalization is the future

In practice many building companies choose to opt for Little BIM – a stripped-down version that acts as a stand-alone solution with limited functionality. Its use is generally restricted to employees of one company or even one group within the company, such as planners or asset managers. Here, again, fragmentation means that builders hesitate to share costs with other companies, any of which could one day become their competitor.

Michael Shomberg, global vice-president and general manager for engineering, construction, and real estate at SAP, a German enterprise software company, is convinced the future of construction lies in digitalization.

"From supply chain to workforce planning, digital technologies are bringing greater efficiency and scalability to the construction industry," he maintains. "Robotics and 3D printing, for example, require 30% to 60% less building materials and can be completed between 50% and 80% faster."
Shomberg has identified five key areas in which digitalization will transform the construction industry:

■ **Expertise and knowledge:** As a new generation enters the workforce and experienced craftsmen retire, there is an urgent need to make up for the resulting experience gap – if not, safety, efficiency, and productivity will be jeopardized. Construction, like all other industries, can expect to run up against a dearth of young, talented professionals who will be able to pick and choose their employers. These tech-savvy millennials expect digital rather than paper-based processes.
On the other hand, the newcomers lack the experience and knowledge of their older colleagues – most of whom are heading for retirement. Builders need to adopt new ways and formats, such as tablet and smartphone apps.

■ **Construction sites:** Builders need to industrialize to survive. Many activities traditionally performed on site will be transferred to factory-like settings with greatly improved safety and efficiency. In these off-site "construction factories," prefab modules can be made to much lower tolerances, at less cost and with better quality. These "Lego-like components," as Shomberg calls them, will be moved to a construction site to be assembled by low-skilled workers – perhaps with the aid of wearable devices that make up for their lack of expertise by providing instant digital guidance and advice. Shomberg sees a future in which information from hyperconnected smart sites will be gathered by sensors and continuously transmitted back to headquarters to provide real-time reports about building progress, allowing subcontractors to be paid sooner. This information stream will also be used to improve safety and reduce downtime, by anticipating and correcting problems before they occur.

Give and take
Members of construction teams need to share information more freely to get a complete picture of a project's status and the steps that need to be taken next

Kid will be kids
Young, tech-savvy millennials expect digital rather than paper-based processes. Builders need to adapt fast to new ways and formats, such as tablet computers and smartphone apps

■ **Project collaboration:** Owners, contractors, architects, and other members of the construction teams will work on contracts which demand they share knowledge freely, and pay will be based on a project's progress rather than individual performance.
They will have access to information systems that give a complete picture of the project's status and the steps that need to be taken next, including 3D drawings, job costs, as well as unstructured data, such as Word or Excel documents or manuals. This will virtually eliminate change orders, but more importantly, this kind of sharing will build trust and respect among team members, turning them into stakeholders instead of hired help.

■ **Skill networks:** In the social media age, Shomberg believes we will see the emergence of digitally networked workforces where skilled craftspeople will post their availability online and firms will search for workers based on their scores from former employers and clients. Workers will also be able to grade companies to alert future job seekers to employers that have been perceived as unfair. In this world of social networking, trade unions continue to play a role, Shomberg insists, primarily by implementing training programs to help members develop new skill sets and better understand new technologies.

■ **Commissioning and operations:** At the end of a building project, the handover of critical information must happen, and here digital systems could prove a boon. Information can be transmitted seamlessly from the developer to landlords or tenants without the need to re-enter anything manually. Data generated by BIM, ERP, or a project management system (PMS) can be linked at an early stage, thus reducing errors and the need for costly rectification and reworking.
An added bonus is the ability to include information on warranty and maintenance of installed equipment, such as air conditioning systems or elevators, so owners will have access after the builders have gone.
Most of Shomberg's vision remains distant for most constructors. Things like digitalization of knowledge or networking closely with those who might become competitors is still anathema to many. People in construction seem to cling to their traditions, many of which would be recognizable to the guys who built the pyramids.

Indoor Tracking

THE HARD HAT JUST GOT SMART

In the construction world health and planning, monitoring, and enforcement relies mostly on human experts applying knowledge on an as-needed basis. Because human error in the project planning phase can occur and safety plans are rarely updated once construction is underway, the conditions in work spaces must be checked frequently.

Studies show that the health and safety process remains a key issue. The fact that about 60,000 construction worker deaths worldwide occur each year shows the need for suitable tracking and control systems.

An interdisciplinary team from the Ruhr University in Bochum, Germany, led by Jochen Teizer and Mario Wolf has set out to create an IoT-based system involving "smart hard hats," specially modified safety helmets that will help solve these kinds of problems. As Teizer explains, the goal of the project is to collect, collate, and examine tracking and forecasting information to assist in the identification, preparation, and execution of each single step of a work process.

Mario Wolf states that IoT's power lies in the ability to interconnect digital and physical objects, such as 3D computer models, mobile devices, machines, and tools, to enable a broader, smarter range of new applications and services to be developed.

In the university team's case, each "worker" was equipped with smart personal protective equipment – hard hats or reflective vests – upon which sensors had been mounted to continuously collect environmental data, such as levels of illumination, from the surroundings in real time. These readings were automatically assigned to individual locations, for instance from the ID of a work space.

Data sets were collected via the hat-mounted sensory equipment, based on Bluetooth Low Energy (BLE), as well as through mobile devices, typically smartphones, connected to the Internet.

For the helmets, 3D-printed casings were created to house Avnet's Visible Things Bluetooth Smart Sensors, which allow the collection of environmental data. The sensor casings were then mounted on the side plates of standard industrial hard hats.

By combining the traceability of the worker's location with environmental data, the IoT platform is able to monitor key safety-related parameters, like time spent in low or high temperatures, or the lack of adequate lighting in a work area. For example, some regions in the basement of a building under construction often offer some of the poorest work site conditions. Accidents in such spaces often lead to injuries such as sprained ankles, which results in high costs due to the enforced absence of workers for days at a time.

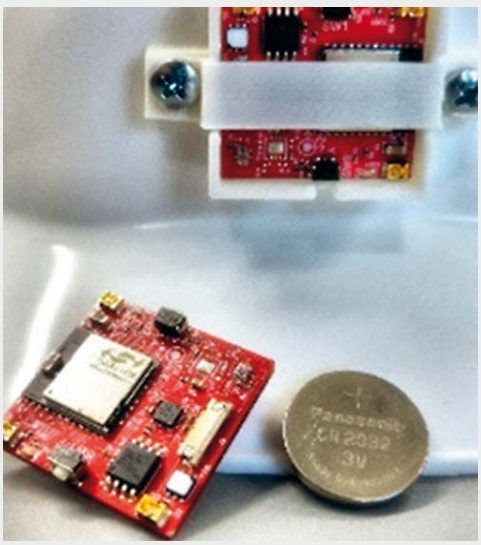
Future work on the project will include the implementation of an improved location tracking algorithm, as well as the introduction of advanced sensory equipment using communication over the LoRaWAN low-power wireless standard.

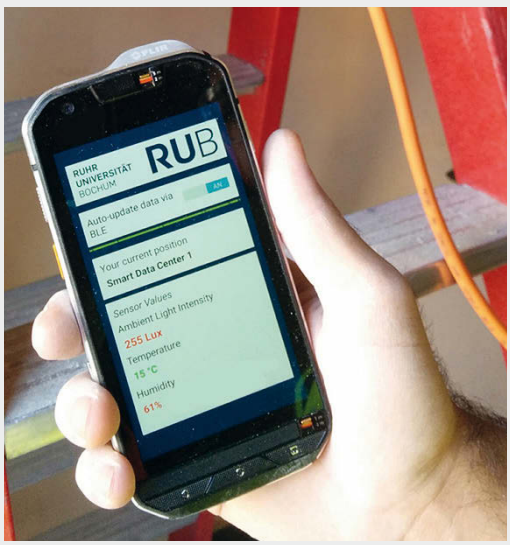
A new prototype helmet, designated SmartHat 4.0, will then be the subject of further field studies on an actual construction site.

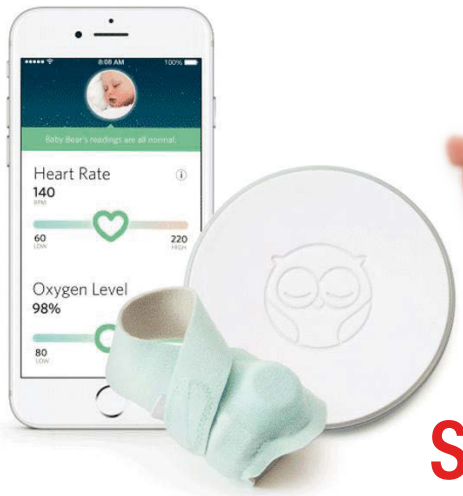
Jochen Teizer Bochum's Ruhr University

Constant data collection

Data from the smart hard hats are collected through Bluetooth Low Energy sensors and can be viewed on smartphones and other mobile devices







Smart Socks

HOPE, FEAR, & INSPIRATION

IoT can save the lives of newborn babies. That's what two bright young engineers in Nevada set out to do with a little help from their friends at Avnet.

By Mark McCoy

In 2012, Kurt Workman was a full-time chemical engineering major at Brigham Young University (BYU). Kurt's aunt had just had premature twins so he and his wife were lending a helping hand whenever they could. They saw firsthand the constant worry Kurt's aunt shouldered.

They wanted to start a family of their own soon but Kurt knew that with his wife's congenital heart defects they could face similar challenges and plenty of sleepless nights of their own. Around the same time though a friend who worked as a nurse at the University of Utah Medical Center introduced Kurt to a clinically proven technology used by hospitals called pulse oximetry.

A pulse oximeter is a clip-on device hospitals put on a patient's finger which uses wavelengths of light to measure heart rate and blood oxygen levels. That was all the inspiration he needed to create Owlet and its product the Smart Sock.

The sock is a health monitor for newborns to wear at home, designed to notify parents if heart rate and oxygen levels fall outside preset zones, helping to give peace of mind to anxious parents.

Kurt Workman

"There was a lot of stress at the time, but Avnet really came to bat for us"

Zack Bomsta

"Making a real difference in the world is totally worth it"

A coincidental meeting with fellow BYU student and electrical engineering major Zack Bomsta, himself a new dad, helped determine the trajectory these budding entrepreneurs would take. Together, Kurt and Zack with their other co-founders, developed their idea, competing in and winning several competitions at BYU.

With more recognition came more attention, including that of Dianne Suggett, an Avnet account manager. This led to Avnet helping to guide them and their idea to market.

Barriers that pop up overnight

The Smart Sock first went on sale in October 2015 on Owlet's website. Today, it's available on the shelves of Buybuy Baby, with plans to be in other big-box retailers and additional countries later this year. It's also been shown to reduce anxiety and improve sleep quality in longitudinal observations published in the peer-reviewed medical journal, Global Pediatric Health.

Trent Foster, an Avnet field application engineer (FAE), worked with Owlet during its early days in the product design phase. "Their goal was to make a difference in the world," he recalls. "That's what they wanted to do. Seeing them do that (…) that's the most rewarding part. A mentor once told me, 'if you knew what it was going to take at the start, you wouldn't start.' But the reality is, making a real difference in the world is totally worth it."

One major barrier cropped up a year into development. The Owlet team had assumed that the sock's sensor module on the baby's foot could send data straight to a smartphone through Bluetooth. Further testing uncovered range constraints and communication reliability issues. With delivery dates promised to early backers, the team realized they needed to develop a dedicated base station quickly – as a go-between to communicate with both the sensor and the smartphone.

"Up until that point, we were planning on using the phone and all the conveniences that come with piggybacking off a smart device. So, late in the game, we had to figure out how to make this Wi-Fi base station work. There was a lot of stress at that time, but this is where Avnet really came to bat for us," Zack remembers with relief.

As the team was frantically trying to identify the right Wi-Fi chip set, Avnet introduced them to another startup that happened to be developing just the module Owlet needed.

"At that time, we didn't have any cash to throw at buying inventory and Avnet was able to step up and help us get the inventory and work out the logistics, both with the chipset developers and their contract manufacturer, so we could get those parts delivered to us. Avnet was the glue that held all of it together," Zack says.

A Platform Approach to Securing Your Embedded IoT Devices

With seemingly **more hackers than security experts available to protect your IoT devices**, it is essential to take advantage of silicon-to-cloud platform-based solutions that ensure the security of your devices while providing flexibility, and improving your time to market and development and infrastructure costs.

By Mark Schaeffer

Deciding on your approach for deploying security is like deciding between insurance plans. Your objective is not to deploy security technologies, it is to get a positive ROI (return on investment) on solutions to security-related threats to your business.

The impact of these threats and the need for the appropriate solution will be driven by many factors specific to your business. For example, do any of these threats have a direct impact on your revenue, as is the case with power meters, set-top boxes, and gaming platforms? Can a single event cause injury or death? If a hacker only has the resources to break into a single device, this won't cause much damage for a gaming platform, but it can for a medical device. Many attacks require physical access to the device – someone might attack their power to reduce their utility bill, but they won't be attacking their medical device or thermostat.

Mark Schaeffer
is the Senior Product Marketing Manager for Security Solutions for the Renesas Synergy Division. Mark can be contacted at mark.schaeffer@renesas.com.

Another important consideration is whether your industry has security compliance requirements. POS terminals and power meters for example have requirements for protecting keys in hardware. There may also be requirements for certain countries, as well as with doing business with certain government or military organizations.

Given the challenges faced by device designers today it is impossible to design every aspect of the system from the ground up. Given the highly competitive environment and increasingly challenging level of attacks and the regulatory environment, time to market is everything. Would you rather have your teams focused on value-added differentiation at the product level or development of the security solution? That's why a platform approach to developing IoT solutions should be considered. IoT products and applications across the spectrum require many of the same security solutions, so it makes sense to leverage the security solutions that have already been built.

Renesas Synergy™ is a platform-based approach to embedded systems where the Synergy ARM-based MCU is bundled with software and services from Renesas and partners to provide security solutions for customers. To find out more about how Renesas Synergy™ platform can make your products safe and secure, visit:
www.renesassynergy.com

Threats causing damage, injury, or liability	Solution
Malware – Invalid firmware	Secure Boot → Will only boot or flash firmware that is from a known source (e.g. the OEM) and has not been modified → Restricts the ability to roll back to older versions of the firmware (e.g. that might have vulnerabilities) → Contains a unique secure identity (protected by the MCU hardware) which can be used to prove (attest) that the device is authentic and is running authentic, unmodified firmware. → Secure Boot loader is protected from modification by the hardware with OTP (one-time programmable) memory → Supporting infrastructure and tools to establish the OEM ID and secure each firmware release
Firmware misuse – IP theft, device cloning, vulnerability analysis	Firmware Encryption *(option for Secure Boot)* → Firmware is encrypted and can only be decrypted and used by devices that have a valid identity established in ***Secure Boot*** → The number of devices the firmware can be flashed to can be controlled and audited
Compromised data in motion – Data transported across networks is not from an authentic source, has been modified, misused, or stolen	TLS (Transport Layer Security) → Data is encrypted at the source and can only be decrypted by the intended target destination → Any modifications of the data are detected and rejected → Any replaying of encrypted data is detected and rejected → Randomness is added to the data so the contents of encrypted data can't be inferred → Supporting infrastructure and tools to establish a secure identity for the device and for the cloud
Compromised data at rest – Data on the device is stolen, modified, or used by unauthorized parties	On-chip security functionality → Data is encrypted on the device and can only be decrypted and used by secure portions of the application (e.g. that are protected by the MCU hardware) → Application-specific protocols and other security requirements can be implemented with easy-to-use security services and cryptographic APIs

Quantum Computing

EINSTEIN'S NIGHTMARE

Physics is hardly the most popular course in school and within that field quantum mechanics certainly ranks last among students. Subatomic particles behave in such bizarre ways that even Albert Einstein, the man who paved the way for quantum, kept his distance throughout his life. In fact, he hated the whole idea. For him, the last straw was the concept that two identical particles, when created as pairs, could remain connected for all time, even if separated by huge distances.

No one has ever succeeded in providing mathematical proof of this phenomenon, which is known as quantum entanglement. In 1975, a Russian scientist even demonstrated that, in the world of quantum physics, it would be impossible to build a functioning computer. However, in 1982, the brilliant US physicist Richard Feynman suggested a solution to the problem: **turn around and let the quantum particles themselves do the computing!**

If he hadn't been a Nobel Prize winner, probably no one would have listened. How on earth could particles be taught to perform computing tasks? To do so would mean locking them up in tiny cages, a kind of test tube constructed out of magnetic fields, in which they would "compute" with the help of laser bursts or microwaves. The interference patterns created would constitute the results. Impossible – or at least everybody thought so at the time.

Nevertheless, the concept took hold in the minds of a handful of very intelligent people and, over time, it started to assume the nature of a viable research project. Since 1985, we have known that it is in fact possible, at least in theory, for a quantum machine to perform everyday computing tasks. The tricky part was translating theory into practice and actually building one.

Where a classical computer uses binary digits, or bits, to perform calculations, a quantum computer uses qubits – and it works incredibly faster than the classical model.

Qubits can be created using any quantifiable material that can be isolated; materials could comprise individual atoms or ions in magnetic fields, electrons in solids, or the spin of an atom's core.

Bits can exist in two states (either one or zero). Qubits, on the other hand, can exist in a number of different states simultaneously, thanks to the superposition principle.

> Quantum computers would then be so powerful that no encryption method would be safe from being cracked

Bernd Schöne
is a veteran German Internet journalist and an expert on cybersecurity

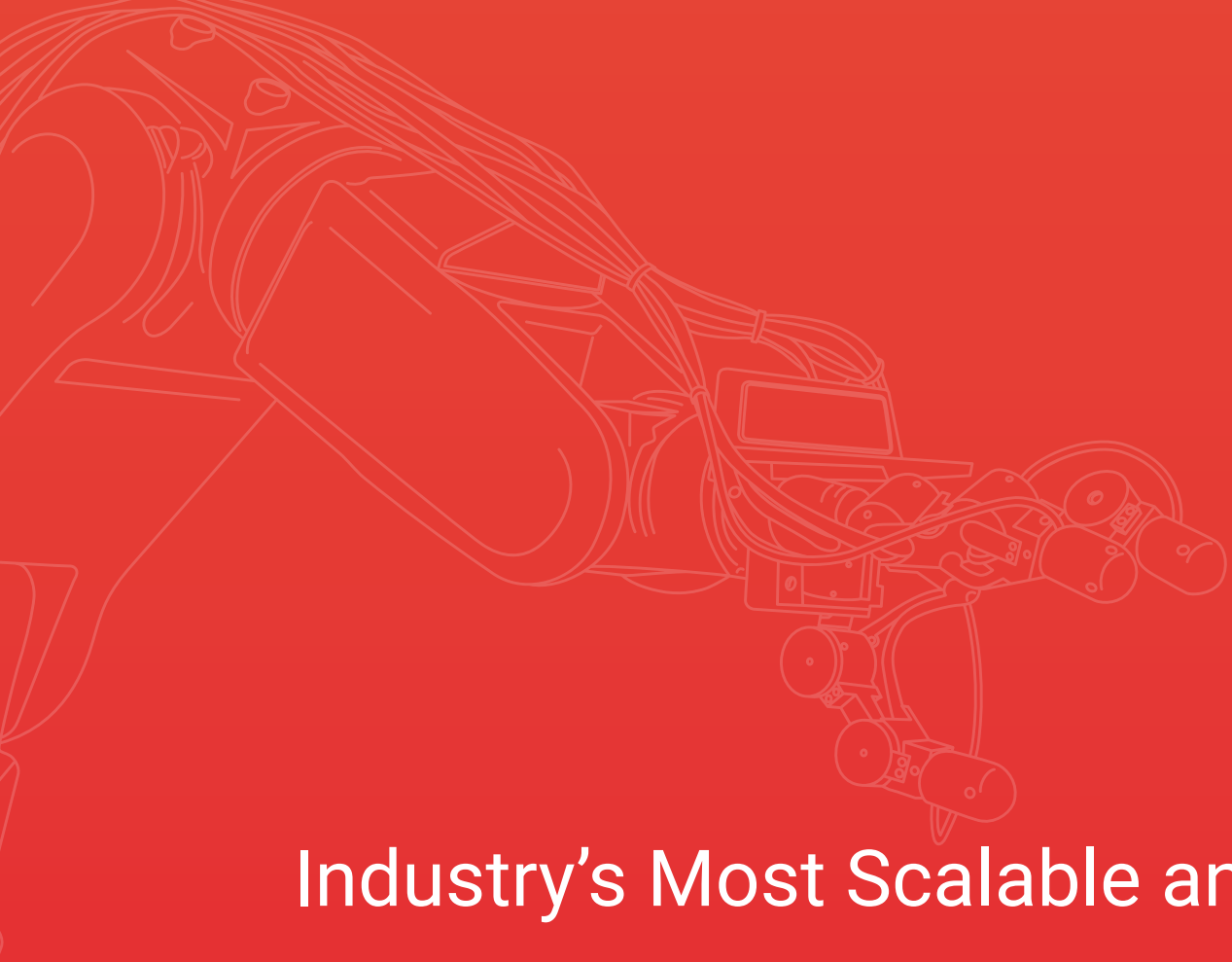
Superposition means a number of quantum states can be added together, akin to a child stacking toy bricks, and the result will be another valid quantum state. Therein lies the enormous power of the quantum computer because it needs far fewer steps to calculate its results than a traditional electromechanical computing machine.

In 2001, IBM presented the world's first quantum computer. It contained seven qubits and was capable of answering simple mathematical questions. Should the number of qubits actually reach 1,000 or more, it will be the last time data security experts will be able to enjoy an undisturbed night's rest. Quantum computers would then be so powerful that no encryption method would be immune to being cracked.

The situation gets worse because the public/private key architecture, core to current cryptographic systems, would also come under attack. Quantum methods would provide the simplest way to break encryption. As far back as 1994, a Massachusetts Institute of Technology (MIT) professor, Peter Shor, developed an algorithm to break numbers down into their prime factors. **If the Shor algorithm ran on a quantum computer it would be able to decode the strongest crypto keys in minutes – if not seconds.**

In 2015, the US National Security Agency (NSA) announced that, in future, it would only use encryption systems capable of withstanding attacks by quantum computers. In response, the National Institute of Standards and Technology (NIST) made a call for systems that could meet NSA's demands. Early in 2017, German processor manufacturer Infineon announced it had the first quantum-proof security chip. Dubbed New Hope, it is currently among the submissions being evaluated and the firm's hopes are high it will be the one to turn the tables on quantum-age threats. The submission deadline was in November 2017 and eggheads at NIST and NSA are currently evaluating the entries.

Time is running out. While hackers may not be able to buy a working quantum computer at their local hardware store yet, a simpler, cheaper solution is just around the corner. Quantum simulators will soon be tailored to address a single computing function (such as cracking crypto keys). Who knows, maybe these simulators are already here in the deep recesses of some government's security agency.



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Data Networks

IN IOT WE TRUST

The Industrial Internet of Things, or Industry 4.0, not only connects machines and computers but also vendors, suppliers, and customers. Transmission and exchange of confidential data requires secure links and virtual data spaces. The Industrial Data Space initiative aims at achieving just that.

By Gerhard Kafka

The Industrial Data Space (IDS) initiative was launched by Fraunhofer-Gesellschaft in late 2014 with the backing of industry partners and government agencies. Its purpose is to establish a reference architecture for a virtual data space using standards and common governance models to facilitate the secure exchange and easy linkage of data in business ecosystems and to promote its use on a European and international scale.

The three elements that need to be upheld to provide information and industrial system asset security are confidentiality, integrity, and availability, often referred to as CIA:

Confidentiality is the principle that information is not made available or disclosed to unauthorized individuals, entities, or processes. Confidentiality in business includes encryption and access control technologies.

Integrity ensures that improper information modification or destruction is guarded against. Data integrity, a subset, ensures that unauthorized parties cannot alter data and take control of the system without detection.

Availability is the property of timely, on-demand, and reliable access to, and the use of, information by an authorized user. Availability controls usually involve redundancy and engineering change control. Sometimes security activities are included.

Standards for industrial security

The Industrial Internet Consortium (IIC) published a comprehensive document, *Industrial Internet of Things Volume G4: Security Framework,* to initiate the creation of a broad industry consensus on how to secure Industrial Internet of Things (IIoT) systems. These connect and integrate industrial control systems with enterprise systems, business processes, and analytics. They also enable large advances in optimizing decision-making, operations, and collaborations in numerous increasingly autonomous control systems.

One section of the book gives an overview of existing standards:

- The IEC publishes the IEC 62443 series of standards for industrial automation and control systems security. The series is comprised of four sections: General, Policies & Procedures, System, and Component.
- The National Institute of Standards and Technology (NIST) has published *NIST SP 800-82 Revision 2*. This offers guidance on improving security in industrial control systems (ICSs), including supervisory control and data acquisition (SCADA) systems, distributed control systems (DCSs), and other control system configurations such as programmable logic controllers (PLCs). Performance, safety, and reliability requirements are also considered in the 2015 update.
- NERC CIP Standards, published by the North American Electric Reliability Corporation, aim at improving the security and reliability of the electricity industry by defining auditable requirements for critical infrastructure protection (CIP).
- The *IEEE Standard for Intelligent Electronic Devices Cyber Security Capabilities* (IEEE Std 1686-2013) defines functions and features to be provided in intelligent electronic devices (IEDs). The document addresses access, operation, configuration, firmware revision, and data retrieval of an IED.

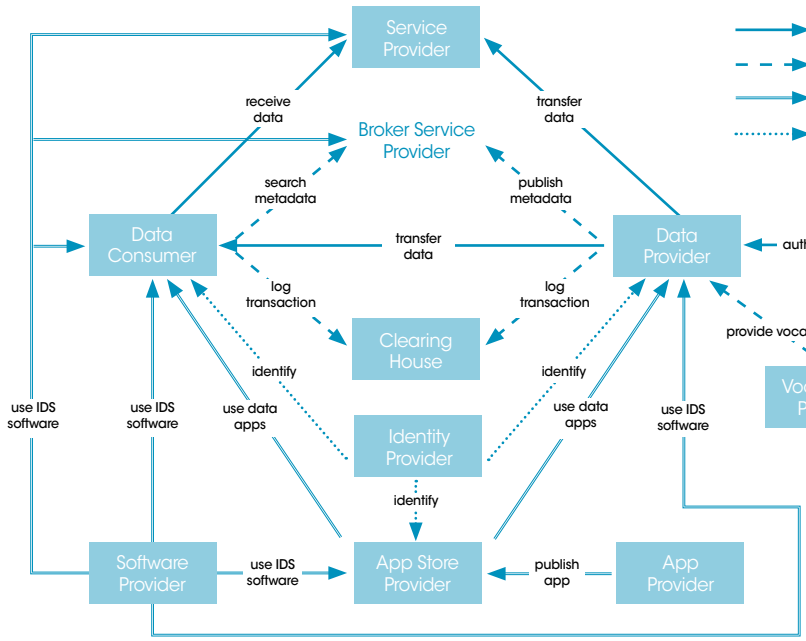
> We have a compelling opportunity for Germany to take the lead in the digital transformation of industry by creating a de facto standard
>
> **Reimund Neugebauer**
> President of Fraunhofer-Gesellschaft

Virtual data rooms

Historically, the term data room comes from its purpose with regard to due diligence audits for mergers and acquisitions (M&A). Originally, during an M&A, companies created actual, tightly secured rooms on neutral ground, such as within a law firm's premises.

Today, virtual data rooms have become the norm but are now located in the cloud, where they securely house all relevant and related content to be audited. ➔

IDS components



The IDS Business Layer connects data owners with defined business partners

Virtual data rooms require a journal documenting all procedures within the data room:

- who is authorized to read files
- who has access to named files, when, and for how long
- what files are being accessed
- what is being done with them

There are several applications that target virtual data room security.
A highly secure, platform-independent file exchange package is available from Dracoon as an on-premises or cloud version. With Europrise, ISO27001, and ULD certification, Dracoon complies with the highest security standards. Proprietary TripleCrypt encryption, comprehensive role administration, and white-label branding has helped to attract more than 400,000 users. The application is used by several large original equipment manufacturers (OEMs): Deutsche Telekom, Bechtle, Hutchison, and British Telecom.
Endian claims its 4i Edge products are "unique in that they provide a comprehensive security layer with a simplicity that is rare within the IoT industry." The appliances provide secure remote network access through technology alliances with third parties, such as Cyren, Panda Security, and Cloud4Wi, to offer cutting-edge technology.
The Private Data Room from ITWatch protects applications, content, and printing hardware from malware infiltration and from unauthorized access by unwanted external and prohibited internal sources, including general systems administrators.
Regispace for the Industry Data Space by Regify is a virtual data room for IIoT/Industry 4.0. It enables the secure exchange of data and provisioning of networked services for collaboration over value networks comprising customers, suppliers, and other business partners. It protects IoT and other data against unauthorized access and enables data owners to make data available to partners at a granular level or in an end-to-end secured process.
Scadafence's passive solutions for smart manufacturers are designed to reduce operational risks such as downtime, product manipulation, and the theft of sensitive proprietary information. The company's broad solution suite includes continuous real-time monitoring of the industrial environment as well as lightweight tools designed to automate the security assessment process. It is software-based and available either as a virtual appliance or as a network appliance.
Uniscon's Sealed Cloud infrastructure provides overall data room protection and a detailed journal. It includes a number of patented services and solutions, some of which are available from partners such as Deutsche Telekom. The technology ensures that memory contents and all data transfers remain encrypted. Moreover, it keeps content and metadata protected during processing.

> The Industrial Data Space concept has met with considerable interest in many workshops and forums held in connection with Germany's G20 presidency
>
> **Boris Otto**
> Head of research for the IDS initiative and director of the Fraunhofer Institute for Software and Systems Engineering (ISST)

Industrial Data Space

The Industrial Data Space initiative is organized in two branches: a research project and a user association.
The initiative's launch in 2014 was therefore followed in January 2016 by the creation of the Industrial Data Space Association, a non-profit body representing users' interests in the standardization of research results. The association has members from 74 companies based in 13 countries.
The activities of IDS are conducted in close collaboration with Plattform Industrie 4.0, an alliance of bodies from politics, science, industry, and trade unions.
The IDS reference architecture has a structure of five layers:

- The Business Layer – specifies and categorizes the different stakeholders
- The Functional Layer – defines requirements and features
- The Process Layer – describes interactions between IDS components
- The Information Layer – defines the model's static and dynamic aspects
- System Layer – contains logical software components, covering integration, configuration, and deployment.

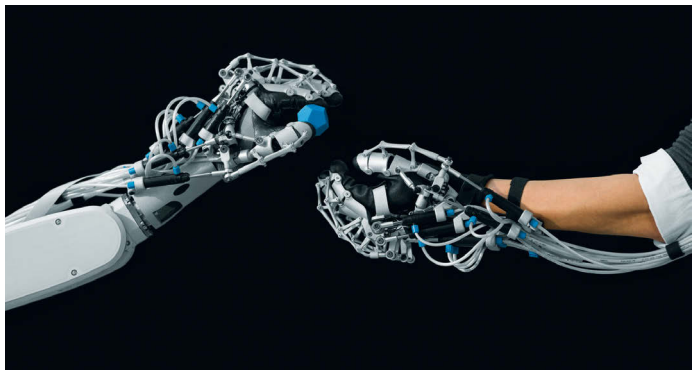
The next goal for IDS is to carve out relationships and compatibility with other reference architectures, such as the Industrial Internet Consortium in the US and the Japanese Industrial Value Chain Initiative.

Interview

How can users in manufacturing or automotive securely and effectively communicate with each other?
Data space platforms can be integrated in any workflow to allow users to communicate securely and verifiably on any digital channel, using any device. The wide spectrum from human-to-human interaction to machine-to-machine (M2M) data transactions must be supported across interconnected business networks which are common to automotive and manufacturing industries. Beside a comprehensive approach, a realistic price model is required otherwise a good overall architecture will soon come to an economical end.

What are the most important capabilities for secure IoT communications?
We focus on three aspectss. On top, confidentiality is key. The market favors encryption solutions that are both secure and user-friendly. Second, easy accessibility for users is

Business process control with smartphone or tablet (Komsa)



IDS supports interaction between humans and machines (Festo)

IDS in practice

How to create a really smart factory

Steel producer Thyssenkrupp Steel Europe has provided the first use case for IDS with an information system for truck logistics. The aim is to optimize the loading and unloading times of trucks and adapt them flexibly according to transport routes and traffic disruptions. The company handles around 20,000 trucks per month so, with just 30 minutes available to load and unload each truck, any delay in arrival can quickly throw the entire schedule into disarray.
Technology partner Komsa and Thyssenkrupp have developed an end-to-end combination of connected devices between the truck drivers and the weigh gates at the entrance to the loading bays. The aim is to automate rescheduling of truck arrivals based on reliable online data, by using real-time management of time slots and dynamically estimated arrival times Messaging using GS1 EDI XML allows instant and comprehensive status change notification.

Control and automation firm Festo and bearings maker Schaeffler have developed an integrated equipment platform using Object Linking and Embedding (OLE) for process control unified architecture (OPC-UA) over an IDS secure channel. The modular service-based concept can be extended to incorporate semantic technologies or other protocols and provides support for horizontal integration across value chains. System features include process optimization based on higher transparency, knowledge creation and documentation based on data correlation and analytics, and the transfer of new added value to partners.
Salzgitter, a German steel producer, with engineering and electronics company Bosch have developed an intelligent stock information system called From Ore to Refrigerator. It merges existing procurement systems to analyze the underlying supply chain and reveal possibilities of new business models for brokerage of raw materials and metals to customers. Results: automatic management of semantic description of steel quality criteria, machine interface for availability, and greater transparency and faster response times.

vitally important for adoption. The requirements range from simple access rights and identity management to affordable costs. Last but not least, quality counts. Quality of service must be ensured and governed by service level agreements across the IoT and business networks.

How many instances of IoT platforms would a company need?
The abundance of IoT platforms with each vendor of machinery having its own [architecture] leads to situations where one factory may have to deal with several IoT platforms. The producer doesn't want this. As the data owner, the producer wants control over his own data instead of feeding his production data into IoT platforms of vendors. As much as the producer wants the big picture in real time, he doesn't want to engage in complex integrating projects that connect the IoT platforms. Therefore, networked communication is needed that connects whole ecosystems (supply/demand/production networks). One single account from the provider of choice will give global access across

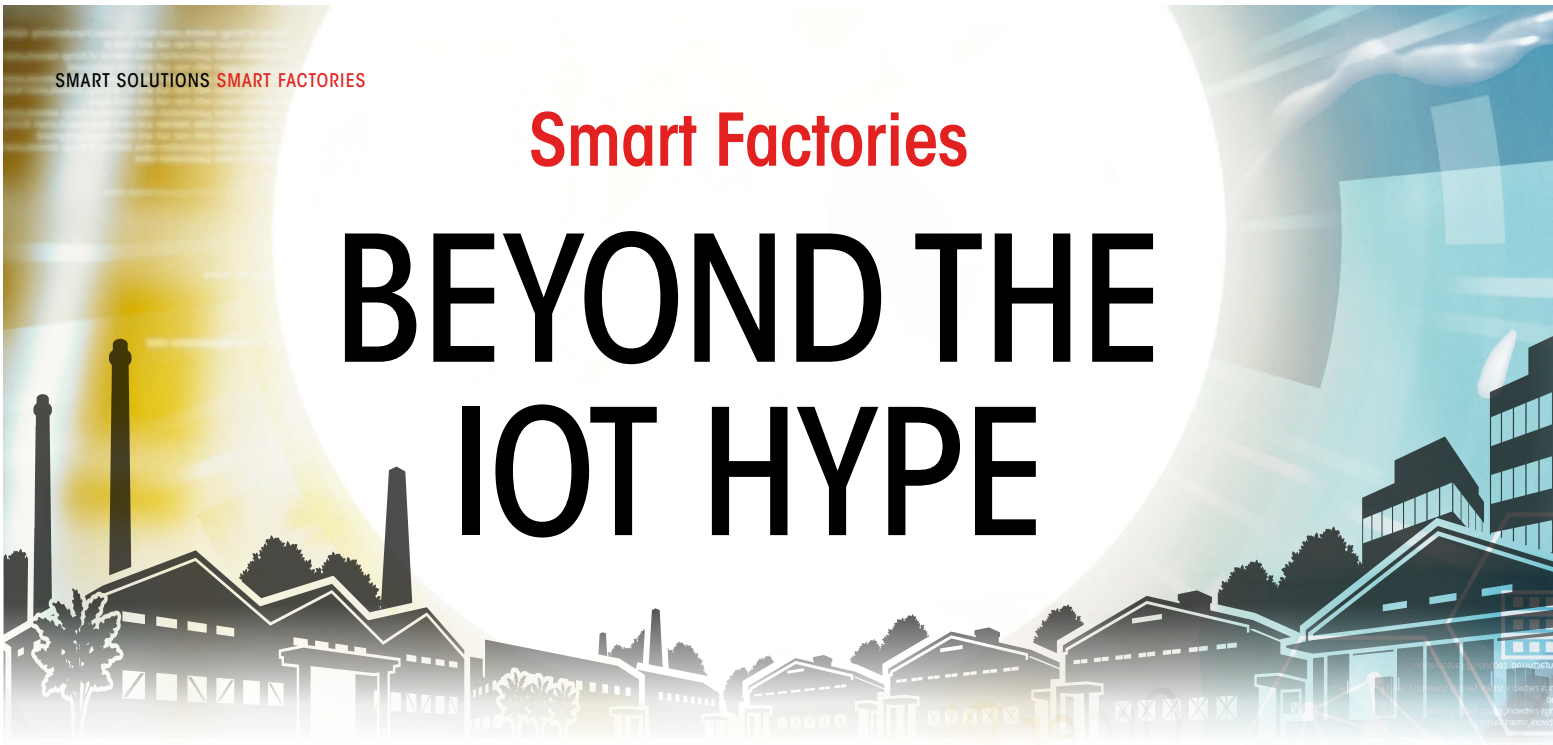
IoT or Industry 4.0 platforms. With Regispace (*www.regispace.net*), we've successfully implemented core IDS proposals in a number of industries.

Can you give us a few examples?
Several partners in Luxembourg and the UK operate Regify platforms for the health sector. These platforms ensure full control of data for the data owner, compliance regarding data privacy and

> Unlike the Internet, which has a sophisticated governance ecosystem, the whole world of blockchain is the Wild West
>
> **Kurt Kammerer**
> CEO of Regify and founder of Regify Asia

security, and at the same time they enable networked communication across the entire health sector.
Regify's patented and distributed architecture connects users (from humans to machines) across instances of platforms, lets them transact while respecting access rights that each owner of data can grant or revoke at a granular level. Users simply register with their chosen provider to gain full access to other users across the data space providers.

How about standards for secure data space?
Standardization efforts such as IDS and other international approaches are important because they facilitate cooperation within an industry. To date, many users consider comprehensive architecture and data models as too theoretical for today's challenges. Therefore, Regify solutions work on every digital channel and every device independently of which data partners want to exchange, standardized or unstandardized. Our European, and especially our Asian, customers are calling for this.



Smart Factories

BEYOND THE IOT HYPE

Thanks to IoT, **managers have a tremendous opportunity to improve operations through productivity, quality, and flexibility**. Making the most of them requires more effective connectivity and information flow between all the various data-generating and data-consuming devices, processes, systems, and people within the organization.

By Gordon Feller*

Manufacturing plants are running at a much higher utilization capacity than ever before. Often, it is a 24-hour a day, seven days a week operation. With downtime costing plants up to $20,000 a minute, they simply cannot afford disruption to their processes.

Manufacturers face multiple challenges. They need increased flexibility in their manufacturing process to meet their evolving consumer demand and global landscape. They have constant pressure on them to keep up with ramping demands from limited CapEx spend, in many cases relying on their existing resources and assets. They need better access to data to make informed decisions on where to invest and want access to leading-edge experts, but suffer from limited resources and ageing workforce issues.

Consider the makeup of the manufacturing infrastructure: over 50% of the devices connected to industrial applications are not automation devices. One can't merely focus on connecting to specialized devices – solutions are needed that seamlessly connect all devices reliably and securely.

> IoT helps us deliver a proactive go-to-market strategy for our customers
>
> **Mike Cicco**
> CEO Fanuc America

Consider the lessons learned at Fanuc, one of the world's largest industrial robot manufacturers. The company was struggling with a lack of visibility of how its customers were leveraging its equipment on the factory floor.

The only insight gained came after a problem had already occurred resulting in costly downtime for customers. After meeting with Cisco and exploring possible solutions, Fanuc saw the potential to change its entire go-to-market business strategy.

Leveraging new tools from the digital world, Fanuc now extracts customer data from its processes, stores it in the cloud, and employs predictive analytics to remedy any potential problems before they can negatively impact customers. The company called on its technical expertise to influence customers' IT departments into sharing their data in the cloud.

"By using this data and improving its response time to potential incidents, Fanuc is leveraging the Internet of Things to deliver a proactive go-to-market strategy for our customers," says Mike Cicco, president and CEO of Fanuc America.

IoT is just one part of a much bigger transition that's been happening for a long time in manufacturing. More "things" on the plant floor are being connected using the technology that powers the Internet.

Sensors can measure almost anything

Things (machines of all kinds, and even non-machines) are being embedded with smart sensors and gaining the ability to communicate. These are not just sensors for the measurement of temperature, pressure, humidity, and other parameters. They can be almost anything. For example, a camera can be a sensor and it can be used to monitor movement, quality, or even temperatures using infrared imaging – which all makes for a more intelligent manufacturing environment.

Input/output (IO) devices on the factory floor are becoming more intelligent, which means they can generate and transmit more insights in real time and benefit from the diagnostic data created by the sensors. Meanwhile, connectivity is going deeper, well beyond the plant controllers, and on to other factory assets, such as robots. Video cameras, scanners, diagnostics tools,

*Gordon Feller is an advisor on tech trends based in Silicon Valley: *gordon@MeetingoftheMinds.org*

and even personal mobile devices can be added to this growing list of IP-enabled devices.

These connected things become the tools for a better understanding of all the factory's complex processes – and then using that knowledge to more rapidly adapt to change. Smarter machines can be better controlled, thereby increasing efficiency, in what has come to be called "plant-wide optimization."

When it's a success, IoT is often a combination of connectivity with real-time analytics and new cloud services. The result can include an increase in manufacturing output, higher uptimes, more flexible manufacturing, and lower costs from the consolidation of siloed systems and proprietary networks.

Securing the new architectures from attack is becoming more important as more of the factory floor devices get connected. Hooking up these devices to the whole enterprise is a noble goal but it means an increasing number of operations can become the focus of attacks. Reducing risk in today's largely unprotected plants is the direct result of bringing in new security solutions.

Still questions proliferate. Can IoT help with deploying a converged network infrastructure? Help manufacturers improve business performance? Simplify the network architecture and build IT-friendly machines?

Those advocating IoT inside the factory are looking for some key goals:

Lowering total cost of ownership: A single network architecture and open standards help to eliminate the costs associated with multiple isolated networks and proprietary systems.

Improve operational responsiveness: Deeper insight into operations and real-time collaboration between manufacturing, engineering, and suppliers improves the quality of decisions and helps manufacturers to quickly and efficiently adapt to changing business requirements and supply-chain management needs.

Reduce time to market: By replacing a multi-tier networking strategy with one standard network architecture, OEMs can reduce the time it takes to design, develop, and deliver machines. Manufacturers, meanwhile, can reduce their time to market with fewer integration risks and better visibility into data.

Protect critical manufacturing systems: The development of a comprehensive security model while enabling secure information visibility and access across production lines.

Putting it all together

Factory wireless solutions create new flexible communication opportunities between things, machines, databases, and people throughout the plant

Dieter Zetsche, chairman of Daimler, says that the pace of acceleration in manufacturing is changing so quickly that he expects to see more changes on the factory floor in the next ten years than we've seen in the last 100 years. If you look at the movement toward smart manufacturing, many leading companies are deploying new, more intelligent, connected machines driving significant output and productivity gains as substantial as in previous industrial revolutions, like the impact of the steam engine. It's a pretty exciting time in manufacturing.

It's time to look at the Internet of Things as a key enabler in manufacturing, not just the trends but some concrete solutions and use cases that can be deployed to help get started in capturing some of that value.

Looking at what's connected today, it is apparent that an inflection point was passed near the beginning ➔

photo ©: Fanuc

of this century and since then there's been a huge upswing in the number of connections. About 2% of what can be connected is connected today but by 2020 there will be 50 billion smart objects connected. This will affect every business.

Connectivity has been a trend for many years and is passing another inflection point. It's changed cars into connected vehicles; it's changed TVs through connections to the Internet; and it's changing many other consumer products as well.

IoT's biggest impacts are showing up on the business side of a company's operations. This means manufacturers who leverage IoT can improve core processes in business enterprises, much as the first generation of the Internet led to transformations such as e-commerce and e-fulfillment that saved billions of dollars for customers. The Internet's next generation is seeing the move from PCs to mobile devices, robots, and sensors and this will, likewise, transform business again.

New products can be introduced faster

Robotics and automation advancements are already playing a critical role in this evolution. Over a million examples are in use today and they are being deployed more broadly from largely automobile manufacturing into other areas including warehouses, energy plants, and hospitals.

Emerging processes are also being adopted such as additive manufacturing (3D printing) as it moves well beyond plastics and into metals and a varied assortment of other materials.

The trend of introducing products more quickly and frequently is also increasing. No longer is it sufficient for most manufacturers to introduce products once a year. Leading manufacturers such as Samsung, Apple, and Microsoft now introduce products numerous times each year.

Inside the factory, IoT is building smart new connections. The journey is going from an unconnected factory with proprietary serial islands to a connected one with multi-capable flexible platforms. Sometimes this

> The pace of acceleration in manufacturing is changing so quickly that I expect to see more changes on the factory floor in the next ten years than we've seen in the last 100 years
>
> **Dieter Zetsche**
> CEO of Daimler

can be a very daunting process, with so many moving parts and people to coordinate.

In Phase 1: The unmanaged, unconverged network establishes a base network environment, allowing for richer sensor data to be acquired. Although this phase remains siloed and lacks security, the model does at least connect devices to a common infrastructure.

In Phase 2: Network convergence is introduced, which improves visibility into the plant, and also introduces cost savings through production visibility. Siloed networks are converged into a common plant infrastructure.

In Phase 3: This is when it's best to introduce a flexible, multi-capability network environment. Critical services such as security, mobility, and other collaborative services are then integrated into the overall plant network, allowing for real-time access to both production and business data.

By converging the previously siloed sensors, machines, cells, and zones, IoT-powered factory automation systems help integrate manufacturing systems and business systems, to bring everything online on a single network. This provides flexibility to adapt quickly to changes, whether these are new product introductions, planned product line changeovers, or other adjustments. Each affected zone, from the enterprise to the plant floor, gets real-time alerts about changes through networked mobile devices, video monitors, and human-to-machine interfaces (HMIs). Real-time information also links back into the entire supply chain, so each step in the manufacturing value chain from supply through to distribution can quickly respond as needed.

These are the components in the ideal suite of solutions – and they work well together, in this fashion:

Factory wireless solutions create new flexible communication opportunities between things, machines, databases, and people throughout the plant. From asset tracking to visibility of automation controls and HMIs, wireless network environments on the shop floor can increase productivity and production speed. A unified wireless infrastructure delivers the reliability and performance needed for mission-critical plant floor applications (like wireless torque tools).

It can also be a platform for additional industrial global applications, such as Wi-Fi asset tags that help increase productivity by making it easy to find production assets and inventory – or mobile high-definition video cameras that enhance remote troubleshooting and collaboration.

Controlling access to plants and machines

Factory security solutions work with factory automation systems to create plant security for both digital and physical assets. It gives detailed control of plant network access by user, device, and location. For example, a plant manager can limit a remote or on-site expert's access to just the machines they support.

Factory energy management solutions enable intelligent IoT applications, such as analytic engines that communicate with machine sensors, to stream detailed operational data between the plants and the higher-level systems. This provides real-time visibility into valuable energy use information. For example, instead of consuming power when not in use during breaks and weekends, machines can be triggered by automated controls to power up only according to

production schedules sent to HMIs, helping to cut plant energy use by between 10% and 20%.

What is the real business value of a connected factory? Persistent problems created by inflexible production lines show up when it takes weeks to reconfigure one. When companies deploy factory automation solutions they can build their products on any production line. Debugging times go from hours to minutes, increasing the operational efficiency.

Factory wireless solutions help solve issues like long search times to find parts, or the cost of cabling and need to rewire, which lowers operating costs. Factory security is critical and identity-based access and secure remote monitoring reduce risk and allow new business models. Companies struggle with energy costs but if they can't get any data about energy usage how can they meet requirements or regulations? Factory energy management helps to lower energy costs.

Factory automation systems include rapid fault isolation, greater ease of use, more flexible manufacturing, and greater resilience. Ease of use is particularly important at three in the morning when a malfunction occurs. Look at the difference experienced by an operator on the floor who's able to identify the issue, pull a device from the storage room, and just plug it in.

Contrast that with needing to bring production down for several hours, trying to get the right expertise at that time – this difference can translate into lasting savings of bottom-line dollars.

Use cases can be found almost everywhere, from controls visibility to wireless tooling, asset tagging, and mobile video. A number of products are helping to make a more seamless factory floor experience.

Connected factory automation solutions are not just about connecting these automated systems, but binding these systems together and moving to converged platforms. This enables better visibility and faster diagnostics that can concretely reduce downtime and new business models, like flexible manufacturing. Some users report lasting productivity gains, including up to five-times improvement in build-to-order cycle times – allowing them to go from months to weeks. Practically speaking, it means plant managers can troubleshoot not just switches, but every plant floor device. Finding the root cause of a problem faster, versus spending hours trying to find out where there is a problem.

Avoiding downtime is a crucial goal

One manufacturer had a line card that went bad – but because the managers didn't have visibility, they started pulling line cards and other things, and wound up with ten hours of downtime. This was something they could have (and should have) identified and fixed in minutes.

There are many leading suppliers of industrial automation equipment and control systems – and they all seem to be focused on IoT. It's a critical part of every strong factory which looks to reap the full benefits delivered by emerging technologies. Here are a few helpful hints:

- **Take the technology view:** Support the use of open, unmodified standards, with intelligent networking features in automation networks through ODVA, ISA, and others.
- **Focus on reference architectures:** Offer tested, validated design and implementation guidance, and best practices for a converged network architecture.
- **Value both people optimization and process optimization:** Develop process guidelines for help with convergence, and facilitate training and dialog with people in IT and manufacturing.

As the role of IT has changed, navigating this increasingly complex landscape has required more than beefing-up already isolated systems. It's more than business as usual.

Today, it's become critical in the world of manufacturing to assess how emerging platforms perform, and how they integrate and converge. The desire expressed by executives who manage the machine-building companies is for IT systems to continue to become increasingly simple, smart, and secure. This means rapid new service deployments, more compelling user experiences, and organizational agility.

The technology these companies most desire is the tech that enables their firm to acquire and analyze the influx of data. It reduces complexity, allowing the company to shift from focusing on cost to focusing on growth. It empowers the company's leaders to make the best choices about where data and applications reside, and how to protect those key assets wherever they are.

Leaders who actively embrace these dynamic changes are thriving and reaping the rewards as new growth opportunities appear.

The future of manufacturing

Advances in robotics and automation are already playing a large role in the evolution of the automobile industry

CONNECTING IOT TO BUSINESS

During its short history, the Internet of Things has mostly been about technology and, yes, getting everything connected to everything else is a huge challenge for IT departments as well as for vendors. Big companies like Google, Amazon, and Microsoft focus, for the most part, on infrastructure by providing platforms as a service.

While that remains important, the truth is that business outcomes drive IoT, not technology. When we talk to enterprise customers and to the people who are driving their business models, it soon becomes very clear they know exactly what they want to achieve, and they realize that if they could only connect it would create entirely new business models that would enable them to make more money.

The problem is that the people responsible for a desired business outcome generally have no idea at all about the technology they'll need – the hardware, the software, and the embedded solutions – that will deliver the results they're aiming for. It may sound like a cliché, but that poses both a problem and an opportunity.

When we find a company in this situation they do not need proof of technology (something that we here at Avnet Silica have been rather good at over the years), but proof of business outcome. They don't care what the technology looks like, they just want results.

Within IoT, unfortunately, things aren't integrated tightly enough – at least not yet. That's why we're busy doing exactly that, specifically connecting from the sensor to the gateway all the way up to the cloud in order to deliver the right information at the right time to the right place – remember the old IBM slogan? We design dashboards that show sensor activity, and while that's all very fine, in the end all it does is to prove sensor technology. It doesn't prove anything about the business case.

What we are doing today is integrating all the technologies and moving ever closer to the customers' applications and their business models so they can quickly reach their business goals. At the end of the day, that's what's going to accelerate the entire IoT market.

The challenge for Avnet is to bring our edge solutions into the world of the platform providers, people like IBM, Microsoft, Google, and Amazon AWS – it's unlikely there'll be more because of the huge development costs. These platforms are beginning to resemble utilities, like the guys who deliver electricity or water to our homes.

In IoT, it is becoming more and more important to get to the applications that drive the business. And while there are only a handful of platform providers, there are hundreds and hundreds of application providers that cater to the needs of all kinds of businesses. Those are the ones we need to bring into the world of IoT so we can offer our business customers the end-to-end solutions they need if they are to achieve the outcomes they're aiming for.

The technology we need to create the world of IoT is largely available already. What we need now is for the technology people to find a way to connect with the business world. Aligning IT and business has certainly never been more important than it is today.

> In IoT, it is becoming more and more important to get the applications to drive the business

Philippe Fremont
Vice President
of IoT for Europe
Avnet Silica

See IoT in a whole new way with Embedded Vision

AVNET SILICA

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SMART PRODUCTS

NIU

Smart scooters

In the world of electric vehicles Chinese startup NIU believes that four wheels may be good but two wheels are better. At the 75th anniversary of the Eicma Motorcycle Show in Milan, the company unveiled four smart e-scooters to tempt urbanites over to their eco-friendly vehicles. Powered by Bosch electric motors, all but the budget U-Pro scooter have a range of over 130 km from a single charge and the Li-ion batteries are removable to allow them to be recharged in the home or office, so there's no need to hunt around for an empty charging bay for parking.

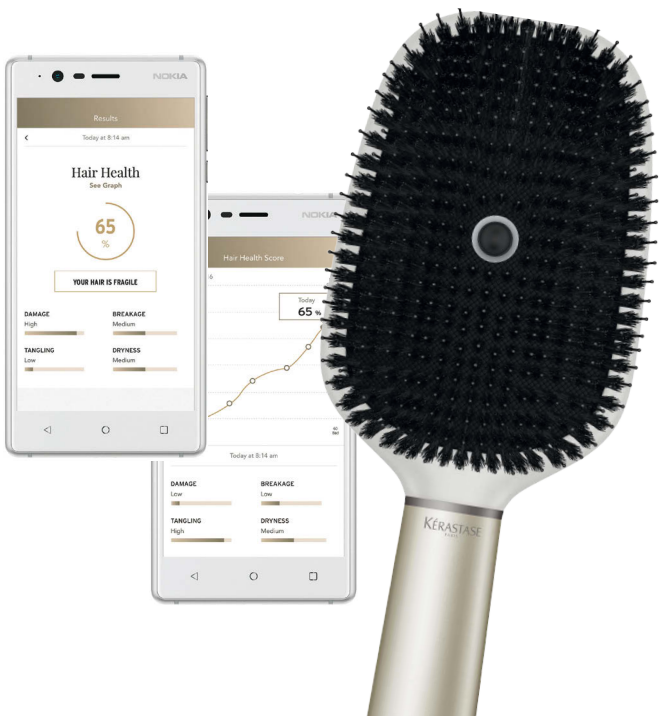
Top of the new range is the Project X with a maximum speed of 120 km/h and a range of 160 km. Next comes the N-GTX (100 km/h, 180 km), the N-GT model (80 km/h, range130 km), and the U-Pro (45 km/h, 70 km) with its ultra-minimalist design. All models will be available on the European market in 2018.

"We have designed these two new models GTX and GT to meet the expectations of people looking for a more powerful and sustainable experience. They have been designed for speed, endurance, and power with an attractive design and faster acceleration," says Token Hu, co-founder of NIU (pictured). The U-Pro scooter was designed to be ideal for everyday commuting in urban areas. It reaches its maximum speed of 45 km/h in a few seconds and the removable battery recharges in seven hours. It will be available in Europe from April 2018. "We are excited about Project X because it forced us to reimagine battery and motor design in order to meet the demands of speed and range, and we think we will convert a lot of skeptical petrol moto-scooter riders to electric because of a smart price matched with this level of performance," Hu adds. The onboard telematics run Android OS and feature a touchscreen display. This connects to the NIU E-Scooter app, which contains a maintenance manual and usage records, and alerts the user about the battery level and any malfunction that may occur. It can also report if the scooter is moved without permission and has integrated GPS tracking to locate a lost or stolen bike.

Kérastase

The future of hair care

Nokia has developed the world's first smart hairbrush to enable people to track and improve hair health over time. Hair Coach results from a collaboration between Kérastase and L'Oréal, who bring extensive hair expertise, with Nokia providing the essential state of the art sensors and app connectivity. The resulting innovation is a brush that syncs seamlessly to smartphones to provide valuable insights that could radically change the home beauty care regime. The brush detects when it is being used and begins data collection automatically. After each brushing session, all data is sent automatically to a connected phone via Bluetooth Low Energy or Wi-Fi. Even without this tech twist, Hair Coach is a high class brush featuring a sleek, lightweight handle and a high density head of boar & nylon bristles. The built in sensors deliver a complete hair diagnosis without any additional effort and the statistics allow users to follow their hair health progress over time The smartphone app also provides hints for a personalized care routine and curated tips from Kérastase.



Motorola

Motorola Sphere Bluetooth speaker with integrated headset

The Sphere 2-in-1 Bluetooth stereo speaker from Motorola delivers music remotely in full, bright, HD audio through speakers or headphones. It has an ergonomic 360-degree silhouette and 2 × 8W bass-porting speakers to deliver a natural sound experience. It connects wirelessly to smartphones, tablets, or other audio-enabled Bluetooth devices. Users can choose to use either the stereo speaker or the headphones when they want to listen privately. A built-in microphone allows phone calls to be answered through the speaker system. Sphere makes it easy to listen to music anywhere: in the bathroom, kitchen, bedroom, or garden. The play time of the headphone is 22 hours and the speaker can be used as a charging dock for other devices.

Ubtech

A pet robot for every home

Ubtech claims its Lynx with Amazon Alexa is the first humanoid robot to offer a truly humanlike experience. The exclusive alliance means that Amazon's cloud-based voice service gets a physical presence rather than being a disembodied voice in a can (see *Robot 2020* p54). With voice commands, the 50 cm tall Lynx can dance, sing, take photos, act as an exercise coach, and even provide yoga lessons. It features voice, face, and presence recognition as well as Surveillance and Avatar modes. A built-in passive infrared (PIR) sensor allows Lynx to detect movement within a room and record and send a 30-second video clip to a smartphone. This means Surveillance mode can alert an owner to any unusual home events occurring when away from home. In Avatar mode the owner can access Lynx's video and motion through a phone app to "join" events such as a missed family birthday, or, as incoming calls can be routed through Lynx, a chat with the boss can be given an amusing edge. The Alexa link allows the robot to respond to voice commands or queries and it can play selections from Amazon Music or receive iHeartRadio, TuneIn, and other services. You can also find and order items from Amazon. So, if you want a companion for Lynx, you just have to say and it can order it for you at a price of €800 …

SIAR

Sending robots down the drain

The Sewer Inspection Autonomous Robot (SIAR) project is developing an autonomous ground robot that is able to examine sewage systems with minimal human intervention. If the going gets tough, the vehicle and its onboard sensors can be controlled manually. The SIAR consortium comprises three partners: IDMind, a Portuguese SME specializing in robotics, with the Spanish universities of Seville and its near neighbor Pablo de Olavide. The project is being developed under the ECHORD++ initiative of the Public End-user Driven Technological Innovation (PDTI) scheme, which encourages SMEs to develop robotics technology according to the needs of public bodies. The aim is to develop a solution that improves the efficiency and range of the inspection service while reducing associated risks.

Evaluation experiments are running regularly in the sewers of Barcelona, Spain. Local support is provided by Barcelona Cicle de l'Aigua – the managers of the sewer network. Currently, the tests are based on IDMind's RaposaNG robot but a new vehicle will be built based on the experience gained. This robust IP67 robot frame will be designed to work in the hardest environmental conditions, with increased power autonomy. It will also feature broader inspection capabilities, better communications, plus autonomous navigation and inspection functions to give improved cost-effectiveness.

Toyota Motor

Toyota's third-generation humanoid robot

Toyota Motor has revealed a new robot named T-HR3, which is billed as an evolution of a previous generation of instrument-playing humanoid robots which were created to test the precise positioning of joints and replay of preprogrammed movements. T-HR3 is more practical and can safely assist humans in different settings: in the home, in medical facilities, on construction sites, in disaster areas – or even in outer space.

"The Partner Robot team members are committed to using the technology in T-HR3 to develop friendly and helpful robots that coexist with humans and assist them in their daily lives. Looking ahead, the core technologies developed for this platform will help inform and advance future development of robots to provide ever-better mobility for all," said Akifumi Tamaoki, general manager of the Partner Robot Division.

T-HR3 is manipulated by an operator perched in the Master Maneuvering System and kitted out in a wearable control outfit that maps hand, arm, and foot movements to the robot, allowing the entire body of the robot to be operated instinctively. A head-mounted display, similar to a VR headset, allows the user to see from the robot's perspective.

The system's master arms give the operator full control of the robot's corresponding joints, down to the fingertips, and the "master foot" allows the robot to be moved forward, back, or laterally by the stationary operator "walking in place" in the control chair. A self-interference prevention system ensures that the robot and user do not disrupt each other's movements. Onboard T-HR3 motors, reduction gears, and torque sensors, developed in collaboration with Tamagawa Seiki and Nidec Copal Electronics, add precision to each joint's movements. These modules translate the operator's actions directly to the robot's body parts from the Master Maneuvering System's 16 control systems – the result is a smooth, synchronized user experience. The Torque Servo Module is the key to enabling T-HR3's core capabilities:

- Flexible joint control, to control the force of contact with individuals or objects in the environment
- Whole-body coordination and balance control, to maintain balance after collisions
- Remote maneuvering, to give users seamless and intuitive control over the robot

T-HR3 was first shown to the public in November at the International Robot Exhibition 2017.

Misfit

A smartwatch with a difference

As hybrid smartwatches go, the Misfit Command has the power and connectivity of many of its peers – but it has the look of a stylish, classical analog watch. The 44 mm diameter case is 15 mm deep and is crafted from stainless steel in matte finish with a polished top ring. For the strap there are four options: stainless steel, leather, sport, or nylon. Battery life is amazingly long and the removable cell will last up to a year. Even if the reality is only half of the specified estimate, it's still pretty good. The watch is also water and shock resistant. On the features front, Command can give customized notifications for email, calls, and texts. It also has a smart button which can be set to launch your favorite function, whether it's playing music, taking pictures, or connecting to other smart devices – or just to ring its misplaced paired phone. Among the other features are activity tracking through a three-axis accelerometer, sleep quality recording, customizable vibration notifications, smart alarms, and movement reminders. The activity function can be toggled to show progress towards your daily goals for footsteps taken, distance traveled, or calories burnt, and recorded data can be sent to the smartphone. Three of the Command versions are available from the Misfit webstore for €150 but the stainless-steel version is €20 more.

Ikea

Talk to your Ikea lamps

Since Ikea is known for offering affordable furniture for everybody, it's not surprising that speech control added to its smart lighting addresses all common systems. Consequently, its voice system works with Amazon Alexa and Google Assistant, as well as with Apple's Home app and Siri.

"With Ikea Home Smart we challenge everything that is complicated and expensive with the connected home. Making our products work with others on the market takes us one step closer to meeting people's needs, making it easier to interact with your smart home products," says Björn Block, business leader for Ikea Home Smart.

Ikea Smart Lighting is a plug-and-play solution. Replacing a light bulb with a Trådfri LED bulb makes it immediately available for remote control. By using the Trådfri app or the hand control, lighting moods can be designed by dimming and setting a color tone from warm to cold. The system also integrates seamlessly with other compliant accessories from Apple HomeKit, Google Assistant, or Amazon Alexa accessories such as thermostats, door locks, sensors, ceiling fans, shades, and more.

Ikea also announced that there will be additional launches in the near future, enabling people to build onto their smart home solution.

Crownstone

Crownstones light up your life

You can find lots of kits out there that are built to make homes smarter without much installation but Crownstone plugs, developed in the Netherlands, can do a lot more than many competing products by using Bluetooth Low Energy signals. Built-in AI means the plugs can identify connected items by their power consumption and create a Bluetooth map of rooms in a house. The plugs come in two basic formats. One is an adapter which plugs into the wall socket and allows other devices to be plugged into it; the other is a small invisible unit that can be internally mounted in the socket by an electrician. Whichever version is chosen, they are able to switch on the lights as soon as a person carrying a smart device enters the room – and turn them off again when the person leaves. Energy-hungry devices will be switched off automatically when nobody is at home and household tools, like irons, can be made childproof by being prevented from working if no adult is present. The plugs can also be controlled remotely via a smartphone. The Crownstone kit containing two power plugs is available for €90 from the company's webstore. They are only currently available for round European 240 V power outlets but other versions may appear over time. Similarly, the system is open source so time may see extra functionality added to the plugs.

Vrvana

Mixed reality from Apple

So far, the Canadian startup Vrvana has only shown prototypes of its augmented reality headset, currently called Totem. These were impressive enough to earn it a best in show award at CES 2017 but it looks like we may see more soon following a $30m takeover by Apple. Differing from other AR sets, like Microsoft's HoloLens, Totem looks more like a VR headset and uses two OLED displays to show real world images, taken by integrated high-resolution cameras, which can be overlayed with elements generated by a computer or smartphone. The displays cover a very wide angle of 100 degrees, which makes the immersive experience much more realistic than is possible with VR sets, like Oculus Rift.

You can never predict where Apple is heading with technologies it acquires but, as the company has said it sees augmented reality as the next major computing platform, a follow-up of the Totem will probably be an important part of Apple's AR jigsaw puzzle.

Proteus

Always remember to take your pill

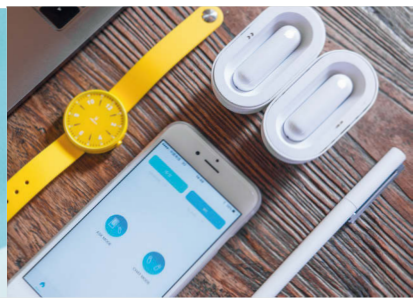
Communicating in a rather complicated way seems to be embedded in the DNA of medical engineering. When Proteus announced Abilify MyCite, it read like this: "Abilify MyCite is a drug-device combination product comprised of Otsuka's oral aripiprazole tablets embedded with an Ingestible Event Marker (IEM) sensor. The system includes: Abilify MyCite, the MyCite Patch; the MyCite App and web-based portals for healthcare providers and caregivers." Prosaic, or even enigmatic, it may be – but the meaning is revolutionary.

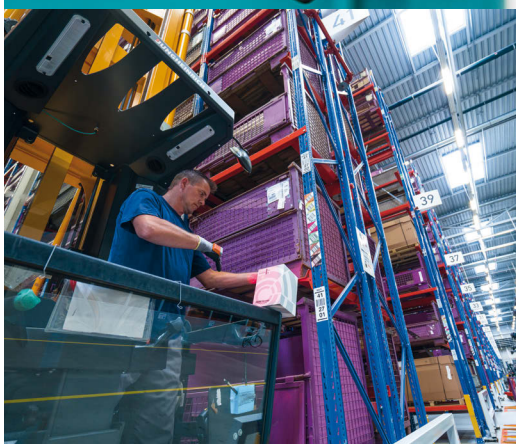
Abilify is the brand name of a drug used for the treatment of schizophrenia and bipolar disorder. A patient prescribed the pills will also be swallowing an integrated IEM sensor that's the size of a grain of sand and made from ingredients normally found in food. As soon as it contacts stomach fluids, the IEM activates and communicates to a wearable sensor integrated in the MyCite Patch worn by the patient. After activation, the IEM is digested and eliminated from the body. The patch records the date and time of the ingestion and communicates this data to the MyCite app on a mobile device. The app allows patients to view their medication ingestion and daily activity and rest levels. They may also enter their mood – important for mental health issues. With the patient's consent, a care team or family members can be given access to the app information. Proteus is also marketing the system under the name of Proteus Discover for use with other pills and medications.

Timekettle

Translate live

Anybody who has read the science-fiction novel *The Hitchhiker's Guide to the Galaxy* by Douglas Adams will remember the Babel fish – an alien species with the ability to instantly translate any language when popped into the ear. Timekettle's WT2 Translator may not be a fish but it does fit the ear and can make conversations between people who don't speak the same language possible. Supplied as two earpieces in a travel case, the WT2 can work in three different modes for various communication scenarios: Auto mode allows natural conversation when each person wears an earpiece and Manual is for noisy environments with the conversation being echoed to a text version on a smartphone. Ask mode can be used when the user wants to ask a quick question. The owner uses the earpiece and holds a smartphone, running the app, like a microphone to let the helpful stranger hear and see the translated query. Timekettle claims that translation latency is between one and three seconds and the accuracy is sufficient for daily communication needs. The earpieces allow face-to-face, hands-free communication for up to six hours without recharging and the app runs on Apple or Android phones. From launch, WT2 supports English, German, French, Spanish, Chinese, and Japanese but additional languages will be added later through updates. Currently, the product can be preordered for $149 from the Kickstarter page for WT2 Translator but when that offer closes it will be available from Timekettle's website for $179.





ProGlove

Fits the industry like a glove

Munich-based startup ProGlove has developed a smart glove – a plug-and-play solution for industrial warehouse stock location and identification. ProGlove has named the product Mark and it's designed to let manufacturing and logistics staff work faster, safer, and easier. The glove replaces cumbersome barcode-reading devices and supplements its integral 2D barcode reader with touch sensors that allow process steps to be documented by simply tapping fingers. This makes tracking and tracing barcoded parcels or locating manufacturing parts as simple as a wave of the hand – the integrated electronics and barcode reader does the rest.

"The close cooperation with clients such as Audi, BMW, Skoda, Mahle, and John Deere shows the enormous ergonomic and efficiency potential of ProGlove. We can save 2,000 minutes a day in one warehouse – immediately, without integrational effort," said ProGlove founder and CEO Thomas Kirchner.

Workers receive direct feedback of their operational steps via "visual acoustic haptic signals" – or in layman's terms flashes, beeps, vibrations, and gestures. This leads to a new level of processing speed, quality, and efficiency. The integrated gesture sensors can also allow the control of machinery without physical contact.

The core of Mark's design is a complemented computer unit. The working glove attached to it can be easily replaced when it wears out. The Mark unit can be helpful in picking, quality checking, security documentation, packing, and assembling.

Dashboards

DESIGNED FOR DECISION-MAKING

Dashboard design is becoming a core component of many solutions, especially as businesses keep accumulating data which has the potential to improve operations and increase revenue. Although there's a known need for dashboards that deliver important insights, there still seems to be a fundamental lack of understanding about why, what, and how data and insights should be recognized.

By Anton Baturan*

How many times has a brief or a client conversation started along the lines of: "We have this great data and just need a cool-looking dashboard to showcase it."? The implication is that with a little bit of makeup data itself will shine. Unfortunately, it's not that easy. When developing or working with a partner in developing dashboards, organizations need to first examine three key areas: the specific purpose of the dashboard, how to define its value, and the role design plays in this process.

> Defining the purpose of the dashboard needs to be the very first step

Businesses sometimes don't realize hat defining the purpose of the dashboard in concrete terms needs to be the first step in any design process, and that dashboards, or any other capabilities that provide greater value to users, do not represent value in themselves.

Underpinning both is the data myth. While in some cases the current mantra of **Data = Value** is true, specifically where data is unique, in most cases data is, or becomes through continuous accumulation, a raw commodity. Distilling actionable insights from vast amounts of rich data is what makes data valuable.

To illustrate, requests to create a new dashboard usually come packaged with the following false assumption:

Data + Dashboard = Value

Although closer, the reality is rather more complicated; it correspondingly has more of a resemblance to:

Actionable insight + Dashboard = Value

Where actionable insight is:

Data + Value definition = Actionable insight

Pivotal to the success of any data display, any product, is actually the value proposition. While this may be axiomatic, it's surprisingly often overlooked. Beyond technical know-how, it is the clear understanding of the business drivers and the contextual human factors that shape how we define value so that it channels broad requirements into a more focused and orchestrated mechanism capable of making a measurable impact.

How do you define dashboard value?

Businesses drive products, including dashboard creation. While most companies start introspectively many stop there, creating narrow, myopic results in the process. The inside-out view of the product can reflect business drivers as well as use case hypotheses. Yet, these hypotheses will be invalid if they are not matched with the outside-in view reflecting the

*Anton Baturan is associate VP of experience practice at Ness Digital Engineering

end-user needs and market factors surrounding them. No introspection is complete without context and, to properly define value, business self-analysis must be complemented by a broader look at the market and the human factors surrounding the overall product use.

The value proposition is obviously not unique to dashboards – it should be part of any product or service strategy. What this means is that, inversely, the lack of focus observed in dashboards is usually a symptom of a larger issue, specifically the lack of an holistic product strategy.

Companies that work on digital platform engineering tend to use two types of team exercises to address this problem: Value Proposition Canvas (VPC) and Business Model Canvas (BMC) workshops. These are common, lean startup tools for both developing an holistic understanding of top-level business or product models and defining user-centric product or service needs, respectively.

The latter of the two explicitly addresses dashboard requirements by aligning business and user goals, or, more specifically, in business-to-business (B2B) and business-to-work experience (B2WE) scenarios that dominate dashboard design, and reconcile a product's business model with a customer's objectives and an individual user's needs.

By contrast, too often we see universal dashboards displaying an overview of everything made for everyone. Simply put, this is "stuff" – a highly commoditized accumulation of generic data. If it's true dashboards can transform a business, it is true only if we accept dashboards are not a static destination but a vehicle that enables users to reach their objectives more effectively.

The role design has to play in this process

Picture this scenario: being asked to design a dashboard for a DevOps-related product. The brief consists of only a set of technical productivity tools used by engineers and technology managers. Yet, neither the brief nor conversations with the product owners reflects a perspective on user needs, pain points, or specific value each piece of data is meant to create.

The focus becomes what technology can do irrespective of any specific need or benefit. As a result, the dashboard you're asked to create would be a universal gateway for all users by displaying a snapshot of all content that would then provide drill-down access to all the detail. In other words, the dashboard would be an index of technical capabilities made visual, and not a way to improve productivity.

This is a tool for engineers designed by engineers but where no actual engineers had been consulted as users. They acknowledge the tools used (data), but not what would make the effort valuable or how to orchestrate it to make them more productive. Post-rationalized approaches like this use the dashboards as an invitation to a feature rabbit-hole and approach design in a superficial way. Once you have been invited in, you will find the dashboard itself superfluous, if not a gatekeeper.

Fortunately, design challenges situations like this by addressing the problem holistically. From disconnected requirements often focused on outputs, design reaches back to motivations and enables us to weave in human-centered systems focused on outcomes and results. In this engagement, a wide-ranging technical roadmap is transformed into a user-centric product strategy.

> The role of the dashboard is to generate human-focused behavioral and interactive systems that are measured by results

This leads us to another misconception – the primary role of design practitioners is not to design interfaces but to generate human-focused behavioral and interactive systems measured by results. The interface is a natural result of these systems, yet does not precede them.

In this context, dashboard design must be concentrated into the following five areas:

- Discover and define value – for organizations, their partners, and their internal or external end users
- Recognize, comprehend, and reconcile occasional opposing needs from stakeholders, users, partners, and customers
- Funnel those needs into a cohesive service system by mapping, choreographing, and balancing the interaction beyond the screen and across all digital touch points
- Understand the most effective way for those end users to consume the value and effectively act upon it
- Validate

At the intersection of information

No dashboard work should be detached from the larger product. To think that a dashboard is an interface problem exclusively is a dangerous error. For many who understand the complexity of data, it may appear like a flat lid on a large box of information troves. Regardless of its size, and indeed it is comparatively small, it is an intricate intersection of behavioral workflows and information paths. In that sense, a dashboard may be a thin lid, but it is a lid with a lock.

To unlock the power of dashboards is to focus on business and user value simultaneously. By identifying the value for businesses, partners, customers, and, above all, actual individuals physically interacting with the product, organizations can create dashboards that bring forth actionable and personally meaningful insights that deliver efficiency and productivity.

NEWS SMART COMMUNICATION

DJI AeroScope

Keeping an eye on drones

Drone owners can now voluntarily identify their flight operations to authorities without sacrificing privacy thanks to IoT technology. AeroScope, a new aerial identification system from Chinese drone manufacturer DJI, allows law enforcement and aviation officials to track airborne drones remotely in response to safety and security concerns. The system broadcasts the drone's location, speed, heading, and serial number to receivers installed by the authorities at sensitive locations or in response to complaints. DJI says AeroScope addresses the concerns of authorities who have to identify and track illegal drone activity. The company says it will work with other drone manufacturers to create a standardized version of its "electronic license plate for drones."

Microsoft

IoT simplified by Microsoft

IoT Central
Microsoft employs automation to speed up IoT back-end programming

Finding people skilled in building and managing connected solutions can be a major obstacle to successful IoT solutions. No more: Microsoft is now offering a highly scalable IoT software-as-a-service (SaaS) solution, Microsoft IoT Central, which supports best practices and high security. It also provides the reliability, regional availability, and global scale of Microsoft Azure cloud.

The goal is to allow companies to build production-grade IoT applications in hours without having to manage the back-end infrastructure or to teach employees new skills. Devices can be connected in seconds and users can move from concept to production in a few hours.

IoT Central leverages advanced privacy standards to ensure clients can remain in control of their data. By reducing the time, investment, and the skill sets required to develop a robust enterprise-grade IoT solution, Microsoft claims IoT Central will enable clients to reap the business benefits of IoT faster than ever.

Berg Insight

Connected care is booming

IoT analyst firm Berg Insight reports that connected-care solutions are booming, and the number of users is expected to grow at a compound annual rate of 18.7%, reaching 16.5 million within the next four years. Next-generation telecare systems are also appearing with added features such as video communication and remote visits.

"There is a strong need for solutions that enable social-care and health-care services to be delivered more cost-effectively without compromising the quality of care," says Anders Frick, senior analyst at Berg. He believes traditional telecare alarm buttons will be overtaken by next-generation telecare as the largest segment of the connected-care market with a forecasted 8.1 million users in 2022. However, traditional telecare will still boast around 6.2 million users, and telehealth will have 4.0 million users by the end of the same period.

Anders Frick
Social and health care need to be delivered more efficiently

Amazon

Alexa enters the office

Amazon's digital assistant Alexa has been welcomed into many homes (see *Robot 2020*, p54), but now the voice-command, virtual assistant is heading into offices across the world. Alexa for Business will be able to book conference rooms where attendees can start meetings and control the equipment in the room through spoken commands. Companies can tailor Alexa by building customized "private skills" which can be integrated with IT applications and other office systems. The additional functionality for Alexa was revealed last December at Amazon's annual AWS Re:Invent conference in Las Vegas.

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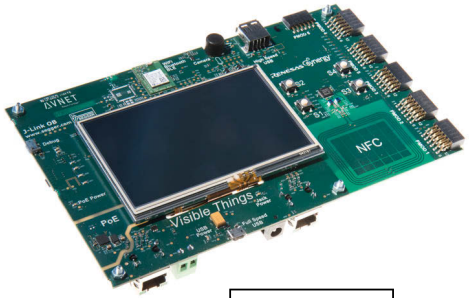

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TAMING THE BEAST

The march of progress in technology often proceeds from magic to manic to toxic. At first it works and it's fantastic – in other words: magic! Then we start to get manically obsessed with it because it works so well that we can no longer do without it; it's habit-forming and addictive. Finally, it reaches the toxic stage where it begins to poison our relationships with other humans, and with ourselves. A truly restrained way of using computers would be to take yet another step by devising rules and laws to govern machines that are more powerful than ourselves.

What can we do, both collectively and individually, to tame the beast we have released upon the world?

First, we need to face the problem, something most people are very reluctant to do. We need to make decisions individually and collectively to discipline ourselves. For instance, we could choose not to keep our smartphones on the nightstand, or not only to switch them off during flights but also at certain times of day or during holidays. On average, people in the United States, across all age groups, check their phones 46 times a day, according to Deloitte. That's up from 33 views per day in 2014. Is this really necessary? Is it healthy? The choice is ours.

Digital obesity is becoming a problem. We're getting fat on data, so to speak, and the effects are similar. It's like eating: we have too many things to eat, and if we try to eat too much we become bloated.

Whose job is it to make these decisions?

We all have a personal responsibility for keeping our own lives under control, but that is not the final solution within a system that's so extremely complex and which, at least now, lacks transparency. Governments, public officials, and organizations need to put pressure on the companies behind this trend. Collectively, we need to understand that technology is a very powerful industry to be faced with, and many of the things it creates are highly addictive. They're like drugs. We need to regulate the issues of digital addiction and make it more transparent. It should not be addictive by design. It's commonly believed social networking companies employ psychologists to work on how to make their platforms more addictive. That is not a good thing. It's like cigarette companies adding substances to tobacco that make smoking more addictive. As a society, we've come to condemn and prohibit such corporate behavior, and we need to find similar rules for keeping people in balance.

> The time you enjoy wasting is not wasted time. No computer in the world will ever be able to understand that

Gerd Leonhard is the founder of The Futures Agency based in Zurich. His new book *Technology vs. Humanity* is out now published by Fast Future Publishing

This is a societal question, not just a private one. If technology becomes too sticky, then people get stuck, right? In the end we need to agree on simple rules about how to keep technology sustainable. I describe this as Digital Ethics and this must, almost by definition, form the core of any truly sustainable technology. Digital human rights and digital ethics must also be established as core rules for doing business in the technology market.

The list would be long, and we need to come to some form of transnational agreement on them, but I'm pretty sure they need to include rules like these: We should never allow humans to be governed by technology, specifically AI. Technology should never cut humans out of the loop just to ensure speed or profit. We should not augment humans to endow them with supernatural powers. We must not empower machines to upgrade and expand themselves without human consent. We should retain our right to disconnect and remain embodied as humans.

This right to disconnect is under threat and we need to push back. We also need to be able to take our time and must not punish people for turning off and signing out. Unlike machines, humans need time to contemplate and digest all this information. The compulsion to be always online is increasing and will only get worse. For instance, if you disconnect your car, your insurance company could cancel your policy because it's no longer able to track you and monitor your driving behavior.

Perhaps the most important rule of all should be: we must not seek to completely eliminate accidents from happening, to suspend the laws of chance or extinguish serendipity, that quintessential human quality of finding meaning in apparently irrelevant or happenstance discoveries. As the old saying goes: the time you enjoy wasting is not wasted time. No computer in the world will ever be able to understand that.

Microsoft

The Internet of Things is fueling digital transformation

IOT MARKET OPPORTUNITY
$1.7 TRILLION
by 2020

TOTAL ECONOMIC IMPACT
$11 TRILLION
by 2025[1]

GLOBAL GDP INCREASE
$10-15 TRILLION
in the next 20 years[2]

EVOLVING TO MEET MARKET DEMAND

The rise of global competitive innovation from both traditional and non-traditional sources, swift technology changes, and ever-shifting consumer demands are driving transformation across all industries. Device manufacturers can thrive by evolving their business models to give customers what they need.

CONNECT AND COLLABORATE

Devices become more valuable when they interact with other devices. What data can you pull from other sources to make your device more valuable?

Use local weather information to influence local activity prompts on fitness wearables.

POSITION INTELLIGENCE AT THE EDGE

Create smart devices that bring intelligence to the edge of the network to create, capture, and process data at the source for instant insights.

Use real-time checkout lane volumes from security cameras to inform staff allocations and improve customer experience.

FIND NEW USES FOR DATA

Provide a holistic view of their customers by combining data from in-store sources, online behavior, and customer history to predict demand and delight customers.

Combine social media data with aggregate store traffic insights to create a more personalized shopping experience.

MITIGATE RISK WITH EDGE-TO-EDGE SECURITY

Customer data security must be top-of-mind across the entire omni-channel experience, with devices that have security built in.

Analyzing the complex relationship between identities, devices, and behaviors enables you to connect the dots when "anomalous" behavior indicates an attack.

HARNESS THE POWER OF DATA

Help customers become insight-driven organizations—pulling data from every device, sensor, upload, tweet, purchase, shipment, and keystroke.

Enable them to evolve from reactive to proactive, keeping pace with rapid market change, innovating to give customers what they want.

WHERE TO START?

Start with what your customers have—their existing devices.

- How can you use that data to create greater value?
- What's the current health and status of their system?
- Can you monitor it for predictive maintenance?
- Is security built into your device?
- Is there edge-to-edge security across the systems?

For more information, visit: **www.InnovateOnWindows10IoT.com**

[1] http://fortune.com/2015/07/22/mckinsey-internet-of-things
[2] http://www.ge.com/digital/sites/default/files/industrial-internet-insights-report.pdf

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