

# SMART INDUSTRY

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The IoT Business Magazine

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## SMART SPORTS

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### FINTECH FUTURE

Banking on IoT

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Controls

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# THE JOYS OF LOCKDOWN



**Tim Cole**

is the editor of *Smart Industry – the IoT Business Magazine*. His latest book *Success Factor Artificial Intelligence* is published in German by Carl Hanser.

**T**his edition of *Smart Industry* has been produced under unusual circumstances. But then again, not. As freelance journalists, most of our contributors are used to working from home, on the road, or from the nearest Starbucks café. They live in places like Silicon Valley, Upstate New York, Berlin, London, New Zealand, or like me high up in the Austrian Alps. IoT is a hot-button topic everywhere and having experts based all over the world makes it easier to follow what's happening and to talk with the people at the cutting edge of technology.

Lockdown, in other words, is our way of life. Others struggle with social isolation and need time to get used to communicating via Zoom, Teams, or Webex. We have been using these and other tools for years, and we can tell you from experience: they do their job very well.

And let's not forget good old e-mail! I fire off maybe a hundred such electronic missives a day, and our contributors are used to responding quickly, sometimes within a minute or two, others as soon as they wake up and check their inboxes in a completely different time zone.

The digital worker is free of the constraints of time and geography, and that is a huge step toward taking control of one's working environment – and one's life. I shudder to think of ever having to go back to a cubicle in some soulless office building an hour's drive away. When I look out the window I see snowcapped mountains and lush green forests, the air is cleaner than in Munich, where I lived for a quarter of a century, and the quiet must be heard (or rather, not heard) to be believed.

Not everyone gets to live in paradise but the lockdown experience has shown many of us that we can take control of how, when, and where we work, thanks to digital technology.

It also gives us new ways to reach out. At *Smart Industry*, for instance, we have used the period of enforced deceleration to explore new formats and methods of connecting to our audience. In May, we launched a series of podcasts, called *We Talk IoT*. Once a month, I spend time talking with our contributing authors about how IoT is transforming the world and I connect with experts from various fields such as cognitive computing, autonomous driving, industrial simulation, or predictive analysis. I do it all without leaving my home office, thanks to a handy little online service called Zencastr and a little help from our friends at NetProducer, a digital production company with team members based as far apart as Salzburg in Austria and Cologne in Germany. You can listen to the *Smart Industry* podcast wherever you get your podcasts, for instance at Spotify, Apple Music, or SoundCloud. Just go to [www.smart-industry.net/podcast](http://www.smart-industry.net/podcast) to find out more.

In addition, we have created a newsletter, *Smart Industry Insights*, that you can receive for free by signing up at [www.smart-industry.net/subscription](http://www.smart-industry.net/subscription).

Did you also know you can read this edition of *Smart Industry* digitally on your computer, tablet, or smartphone? We provide readers with a special e-paper edition that allows you to flip through the pages of our magazine just as you would with the paper version.

Every crisis is a challenge – and an opportunity! As we emerge from lockdown, things won't be the same. But, as many of us are discovering for the first time – or are made aware of once again – the myriad rewarding possibilities that living in the digital age offers us just might be the beginning of a beautiful friendship – and a whole new way of life.

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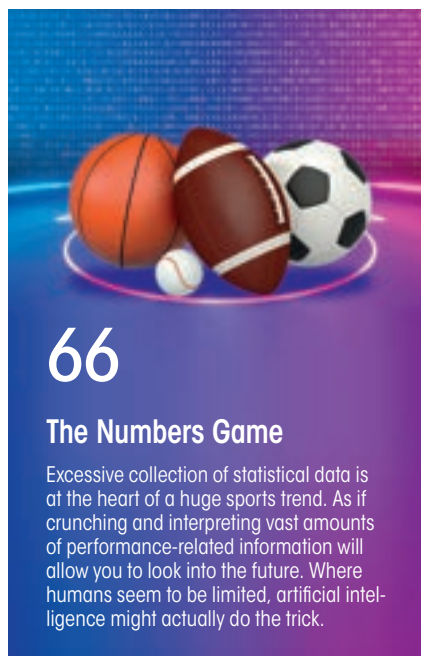
Technologists and business leaders are partnering to reduce greenhouse gas emissions, using advanced data analytics, powered by artificial intelligence. To understand technology's increasingly central role in the unfolding climate-change drama, and for better insights into how tech might save the world, we asked four world-class experts to share some of their insights.



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### AI and the Future of Retail

Amazon has thrown down the gauntlet to the classic retail trade with its "Just Walk Out" high-street stores. This has scared traditional traders but, while China is mobilizing billions to compete, Europe is relying on its culture of regionally fissured markets that has grown over centuries. This is both a weakness and a strength.



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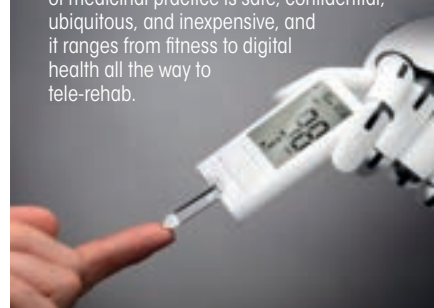
### The Numbers Game

Excessive collection of statistical data is at the heart of a huge sports trend. As if crunching and interpreting vast amounts of performance-related information will allow you to look into the future. Where humans seem to be limited, artificial intelligence might actually do the trick.

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### The Internet of Medical Things

Thanks to powerful data networks, AI support, and lots and lots of new, smarter sensors, the field of telemedicine is booming, giving rise to the term "Internet of Medical Things," or IoMT. This new form of medicinal practice is safe, confidential, ubiquitous, and inexpensive, and it ranges from fitness to digital health all the way to tele-rehab.





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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.

### Alexander Cotte of Livingpackets

## The Box That Never Stops Delivering

Alexander Cotte wants to change the world of mail order with an intelligent reusable package, which he says can be reused up to 1,000 times. The founder and head of technology at German-French start-up Livingpackets has set himself and his young company a truly ambitious goal, namely to put 1.5 billion “smart boxes” into circulation and replacing 100 billion disposable boxes within ten years.

“We want to make shipping more efficient and sustainable,” he says. His brainchild, a black and green package made of foamed polypropylene, has an Internet connection that allows customers to track the shipment via app.

The time seems ripe. Mail order companies have declared war on plastic and packaging waste. In Germany, grocers such as Rewe and Edeka have recently decided to pack vegetables in edible sleeves

### Packaging as a Service

Livingpackets’ black and green package boasts built-in sensors and a camera that provides additional information on the state of the parcel’s contents, as well as a digital display that shows the address the package is destined for.



source © Livingpackets

instead of foil. The software giant SAP has banned plastic from its offices and events. The sporting goods manufacturer Adidas recently introduced its first recyclable sneakers.

By comparison, the mail order business is lagging far behind. Large online distributors such as Amazon, Otto, or Zalando still mostly use disposable cardboard packages. Every German receives around 24 parcels

on average per year, according to a study by the management consultancy McKinsey. Most of them are likely to end up in the household waste.

Livingpackets wants to stand out from the competition with a few high-tech features. Cotte’s black and green package boasts built-in sensors and a camera that provides additional information on the state of the parcel’s contents, as well as



source ©: Livingpackets



**We want to make shipping more efficient and more sustainable.**

**Alexander Cotte**  
CEO at Livingpackets

back to its owner? The mail order business is traditionally not a circular economy. On the contrary: dealers and customers generally try to avoid returns as far as possible because they are time-consuming and expensive and because transport also impacts on the Carbon balance.

For the reusable model of Livingpackets to work, a comprehensive network of return points will be necessary. According to Cotte, the recipients should either take the empty boxes to the parcel shop, give them to the parcel carrier, or send them back themselves. Forging the necessary partnerships for this is likely to be a mammoth task.

If it takes this hurdle, the start-up still has to prove that it can actually persuade the end customer to make the journey to the parcel shop. But Cotte is optimistic: "Over the next ten years, the mail order scene will worry less about finding capital and taxes than about the climate," he believes. The box may be just what they need.

**Kevin Schaff of Twyst**  
**From In-Line to No Line**

Imagine walking into your favorite store, getting a special offer just for you, choosing your items, and then walking out. No line, no checkout, just a wireless, effortless, and secure transaction that automatically charges you for the items in your bag. That's the not-so-distant future of shopping and it's being implemented right now by innovators like

a digital display that shows the address the package is destined for.

Additional packaging waste such as adhesive tape and filling material is made superfluous by a net braced to the bottom of the parcel and a resealable lock. Cotte maintains that the cost per shipment can be reduced to between two to three euros per use plus postage. The packages are not sold, but rather rented out for a fee. He calls this business model "Packaging as a Service."

A test run at the French online shop C-Discount has shown that the packing processes are up to 30 percent faster because the steps involving adhesive tape and filling material are eliminated. In addition, the company is in talks with Swiss Post in Germany, France, and Switzerland about possible partnerships.

Livingpackets is planning to enter the German market by the end of 2020, but reusable packages have not yet become established in the country, because a big question remains: How does the package get

Kevin Schaff, founder and CEO of IoT start-up Twyst.

Here's how it works. Upon entering, you're greeted with a push notification on your smartphone asking if you'd like to try the Twyst Smart Bag. The bag is equipped with Bluetooth and simply by touching your phone to the bag, you'll receive a prompt to pair the devices. Once your in-store and digital shopping experiences are linked, all you have to do is shop.

That's how Twyst is transforming brick-and-mortar retail. In 2015, Schaff, drawing on his background in data analytics, had the idea to eliminate points of friction in retail, like the checkout line, and to capture in-store behavior and turn it into actionable data. Then he met Avnet business development manager Eric Leahy and was introduced to the Avnet Innovation Lab at Arizona State University.

The Innovation Lab was conceived to help aspiring entrepreneurs, like Schaff, to advance their ideas and bring them to market. Leahy was immediately impressed with Schaff's concept and saw the potential in Twyst. Through the lab, he was able to connect Schaff with all the resources he needed: technical support, mentorship and design, manufacturing and marketing expertise.

"Kevin is an amazing guy. He knew that friction within the retail space was a problem. For customers, it's waiting in lines; for retailers, it's trying to understand why people abandon carts. He understood →



**My background is in software. Hardware is complicated.**

**Kevin Schaff**  
Founder and CEO of IoT start-up Twyst



source ©: Twyst Inc.

# Interview



source ©: Altair Semiconductor

## Control and Prevent

*Smart Industry* sat down with Igor Tovberg, Director of Product Marketing at Altair Semiconductor, a Sony Group Company, to talk about how connected medical devices could help combat and avoid pandemics such as Covid-19.

### Are wearables a better way to monitor trends during a pandemic?

Activity and heart-rate sensing are becoming a baseline feature in every fitness band and smart watch, with data being continuously sensed and uploaded into the cloud. This data could be useful in predicting a spreading epidemic. Indeed, a recently published study by Scripps Research Translational



**IoT has an important role to play in containing outbreaks like Covid-19.**

**Igor Tovberg**

Director of Product Marketing at Altair Semiconductor

Institute in *The Lancet Digital Health* analyzed such data and found that resting heart rate and sleep-duration data collected from wearable devices could help inform timely and accurate models of population-level influenza trends. Sensing and analyzing more physiological factors would improve the speed and accuracy in the discovery of epidemics.

### Would wearables help change healthcare habits in patients?

Isolation is one of the preventive actions being taken to stop the virus spread, as exposure to an infected carrier could prove fatal for people with a weakened immune system. Now, more than ever, health stats relating to virus symptoms can be sent to health-care providers with-

out patients having to visit their clinic and risking exposure.

### Are smart cellular IoT wristbands a good way to ensure quarantine compliance?

The general population can wear smart wristbands as a health monitor. With an emphasis on the small size and long battery life, cellular IoT offers reliable connectivity for smart wristbands, with autonomy from paired smartphones. Recently, the Hong Kong government has deployed smart wristbands to monitor city residents quarantined inside their homes.

### Can wearables help save time?

Enterprises, airports, and cities would surely benefit from monitoring devices for citizens, and health-care facilities would benefit from the ability to monitor remote patients. Timely discovery of outbreaks could prevent many new dangerous viruses in the future.

### How is your company contributing to this development?

For personal, medical, or environmental monitoring, Altair's ALT1250 ultra-low-power, compact, secure, and highly integrated cellular IoT chipset enables slimmer devices with long battery life, which can remain continuously connected – reliably connecting people in ways previously unobtainable. All without the need for a smartphone or home Wi-Fi network.

### How do you see IoT's role in future pandemic prevention?

According to Bill Gates, in any crisis, leaders have two equally important responsibilities: solving the immediate problem and keeping it from happening again. It's clear that IoT technology, and specifically medical devices, have an important role to play in the containment and treatment of outbreaks like Covid-19. I genuinely believe that IoT can be fully harnessed to control and potentially prevent the next global pandemic.



source © Twyst Inc.



the problem, just not the best way to solve it,” recalled Leahy.

Schaff also knew that radio frequency identification (RFID) tags were already in most products for shipping purposes and that he could leverage them inside a store. Leahy and Avnet then helped him architect an IoT product from the ground up.

Twyst’s smart bag (or any shopping container, such as a cart) is designed to detect an item’s presence and transmit data via a Bluetooth Low Energy (BLE) network. Leahy helped Schaff choose and source the right technology – the microprocessor, RFID reader and sensors that go in the bag, and the beacons that work throughout the store – to produce and refine early prototypes.

“My background is software. That’s true for most IoT entrepreneurs,” explained Schaff. “Hardware is complicated, you can lose your market position and momentum if you design it wrong. The ability to work with Eric and get his guidance and expertise was a huge benefit.”

Working with Avnet opened doors for Twyst beyond design and supply chain support. Avnet also gave Twyst invaluable exposure to retailers and prospective customers during Denver Startup Week and IoT World.

### Amir Haleem of Helium Total Coverage

The Internet of Things is set to disrupt the world of consumers and industry alike with new services and use cases.

One of the constraints slowing down the adoption of the new technology, however, is the necessary trade-off between network range and power consumption. Specifically, smart sensors, which are required to run on a single battery charge for months or years even, depend on low-power wireless communications. Existing solutions mitigate this problem by either utilizing a mesh network, or by reverting to edge computing. Both approaches fall short when it comes to true long-range use cases, and while 5G technology promises comprehensive coverage for IoT devices, the bottleneck here is power consumption.

Amir Haleem, founder and CEO of Helium Inc, a small company based out of Austin, Texas, promises a solution with the first peer-to-peer network for the Internet of Things. Their network works by installing the Helium Hotspot, which reaches 200 times farther than Wi-Fi, thanks to an open-source “LongFi” format. Using this range, only 50–100 hotspots are needed to cover an entire city.

This long-range, low-power network enables use cases which have been difficult to implement before. Nestle’s beverage delivery service ReadyRefresh, for example, uses the network to monitor the fill level of customers’ water coolers in real time, thereby improving customer satisfaction. Directed more toward consumers are connected pet products, such as smart collars, which ensure that pets are not lost. Similarly, e-scooter company Lime uses the Helium network in

### A Better Bag

Twyst turns a shopper’s bag into a smart shopping assistant.

some cities to track the whereabouts of their e-scooter fleet.

Of course, even with long-range features, networks need to reach a critical mass to be useful for those kind of use cases. “We solved this challenge by ticking another box in the list of currently trending buzzwords: cryptocurrency,” says Haleem.

Each hotspot owner is rewarded with Helium Tokens for both operating the hotspot and transmitting data. These tokens can easily be converted into other cryptocurrencies such as bitcoin or “real money.” This gives hotspot operators a real incentive to invest in the infrastructure. Manhattan, one of the first markets Helium was rolled out in, has almost complete coverage for the Helium network. “By creating the world’s first peer-to-peer wireless network that’s owned and operated by individuals, the Helium Hotspot opens the door to an ecosystem of possibilities,” Haleem explains.

The company met the challenge of securely storing transmitted data by using their own implementation of a blockchain, ticking off another item on the list of trending buzzwords. The Helium network launched in the US in 2019 and now covers almost 1,000 cities. They’ve also recently expanded into Europe and expect an even higher adoption rate due to the relative maturity of the IoT market. The idea certainly seemed compelling enough to convince high-profile investors such as Google Ventures, Munich Re, and Marc Benioff, founder of Salesforce, Inc.



The Helium Hotspot opens the door to an ecosystem of possibilities.

Amir Haleem  
Founder and CEO  
of Helium Inc



source © Helium Systems Inc.





## Climate Change and IoT

# HOW TO SAVE THE WORLD

The use of advanced data analytics, powered by AI, is helping humanity to address climate change in an intelligent way. That is the reason why **so many technologists and business leaders, around the world, are now partnering to reduce the emission** of dangerous greenhouse gases.

■ By Gordon Feller



The entire effort is based on the harsh realities brought home to everyone by the landmark Paris Climate Agreement of 2015. That treaty, signed by more than 188 national governments, aims to limit the global temperature increase during this

century to 2 degrees Celsius above pre-industrial levels, with a stretch objective of only 1.5 degrees. According to the consortium of Nobel Prize winners at the Intergovernmental Panel on Climate Change (IPCC), both of those scenarios will require “rapid, far-reaching and un-

precedented changes in all aspects of society.” To understand technology’s increasingly central role in the unfolding climate change drama, and for better insights into how tech might save the world, we asked four world-class experts to share some of their best insights.



## The View from Los Angeles



source © LACI | Los Angeles Cleantech Incubator

Alex Mitchell is Senior Vice President of Market Transformation at Los Angeles Cleantech Incubator (LACI). His work starts from a simple premise: “Climate change will continue to be the defining challenge and opportunity for the rest of the 21st century.” Reaching the targets, as agreed by Paris Climate Agreement signatory countries, will require an all-hands-on-deck mentality for policy makers, businesses, and technologists. Mitchell thinks that “advanced data will play a vital role in helping humanity address climate change in several key domains. In particular,

**“Climate change will continue to be the defining challenge and opportunity for the rest of the 21st century.”**

**Alex Mitchell**  
Los Angeles Cleantech Incubator

our transportation and energy systems, which represent more than half of America’s greenhouse gas emissions, are ripe for analytics-based breakthroughs. Three in particular stand out: real-time multimodal commute data, improving traffic flows at traffic lights, and real-time energy consumption data.” Transportation accounts for 28 percent of US greenhouse gas emissions, with passenger cars accounting for more than half of that total. Unsurprisingly, reducing private car usage is one of the holy grails of addressing climate change. Mitchell points out that “LACI’s public-private Transportation Electrification Partnership, for example, calls for a shifting of over 20 percent of all trips in single-occupancy vehicles in Los Angeles County to zero-emissions public and active transit by 2028.” However, getting people out of private car ownership will require robust commute reliability information. Today, nearly every form of transportation, beyond the private car, suffers from low-quality real-time data, from inaccurate bus arrival information to incorrect scooter locations. Multimodal trip planners, such as the Transit app, do something that Mitchell finds useful: “Combining data sets across scooters, bikes, buses, ride hail, and walking to help travelers make better informed decisions about how to best get from point A to point B.” Even major public transit operators, such as Los Angeles Metro, are adopting such platforms for their own consumer interfaces.

Despite the proliferation of apps – such as Transit, Moovit, and Google Maps – these companies are still in their infancy. They are only beginning to become proficient at harnessing advanced data to help improve multimodal travel. As Mitchell points out, “the goal is to discourage private car usage.” For example, few, if any, of the apps allow for robust consumer input preferences, such as the ability to signal a longer tolerance for walking. Mitchell notes that these apps aren’t yet handling “robust multimodal execution, such as ‘your commute will now be 15 minutes shorter if you exit the bus in two stops and take bike share.’” Mitchell is quick to turn attention to what he calls “the plebian traffic light,” which is now over one hundred years old. “It hasn’t changed much over time. While it does reduce automotive collision fatalities, it hasn’t kept up with our climate challenges.” Few traffic lights rely on any real-time data of city-level traffic, such as would be accomplished by adaptive traffic control. Mitchell thinks they should assess and analyze “individual vehicle-level data sets to determine when the light changes from red to green.” Instead, they often rely on unsophisticated, preprogrammed instructions. As a result, an SUV might sit idling at a red light for two minutes, while the road with the green light may have no vehicles at all. The net result is a loss of travel time and unnecessary greenhouse gas emissions. Dozens of companies can be cited as actors in this transport revolution, in-

# Actors and Activities in the Urban Climate Innovation Ecosystem



Source © LACI | Los Angeles Cleantech Incubator

cluding these: XTelligent, one of the companies embedded inside LACI; Rapid Flow Technologies, and their SURTRAC solution; and Siemens. According to Mitchell “all of these, and many more, are aiming to handle the massive IoT-generated data sets from cars, trucks, buses, bikes, and cell phones to orchestrate traffic flows in cities, both at the system level and at the individual light level.” Shifting the focus from mobility to real-time energy consumption, Mitchell is thinking about the abundance of data in this realm: “Few

consumers think about their energy consumption until they get their electricity and gas bill. So they fail to realize that tiny changes in hour-by-hour increments have huge impacts on the energy generation system.” When air conditioners go on, for example, a natural-gas-fueled “peaker plant” may be forced into service to cope with the incremental demand, supplementing the base energy load generated by renewables such as solar and wind. Where the system fails today is in alerting consumers, in real time, of

### All in It Together

The concept of ecosystem includes the actors that form part of it, connected to each other through various relationships. In addition, it is necessary to define the limits of that ecosystem, which can be established by the evaluation range of the product/service system of consumers or the perception of those consumers.

the consequences of their behavior and giving them the choice to modify accordingly. Mitchell cites, as an example, the work of one player: “Ohm-Connect Corp. gamifies consumers’ engagement with their home energy consumption, saving an average of US\$100 on their bill and paving the way toward a more renewables-based energy system. As IoT devices in the home proliferate, and as smart meters scale, expect a growing number of ways to help consumers make the right financial and environmental decisions.”



## The Power of IoT

# A NEW “SYSTEMS APPROACH”

**I**nternet of Things (IoT) is much more than the verbiage describing the interconnectivity of many “smart” sensors and devices. IoT’s advocates argue that its real power, and its value, derives from the fact that it allows all those “end points” to seamlessly communicate together, enabling improved intelligence and bringing simplicity to services in everyday life. From mobile payments to smart home technology, IoT applications can enable new and faster communications that can revolutionize the ways we live and interact with our world.

By 2021 a growing number of research organizations and international agencies (such as ISO and ITU) expect that connected “things” will outnumber humans by 5:1, with an estimated 40 to 50 billion connected devices “turned on.” Much like the mobile-communications revolution, this IoT revolution now presents an incredible opportunity for companies – but only those who are prepared for it. Those companies are geared up to deliver significant, enduring, and transformational business impact, and provide additional value to their customers. Building real IoT solutions that solve real problems – that is easier said than done. To assess the real situation, on the ground, let’s first identify what companies across a variety of industries see as the

“big problems” that IoT can solve, thereby creating opportunities for deployments which benefit actual people. It’s on this basis that tangible products will be made and tested, resulting in (potentially) profitable business opportunities. Companies large and small, headquartered in countries across the globe, are concluding that cities are a superb practical point of focus – the place where IoT deployment should be focused. Why cities? For the past century, the global population has continued to shift from rural to urban areas; it’s now predicted by the United Nations that 64 percent of the developing world and 86 percent of the developed world will be urbanized by 2050.

San Francisco provides an ideal urban landscape and fertile ground for driving the IoT innovation discussion into real action. California’s Bay Area now hosts the headquarters of the largest number of Fortune 500 companies of any city in the United States. This rather small region is home to more than 200 leading start-ups which are focused on IoT.

To encourage IoT solutions and business, the City of San Francisco’s government has been busy integrating a new telecommunications network throughout the downtown core that enables faster connections, requiring less data usage for connected devices.



The second leader whom we turned to is Micah Kotch, the Managing Director of the BMW Group's URBAN-X. From his base in New York City, Kotch shines the spotlight on a few of the most innovative solutions that have recently been developed by URBAN-X teams.

During these challenging and adaptive times, Kotch worries that it's easy to take our eyes off the goal of climate change adaptation and mitigation. From the point of view of the URBAN-X teams, "building resilience in our cities is a generational challenge, and technology is a critical tool in our arsenal. At URBAN-X, we believe that by investing in and supporting entrepreneurs using data, machine learning (ML), and AI to address society-scale urban issues, we can build iconic companies for the 21st century."

Kotch thinks that "while we're in uncharted territory, from past experience we know that algorithms can't make adaptive changes on their own." According to research firm Carbon Brief, global carbon emissions could fall by around 2 billion metric tons this year, equivalent to 5.5 percent of last year's record emissions. That would represent the biggest drop since World War II. However UN projections say that holding global temperature rise below 1.5°C will require even greater annual emission reductions of 7.6 percent over the next decade. For Kotch the requirement is fairly straightforward: "We need entrepreneurial heroes who challenge the status quo, use data to improve the lives of real human beings, and have the tenacity and resolve to meet this most critical of mandates."

Start-ups are outliers in solving difficult problems, quickly. URBAN-X has built a portfolio of 51 companies reimagining in-

frastructure; roadways, building design, construction and operations, and wastewater systems. Kotch is justifiably pleased with the results: "From electric vehicle charging, to drone transportation, to the cold chain that our 21st century food system relies on, our teams are harnessing ML to improve inefficient processes, reducing time, cost, and emissions around the world." URBAN-X portfolio companies using advanced data analytics to address our climate emergency include these four young companies, each deploying breakthrough technologies:

- Cove.tool is providing streamlined automated analysis that helps architects, engineers, and contractors achieve energy, daylight, glare, water, and carbon targets while reducing construction costs. Teams reduce analysis time by 66 percent per project by using automated performance modeling. Kotch has this to say about the company's key idea: "As building energy codes are becoming stringent across the world, designers can help cut construction costs by 2 to 3 percent to meet these new codes. Cove.tool's ML algorithms provide visibility into thousands of alternatives. Real-estate developers can invest with confidence while reducing construction costs to meet energy regulations and tenant needs."
- RoadBotics uses advanced AI and computer vision to produce detailed maps of a government's road infrastructure problems. These issues include things like potholes and utility patches, but what they really help communities to unlock are effective preventative maintenance strategies. Kotch explains: "So just like you per-



source © JMC - Josef Mamf Communications GmbH

**“**  
**We know that algorithms can't make adaptive changes on their own.**

**Micah Kotch**  
BMW URBAN-X

form maintenance on your car to help it last longer and prevent major fixes later, the same is true of roads. More than 200 governments around the world use RoadBotics AI to reduce the use of asphalt and concrete, all while achieving better road infrastructure for everyone."

- Sapien provides a turnkey plug load management solution that couples machine learning, an enterprise SaaS web application, and a comprehensive deployment of smart plugs and smart power strips for commercial buildings. The Sapien web application collects energy data through smart devices and controls power delivery at each individual socket for every plugged-in piece of equipment throughout a building. Sapien's web-based analytics platform leverages AI to do something that Kotch thinks is →



source ©: RoadBotics, Inc

important: “generate insights regarding energy inefficiencies, space and equipment utilization, safety, and equipment performance. The result is significant reductions in energy consumption, electronic waste, and carbon emissions.”

- Hades uses ML to automatically detect defects in sewer inspection footage, predicts how defects evolve over time, and identifies ideal repairs. More than 5 million miles of sewers

**The End of Potholes**

RoadBotics has developed technology that identifies potholes, alerting authorities through an interface that zooms into the tiniest detail of the asphalt beneath your wheels.

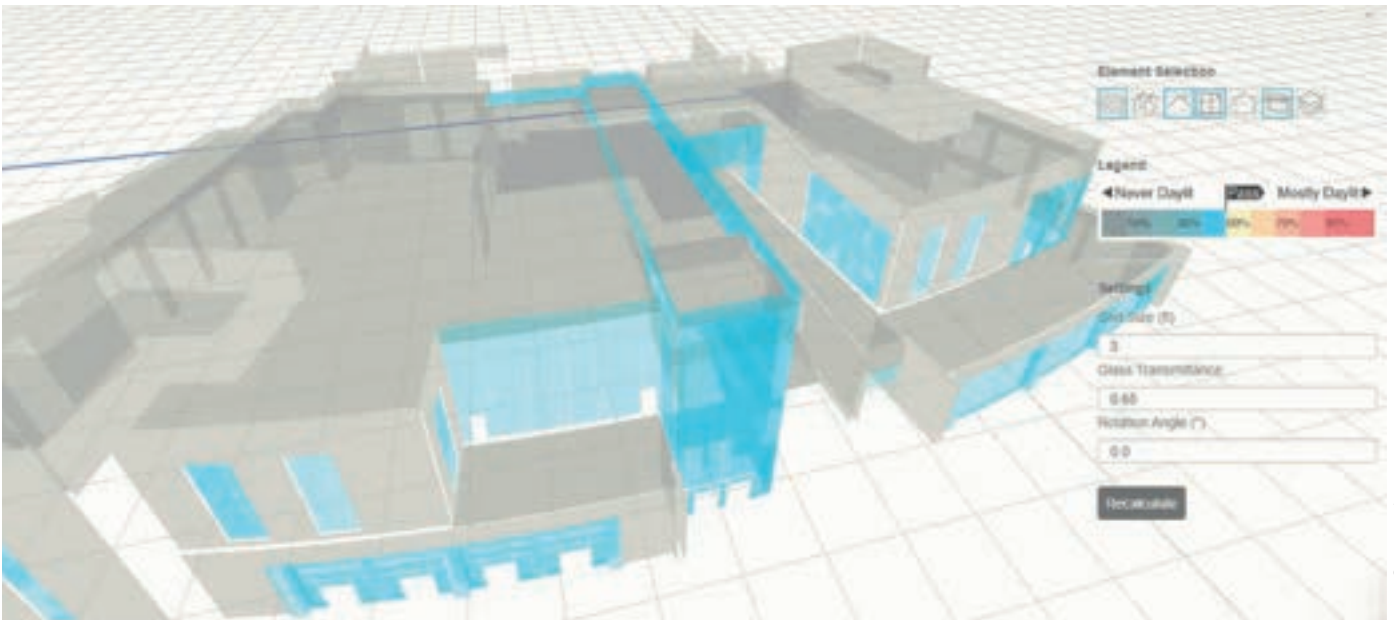
**Daylight Simulation**

At cove.tool, software developers are fighting climate change by helping interested parties use data-driven design through automation and cost optimization.

drain waste and stormwater from cities around the world, which is critical for environmental protection and public health, especially during periods of heavy rainfall amplified by climate change. Extending sewers’ useful service lives not only saves money but also prevents significant greenhouse gas emissions caused by excavation-intensive construction.

Both coronavirus and climate change require rapid responses.

For Kotch and the team at URBAN-X, “the faster we act, the less disruption and loss of life. In both cases, the need for local action, creative solutions that leverage data, sensors and analytics, and good public policy based on science has never been clearer.” We also know that “AI” has become an overused buzzword in its own right. Kotch thinks that “in order to get sustained emissions reductions, technology needs to work alongside policy and markets.”



source ©: cove.tool





# The View from Washington, DC

The third leader providing us with his insights is Seth Robinson, the Washington DC-based Senior Director of Technology Analysis at CompTIA, the world's leading tech association. CompTIA's Board of Directors includes C-Suite executives from some of the world's largest companies, including Hewlett Packard Enterprises, SNC Lavalin, EY, Comcast, SAP, and Cisco.

Robinson thinks that one big "part of the appeal in emerging technologies is the ability to leverage computing power that has rarely been accessible." That power can then be applied to extremely complicated problems. A perfect example is the way that artificial intelligence can be used to attack the issue of climate change.

Whereas earlier software programs were deterministic, taking in defined inputs and producing repeatable results, modern AI programs act more on principles of probability. Massive data sets with varying amounts of structure can be fed in, and the algorithms look for patterns and correlations in order to produce results that have a high likelihood of being correct. This

type of activity is a perfect match for climate analysis, which has always been a guessing game using lots of data.

Robinson's research shows that there are three areas "where AI can have an impact in trying to solve climate change."

- First: AI can assist with the ongoing work in predicting weather patterns and events. Climate modeling got its start in the 1960s and has been constantly



**As with all technology, the tool itself is not a silver bullet.**

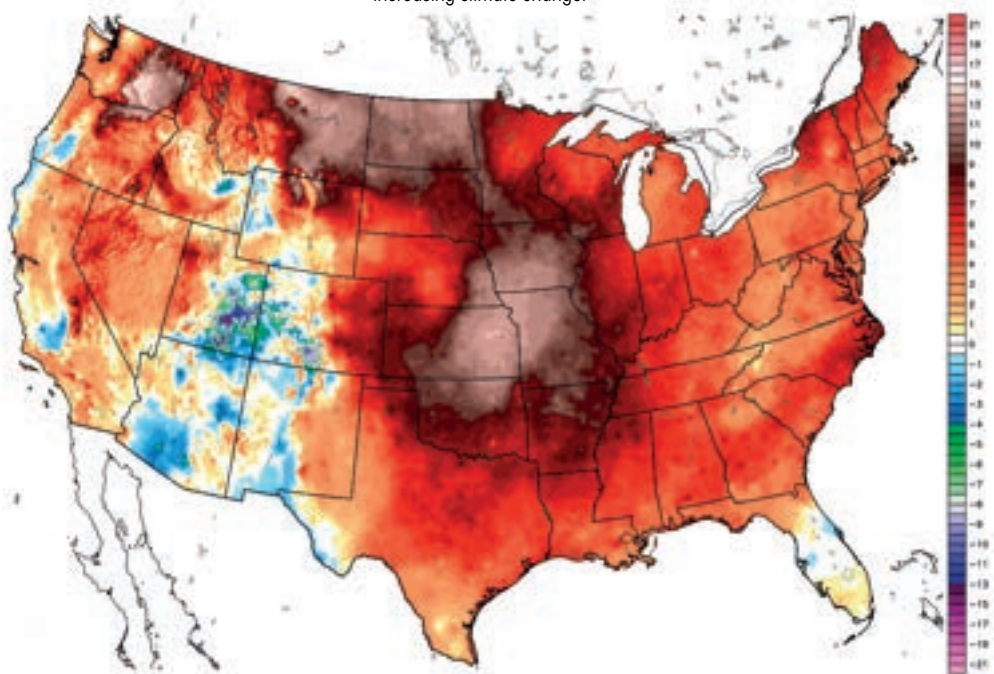
**Seth Robinson**  
CompTIA



source ©: CompTIA.org

### Where Did Winter Go?

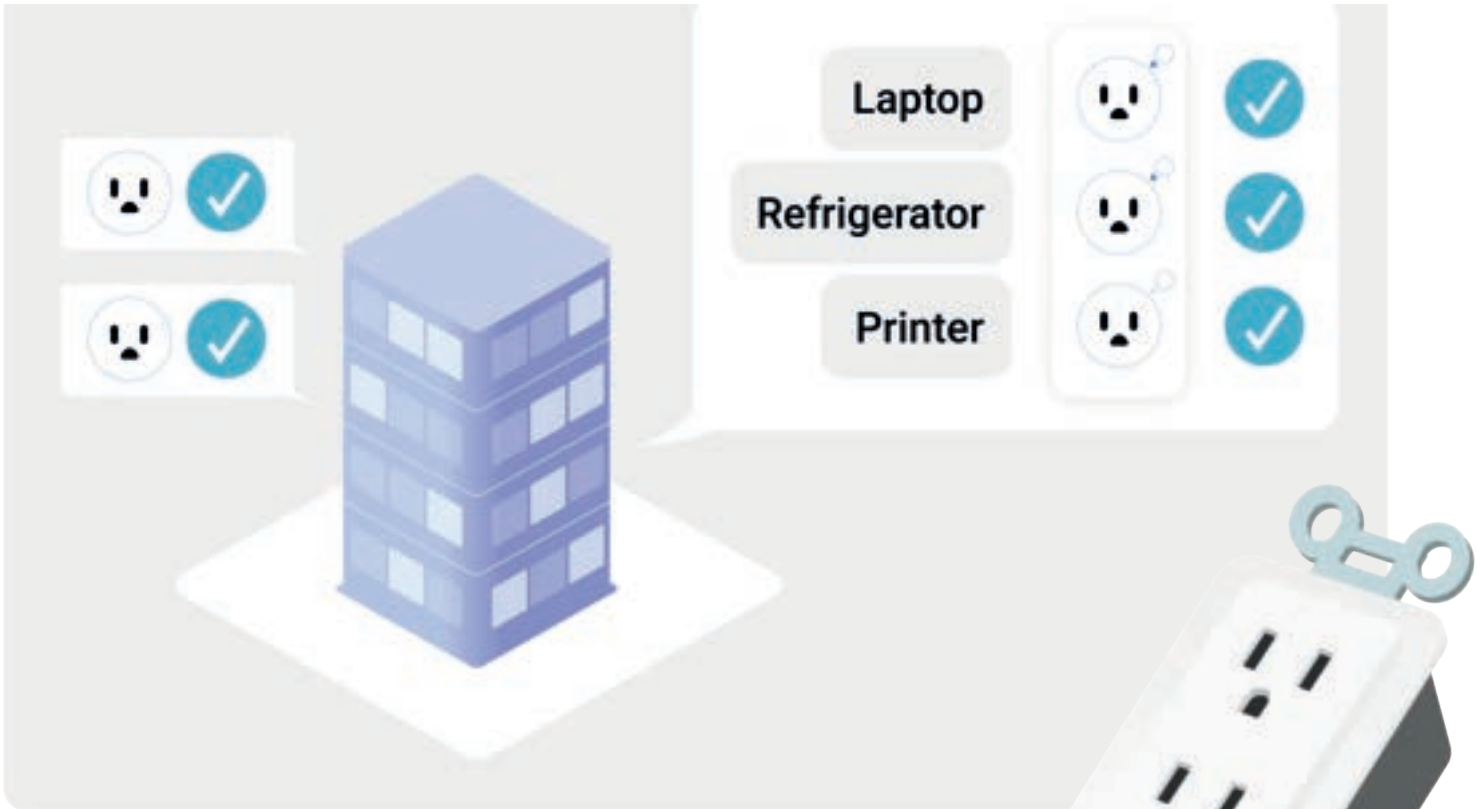
Average December temperatures in the U.S. are more like March or April, meteorologists say. In Kansas City, average temperatures in January 2020 were 12 degrees above normal, an indicator of increasing climate change.



evolving since then. One of the more recent updates has been the addition of data science principles, commonly known as climate informatics. AI algorithms are a natural next step in this activity, driving the ability to reconstruct past climate events and to improve the prediction of the future, especially concerning extreme events.

- Second: AI has a major role in predicting the fallout of those extreme events. While rising sea levels and intense storms may be accepted as likely outcomes of climate change, it can be hard to visualize the actual impact. Using data from previous events and models for the future, Robinson concludes that "AI can build simulations showing the potential scope of damage, which provides decision makers with tangible information as they form their plans." →

source ©: Sapient Industries, Inc



- Third: AI can be applied to the gargantuan task of reducing carbon emissions. This may be the most diverse field in the intersection of AI and climate efforts. The type of activities can range from carbon tracking across a geographic region to optimizing electricity usage or providing suggestions

**Smart Socket**

Sapient couples machine learning and an enterprise SaaS web application with a comprehensive deployment of smart plugs and smart power strips.

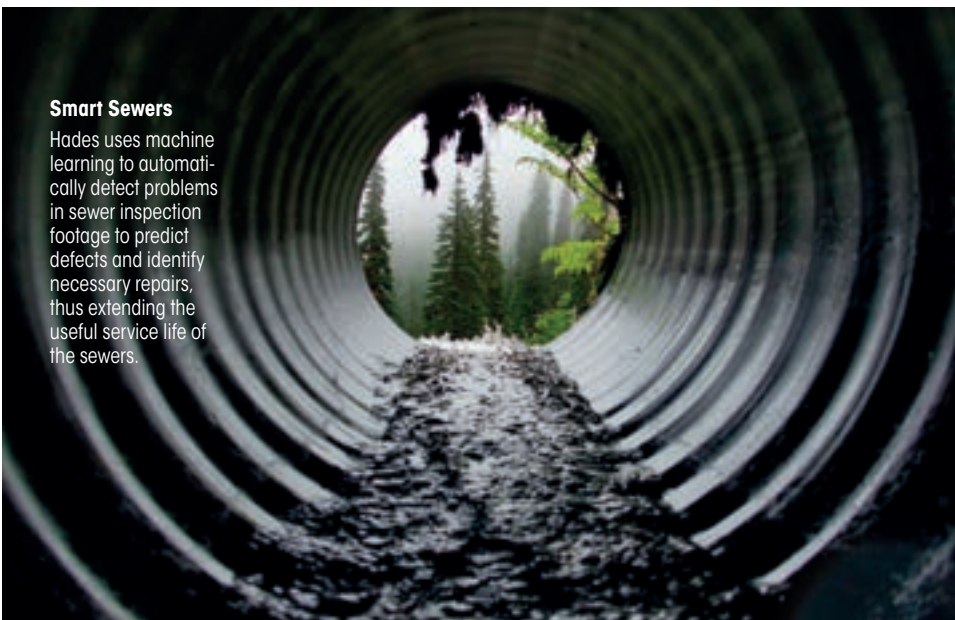
for physical building operations. The findings from these activities can help individual businesses improve their carbon footprint and also help government officials create policies and regulations. For example, The Edge, a unique office building in downtown Amsterdam, is considered



one of the most environmentally friendly buildings on the planet. It uses an AI system which talks to 30,000 sensors to control lighting based on activity – all with the aim of reducing energy usage and moving toward zero climate impact. According to Robinson, “the system is estimated to save over \$100,000 per year in energy costs. Climate change is poised to be one of the great challenges for the global population in the coming decades. Artificial intelligence can provide novel insights and automation, but remember that the results are still based on probability. As with all technology, the tool itself is not a silver bullet. It is critical to also have the right expertise in place to interpret the data and build guidance based on the results.”

**Smart Sewers**

Hades uses machine learning to automatically detect problems in sewer inspection footage to predict defects and identify necessary repairs, thus extending the useful service life of the sewers.



source ©: URBAN-X



## The View from a Wizard Tech Investor Focused on Cleantech Innovations

The fourth leader we've turned to is Steve Westly, a famed Silicon Valley investor who served for years on Tesla's Board of Directors. For decades he's been a top-tier tech leader and venture capitalist, with multiple mega-successes to his name, a journey that started long ago in his role as the first CFO of eBay.

Westly starts from the core premise: ML and AI are helping humanity address climate change "by aggregating and analyzing disconnected data sources to create more accurate predictions, increase energy efficiency, and optimize current systems." He thinks that, as we continue to rely on renewable energy sources, "utilities and energy providers need more accurate methods of predicting energy consumption, in both real time and the long term." ML and AI play a role in using data sources such as local weather, climate patterns, and household

consumption behaviors to help predict future demand. This will lead to more effective energy distribution, which is pivotal in minimizing the carbon footprint.

In the light of Westly's investment experience, one key aspect of reducing CO2 emissions is the electrification of vehicles and fleets, as electric vehicles (EVs) have a 54 percent smaller carbon footprint



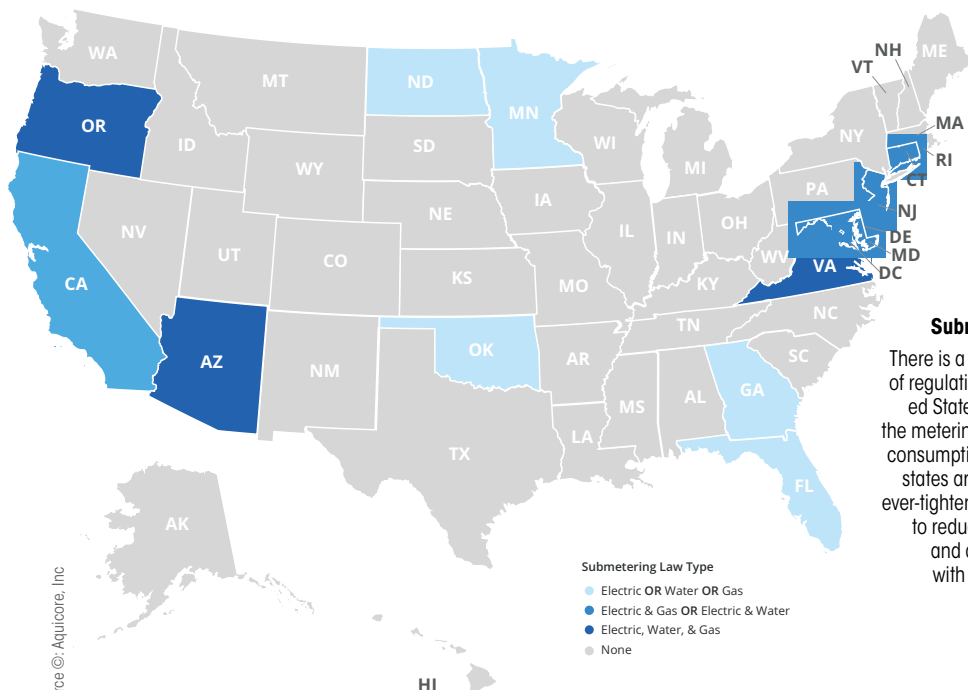
**ML and AI have the power to dramatically change the world of the future.**

**Steve Westly**  
Silicon Valley investor



source ©: Covendish Global, LLC

## United States Submetering Laws – Commercial



source ©: Aquicore, Inc

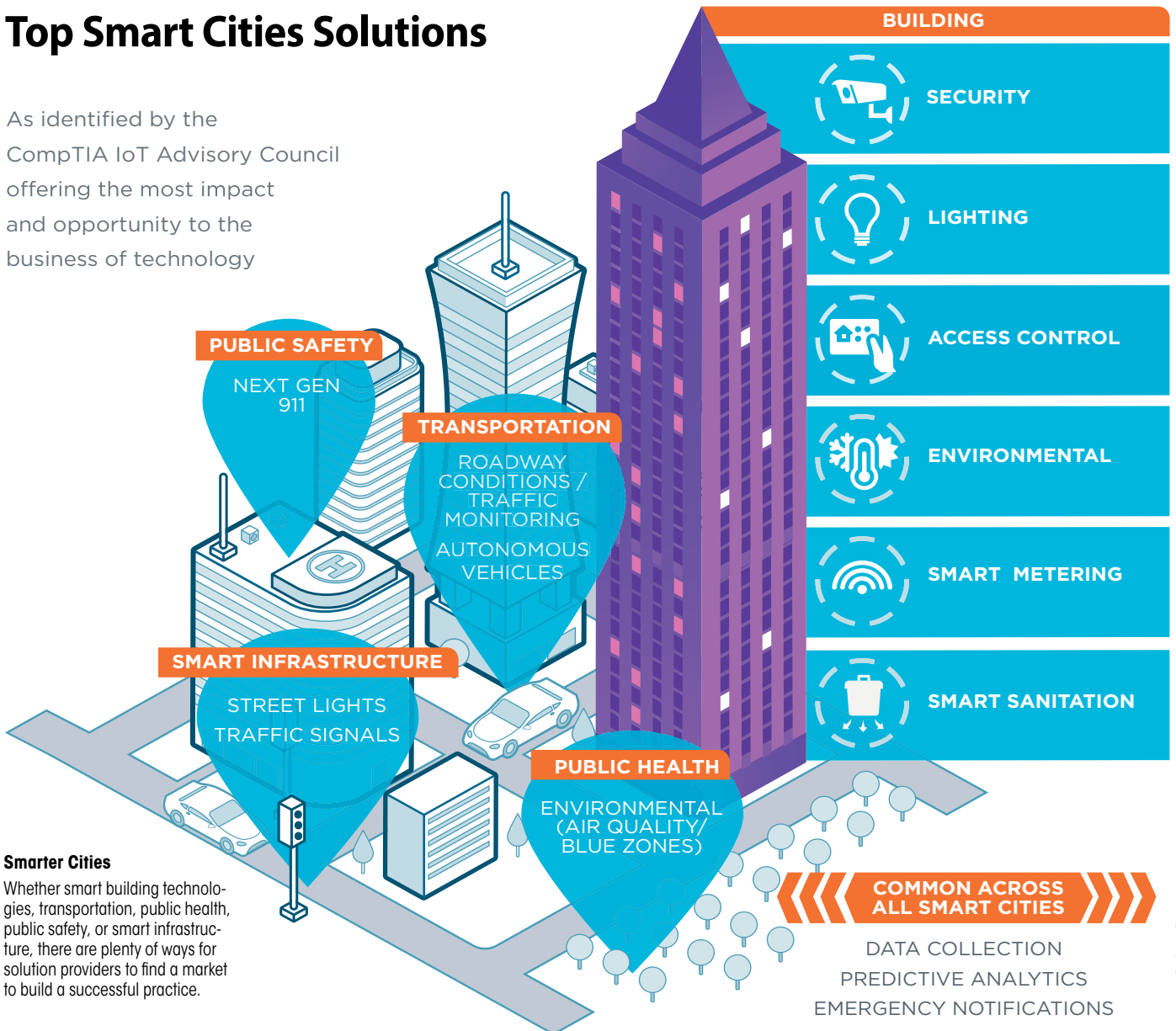
### Submeter Nation

There is a growing wave of regulation in the United States focusing on the metering of electrical consumption. Cities and states are establishing ever-tightening directives to reduce energy use and align payment with consumption.

compared to gas vehicles. "At the individual consumer level, ML and AI algorithms can improve battery energy management to increase mileage of each charge and reduce barriers for widespread adoption of EVs." By 2030, it's predicted that electric cars will account for 70 percent of vehicles sold in China, 50 percent in Europe, and 30 percent of all sales in the US and Canada, leading to more energy demand. Vast new systems must be "designed and built to meet this influx of demand, from public fast charging networks to embedded control schemes and grid upgrades." Westly points to Weave Grid Corp. as "a prime example of how companies are utilizing ML/AI to provide a technology advantage, helping utility companies make better decisions and manage this energy efficiently, while supporting continued reliability and meeting key cost-effectiveness goals." ➔

# Top Smart Cities Solutions

As identified by the CompTIA IoT Advisory Council offering the most impact and opportunity to the business of technology



## Smarter Cities

Whether smart building technologies, transportation, public health, public safety, or smart infrastructure, there are plenty of ways for solution providers to find a market to build a successful practice.

Integrating both historical and real-time data from a diverse array of sources, Weave Grid aims to provide cutting-edge monitoring, prediction, and optimization tools that will enable and accelerate the multi-industry effort to electrify transportation.

Wasted energy in buildings is another environmental issue that has been changed by ML and AI. Commercial and residential buildings account for about 34 percent of greenhouse gas emissions in the US (in New York City, 75 percent of the city's carbon footprint comes from building emissions).

It's now estimated that, in the US, 30 percent of that energy is wasted. This issue has been mitigated due to widespread adoption of networked and highly sophisticated energy meters that provide real-time data every 15 minutes (vs. old models once a month). Westly is impressed by the fact that "this access to Big Data has enabled companies, like Aquicore Corp., to use ML and AI to build intelligent software to drive actionable insights through software that collects, analyzes, and executes actions to improve energy efficiency within a building." This sort of "smart" monitoring system allows

for reductions in energy waste and CO<sup>2</sup> emissions by enacting automatic actions based on algorithms and insights from the data monitoring system. Additionally, a smart building could also communicate directly with the grid to reduce the amount of power it is using if there's a scarcity of low-carbon electricity supply. Westly, the former State Controller of the State of California, sums it all up very well: "ML and AI have the power to dramatically change the world of the future – and perhaps nowhere will it be more important than in the battle against global warming."

## Sustainable IoT

# THE RIGHT BALANCE

The IoT company Telenor Connexion has investigated what impulses for sustainability will emanate from a networked economy. The new *IoT Trend Predictions Report 2020* highlights the role the Internet of Things will play in the fight against climate change.

Under increasing pressure from society, customers, and regulators, the report says companies are looking for ways to balance the pursuit of profit with the reduction of their environmental footprint. The report highlights the key role that the Internet of Things will play in this.

As companies have embarked on the path of digitization and implementation of IoT solutions alongside these efforts, much of the attention is focused on improving efficiency and reducing costs in manufacturing, in transport, within the supply chain, and in the maintenance of products. The cost reduction achieved is often the result of optimizing the use of raw materials and production aids, ranging from electricity, fuel, and water to cotton, iron, wood, and more.

This means that a positive contribution to sustainability has been and is being made through efforts to reduce costs and increase profitability. Customers are also increasingly making more ethical and sustainable choices, with many willing to pay extra for products and services that are produced or delivered in an ethical and sustainable manner.

However, it is difficult to know which purchase option is the more sustainable one. Customers are therefore demanding more information about how the products they buy are procured, produced, and transported and how they im-

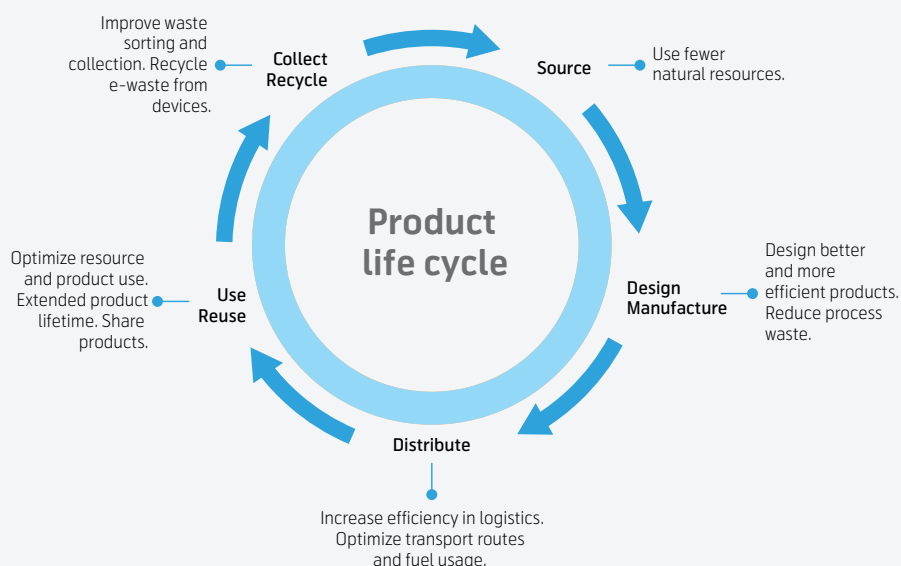
pact the environment as a whole. More and more companies are striving for CO2 neutrality. Another driving force discussed in the report is the role of IoT in combating climate change. Regardless of government regulatory measures, it can be observed that companies are increasingly voluntarily committing themselves to aligning their corporate strategies with the goals of the Paris Accord by becoming CO2-neutral. The latest-generation technologies are generally more energy-efficient and thus more environmentally friendly than their predecessors. Companies will use the data from IoT to create offers for environmentally conscious consumers and companies. This means that companies will collect IoT data and use it to optimize resource use and respond to environmental legislation – for example, stricter regulations on emissions in shipping and the maritime industry, which require

both technical and organizational measures.

Many companies will create new offerings based on sustainable products and services that target environmentally conscious consumers. These companies do not see sustainability as a cost factor but as a competitive advantage that they place at the heart of their brand identity and product design. Innovative companies are beginning to apply the principles of the circular economy to their product life cycle management.

This approach is based on reducing resource consumption, reusing products and parts as much as possible, and recycling raw materials. The principle of closed-loop recycling management is to reduce the consumption of natural resources, starting in the design and manufacturing phase, which must be focused on improving processes and conserving resources.

### How Can IoT Contribute to a More Sustainable Product Life Cycle?



## Interview

# CONNECTIVITY IS THE BIG GAME-CHANGER

IoT is growing up and the needs and demands of customers are changing fast. **For companies, simply connecting a couple of components is no longer enough – customers want solutions that can do whatever the job requires.**

System vendors and distributors are under pressure to provide fully integrated IoT environments out of the box instead of a box full of gadgets and devices.

■ By Tim Cole

*Smart Industry* asked two industry heavyweights to share their outlook on where the IoT industry is heading: Dr. Gunther Kegel, president and CEO of Pepperl+Fuchs, a worldwide specialist in both factory and process automation; and Frank Hansen, vice president for technical resources and marketing at Avnet Silica, the European semiconductor specialist division of Avnet, a leading global technology distributor.

**Why does it make sense to bring you both here together instead of interviewing you separately?**

**Kegel:** I think it's time to understand that we're all working for solutions for our customers – and that requires not only an in-depth understanding of the application but also the ability of the suppliers to find and implement the right solution. More and more, we have to work together, not only in pairs but in even larger teams to give our customers the perfect application. We have our partners that

provide us with parts for these solutions and I truly believe they should become a more integral part of the solution design rather than just supplier. The application-specific knowledge from our company, as well as from our suppliers, is essential to create new and novel solutions that help our customers be more successful.

**What I hear you saying is that, instead of components, customers want solutions tailored to specific needs and tasks. How does this trend affect the market for IoT in general and sensors in particular?**

**Kegel:** Nobody implements Internet technologies just for the sake of the technology, especially not on the shop floor. The real value of technology to the customer lies in the data-driven business models it enables. The shop floor feeds these business models with the appropriate data and that's why these new IoT concepts are very much more

solution-oriented than they are component-oriented.

IoT today is about business and business solutions. Components are still important to our legacy business, of course. In fact, we are experiencing tremendous growth both in our solutions business and at the same time in our components business. Many customers don't want to do the integration themselves so, eventually, they turn to integrated products – but the solution itself consists of more than just components. Electronics, mechatronics, and software all play a part in building the final solution. It would be wrong to say that we are moving away from components into solutions; it's additive. We create more business by offering solutions.

**Frank, Avnet has a history in components. Isn't this solution stuff a whole new ball game for you?**

**Hansen:** Definitely! But the old buzzword IoT is moving into real applications and use cases. More



Frank Hansen



Dr. Gunther Kegel

than 80 percent of our current engagement with customers is in areas like predictive maintenance. That's the entry point for things like data warehousing, data analytics, and machine learning. With the current economic situation, time to market and an optimized cost of ownership strategy are key. We, at Avnet, can support our customers with our own resources, or can help them establish external ecosystems to bring solutions to their customers.

**A few years ago, everybody believed software was eating the world. Today, the buzz is mainly around cloud solutions, data analytics, and artificial intelligence. How should vendors react?**

**Kegel:** Whereas we see lots of software integration on the office floor, we don't have as much on the shop floor, yet. Okay, we see some automation-specific digital communication capabilities emerging, but it's not what you could really call the Internet

of Things. So, for us as a leader in providing industrial sensors and sensor solutions, connectivity is the big game-changer. In manufacturing, sensors are nothing new. Today, while we still have the same sensing capabilities, it's about data and measuring values in order to turn them into data, and then connecting them to the Internet of Things. This requires a lot more electronics and software, which needs to be integrated with the components. We have to convince our customers that we not only understand their applications but can also connect existing components in ways that are simple and competitive.

**Achim Berg, the president of Bitkom, the German IT manufacturing association, recently warned that a lack of experienced personnel in areas such as data analysis and sensors is throwing a monkey wrench into the development of the so-called "Industry 4.0" in Germany. Do you agree?**



**Many customers don't want to do the integration themselves so, eventually, they turn to integrated products.**

**Dr. Gunther Kegel**  
President and CEO of  
Pepperl+Fuchs

**Kegel:** Yes and no. I think we are well-prepared to bring the Internet of Things to the shop floor. That's because Germany as the world leader in machine engineering and automation technology basically owns the shop floor. What we need to do now is to turn these elements on the shop floor into the "things" of the Internet of Things. I think we are in a very good position; we may even lead the race at this point. The question remains, however: what do we do with all this data? Do we also lead the world in terms of machine learning, artificial intelligence, and big data? Unfortunately, the answer is clearly no. There is no company in Germany that is really relevant in social media and all these new data-driven business models. That's the missing link: can we turn our dominant position on the shop floor, where all the data is generated, into a leading position in the use of that data and turning them into a customer advantage? →

**Despite all the hype, Industry 4.0 is still very much in its early stages, in Germany at least. Mechanical engineering still seems to be struggling to digitize; does that worry you?**

**Hansen:** No, not really. I think that what we are seeing right now is a certain degree of internal digitalization but these machines are not completely connected yet. They don't share this internal data with others as they would in an entirely data-driven business model. In their laboratories, in their R&D centers, these machine builders are all completely digitized. Everybody understands that the machines of tomorrow need to reach across the boundaries of factories by connecting suppliers and users; they completely understand the necessary balance between machines and the supply chain. Honestly speaking, I don't know of a single manufacturer who is not eagerly working on getting their machines fully digital and fully connected. At the moment, end users – customers – are frankly not yet that interested. They talk more about partial digitalization that gives them direct access to the machine and to the sensors, but they don't yet think about connecting these machines to all the other machines or machine centers, even across the boundaries of their factory. So, this is more an evolutionary step-by-step approach. I don't think it's the machine builders that are holding us back. These guys are ready and waiting to roll out fully digital machines as soon as the customers start asking for them.

**There are lots of really old machines standing around in the shop floors in Germany that were built long before anyone dreamt of connecting them to anything. What do we do about the legacy systems?**

**Kegel:** Legacy machines are a perfect example of how you can



**The machine builders are ready and waiting to roll out fully digital machines as soon as the customers start asking for them.**

**Frank Hansen**

Vice president for technical resources and marketing at Avnet Silica

add new connected sensors that feed the relevant data into a data-driven business model. You may still be using the mechanical part of the old machines and simply install new control mechanisms with all the digital connections you need. Most of the control-system manufacturers offer this kind of exchangeability even for some very old machines and, if you don't want to do this, you can still add some sensors that allow you to plug in to cloud applications and connect even the oldest machines to a server architecture which feeds into a cloud application. Okay, if you're, say, a super-large process plant, like BASF, that operates steam crackers that were built 20 years ago, then it might be difficult to imagine how we can digitalize all this without exchanging all the sensors and the different actuators. However, digitalizing all this might be very costly and hard to do, especially while the steam cracker is still running. The truth is that we have different kinds of industries that need different kinds of migration strategies toward the digital technology. But I don't think that the machine builders are really the limiting factor.

**Frank, is that your experience, too?**

**Hansen:** Absolutely. I totally agree. At this year's Hannover Fair Digital Days, all the companies were offering their own cloud solutions, and everybody also had their own connectivity solutions available. They're all already showcasing their solutions which are currently available on the market.

**What will the greatest impact of artificial intelligence be to your sector?**

**Kegel:** First of all, we need to understand that artificial intelligence is not really new. I was doing my PhD 30 years ago and guess what? It was about inte-

grating multi-sensor signals into robot control by means of artificial intelligence. Artificial intelligence is not any kind of magic. It's really a set of defined algorithms that have been developed over the last couple of years simply by adding tremendous computational power, tremendous data storage, and, most importantly, labeled data that can be used to train these algorithms much more efficiently than we could 30 years ago.

Users on the shop floor need to return to what I like to call tool realism. We need to understand, in realistic terms, what value these tools can create. It's not that they're standing the entire industry on its head, it's more about an evolutionary approach to things like predictive maintenance. Understanding machine behavior and predicting machine behavior by analyzing standard data sets is crucial. When you talk about an image processing system, this is, today, dominated by deterministic algorithms to which you can apply machine learning algorithms. The advantages these new algorithms are bringing with them will give us the next push – but I would like to state that I'm not overly optimistic that this is really going to change the industrial world overnight.

**Frank, sensors themselves seem to be getting smarter. Is artificial intelligence moving to the edge?**

**Hansen:** Definitely, yes. As Gunther already said, most of our time is spent working with customers to give them an understanding of how artificial intelligence or machine learning can improve their business case today. Customers must be brought to understand what they can get out of their data by developing new uses and new business cases. This is our main focus when we talk with customers about artificial intelligence and machine learning.



# Industrial Solutions Across Edge and Cloud

The world is constantly changing, demanding continuous innovation from the cloud to the edge.

The rapid growth of artificial intelligence is producing unprecedented amounts of data, leaving some factory systems with longer lifecycles struggling to keep up.

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# Customs and Border Protection IOT GETS THE GOODS

Artificial intelligence has played an important role in the massive improvements made in border security by many high-GDP countries over the past two decades. **The border protection industry is now on the cusp of seeing major new products and technologies appearing** that could result in more secure and efficient borders for both passengers and trade.

■ By Stian Overdahl

**C**ustoms and border management have undergone profound changes over the past two decades. Following the September 11 terrorist attacks in 2001, the United States and other countries scrambled to update their border management processes. The focus is on advanced screening to detect possible threats, as well as facilitating trade and travel as the volumes of both increased. With the need to screen passengers in advance of boarding an aircraft or scan a ship's cargo ahead of arriving

in a port, borders have increasingly become "virtual," relying on data, intelligence, and risk management principles to secure them against threats.

Those in the industry have seen a shift from relying on manual checks, training, and instincts toward greater automation, application of artificial intelligence, and data analysis. Thirty years ago, Chris Thibedeau was working as a customs inspector for the Canada Border Services Agency (CBSA) in Nova Scotia – today he is the chief

executive officer of TTEK, a customs and border management technology company. In those days, when a large vessel laden with thousands of containers arrived, analysts would be handed a large stack of paper bills of lading to pore over, looking for signs of high-risk shipments. It might be something as simple as a first time or unknown importer, cargo coming from countries that were a known source of illicit goods, or a shipment suspiciously directed to a PO Box – or it might be something that didn't



If you're just doing random selection, you never find anything.

Chris Thibedeau  
TTEK



source ©: theglobot.com

make sense, like automotive parts being transported inside a refrigerated container. Shipments meeting multiple “anomalies” were often deemed higher risk and worth investigation.

Through this process the stack of paper representing 1,000 commercial shipments might be whittled down to 100 individual shipments for closer scrutiny and inspection. These would be cross-referenced against other databases, including police and customs watchlists, looking for obvious red flags, such as an importer with a history of non-compliance or other enforcement actions. Human intelligence and open-source intelligence would also feed into the decision-making to determine which containers would be selected for inspection on arrival. Finally, the analysts would arrive at a shortlist of maybe just ten containers deemed to be highest risk. “Because we could only look at

ten containers [in a single shift], we became very incentivized to make sure that any container we were going to offload at the warehouse that day was going to be the right one. If you were just doing a random selection, you were never going to find anything,” explains Thibedeau. When Canada, the United States, and other nations moved to en-

**TTEK is building several targeting centers for government agencies worldwide.**

Its library of over 65,000 proprietary rules targets shipments, using deductive and inductive logic as well as predictive, with automated risk-scoring driven by machine learning.

hance border security post-9/11, many countries began to develop targeting systems that embraced the use of artificial intelligence principles to automatically rank shipments for inspection, drawing upon the same risk indicator rules and risk profiles developed by the old-school analysts.

Thibedeau, who was then working at CBSA headquarters and was recruited to lead the development of its commercial risk assessment system called Titan, describes the jump from manually combing through stacks of paper to automated sorting of data as “a game changer” for border control agencies. “With the targeting system we could automate deductive and inductive logic rules to identify known risk indicators and flag shipments deemed to be of highest risk to customs inspectors. We were putting the needles on top of the haystack,” he says. →



While some nations, especially higher-GDP ones, use sophisticated targeting systems and the principles of risk management, many others still rely on less efficient processes. This usually results in extensive inspections of shipments, which can create bottlenecks in the ports of entry and ultimately result in delays and increased costs for importers. Thibedeau's company TTEK is currently building several targeting centers for government agencies worldwide. It claims to have a library of over 65,000 proprietary rules for targeting shipments, using deductive and inductive logic as well as predictive, with automated risk-scoring driven by machine learning. He's optimistic that the global market will quickly adopt this approach as benefits become clear. "We believe we're on the leading edge of risk-based analytics," he says.

### Where There's Smoke

Artificial intelligence can also increase the effectiveness of border security equipment. Smiths Detection, a manufacturer of threat



**Our company algorithms can sometimes outperform the human eye.**

**Marc-Olivier Roché**  
Smith Detection



source: LinkedIn

detection and screening technologies, began using AI to detect smuggled cigarettes inside cargo containers and trucks in 2008. Smiths uses convolutional neural networks to analyze images, produced by its scanners in ports, airports, and other sites, to improve detection of contraband, such as weapons, or to detect irregularities with trade. In some cases, the company's algorithms can outperform the human eye, says Marc-Olivier Roché, Smith Detection's product director for high-energy scanners:

"We've been amazed at how the AI can detect weapons in a picture when an operator might look at the same picture and not see anything suspicious."

Increasing trade volumes and pressure on agencies to reduce or maintain staffing budgets were among the main factors pushing the development of image analysis automation, he says – but it hasn't all been plain sailing. Early versions of the algorithms did not perform especially well, says Roché.

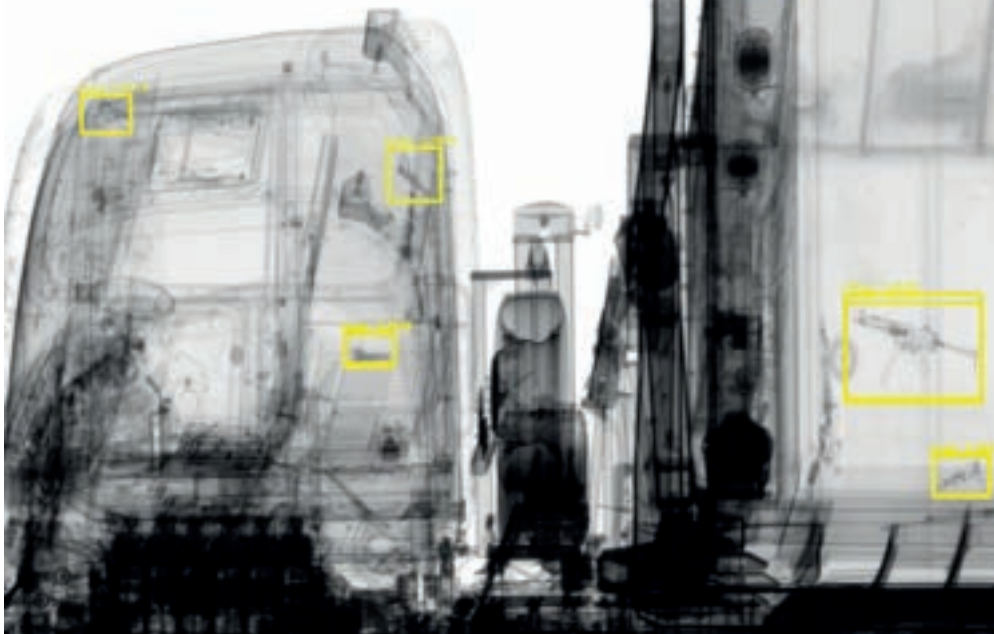
One challenge for many AI companies in the security space was obtaining images to use for training data because the industry-standard images can be hard to source or limited in number. However, persistence has paid off for Smiths and additional training data quickly improved performance: for its weapon detection algorithm, for example, ingesting an additional 5,000 images reduced the false alarm rate from 13 percent to two percent, says Roché. Smiths is currently evaluating the use of AI to create artificial images to speed up deployment.

Producing a workable solution relies on fine-tuning the output. An overly sensitive system will generate too many false alarms, while if not sensitive enough it risks letting contraband slip through. Typically, the best results come from customizing the algorithm's output to an individual customer's profile, says Roché. "Customers with more of a security focus will want a high probability of detection and care less about false alarms. Those with high throughput can't afford having too many false alarms," he explains.

There are still obstacles to adoption. In an industry with precise standards for a scanner's performance, there are no standards to prevent manufacturers making exaggerated claims about their AI products, says Roché. Often, AI isn't specified in tenders, while some clients worry that human operators may become lazy and rely

#### Peekaboo, I see you!

AI can detect weapons in a picture when an operator might look at the same picture and not see anything suspicious.





entirely on the machine’s judgment. Finally, even if their system is responsible for a major bust – say of ivory at a port in Africa – the manufacturers typically can’t publicize results because agencies fear it would tip off smugglers to operational details.

Roché is confident new clients will still continue to be won over, especially as the technology becomes more effective and easier to deploy. The company is also working on additional uses, including being able to detect variations between the contents of a container and its description on the manifest. Initial work has been promising despite the complexity of cargo images. “Imagine a pallet of bananas sitting behind a pallet of oranges. It’s not straightforward for an algorithm to make sense of that,” he says.

## Putting Names to Faces

The use of biometrics for travelers also opens up AI opportunities. Aurora-AI, a UK-based AI specialist in the aviation sector, has installed its facial recognition system in several major European airports, including at Manchester Airport and in two terminals at London’s Heathrow Airport. The system allows international and domestic travelers to mix in a single terminal, offering significant efficiencies for airport operators. Having one set of shops and services and less infrastructure to keep passengers separated is at-

tractive – but shared-occupancy terminals carry risks.

A principal concern is that a passenger arriving on an international flight could directly board a domestic one to bypass immigration and customs, explains Nick Whitehead, Aurora-AI’s executive head of business development. To combat this, the company’s system uses cameras with infrared (IR) flash to photograph passengers as their boarding passes are scanned and they cross into the secure airside area.

This AI process – verification – is able to be done with a much higher confidence level than identification, when a photograph of a person is matched against a database of individuals, and makes facial recognition using verification more suitable for the level of security needed for border control, says Whitehead. Their system must basically guaran-



source ©: airportbenchmarking.com



**AI makes facial recognition more suitable for the level of security in border control.**

**Nick Whitehead**  
Aurora AI

### Crowd Control

Aurora AI has installed a system in several European airports that allow travellers to mix in a single terminal and still maintain complete control.

tee it won’t allow unauthorized passengers to board whilst not falsely rejecting passengers, which creates delays. He confirms that he’s “highly confident” that his system is reliable, and its efficacy is regularly tested by security staff.

Aurora-AI produced its first facial recognition algorithm around 2007, and Whitehead says it can identify an individual from a set of images as large as a single planeload of around 600 people to a standard suitable for border security. “As soon as you start trying to perform identification against a much larger group – say everyone coming to the airport in one day – then your chances of making a mistake go much higher,” he says.

The company also offers a wider suite of AI tools for the aviation sector, including using predictive analytics to generate forecasts. For example, its algorithm can use the schedule of arriving aircraft to predict the flow of passengers into the immigration hall, generating an accurate forecast of how many desks need to be open to maintain a certain queue time. “Using AI based on historic information can provide you with a better prediction than standard modeling,” says Whitehead.

### Dirty Work at the Crossroads

Border security for passengers presents a huge data challenge, ➔

as large amounts of data-sharing between partner nations and across national agencies “makes data veracity, lineage, and provenance tricky,” according to Mike Gormley, head of public sector at data unification company Tamr. Raw data collected by border agents may be inaccurate, misclassified, or otherwise “dirty” – for example, border agents may be in a rush as they enter in data, while travelers may struggle with language barriers when questioned or may intentionally falsify information.

With targeting centers able to access multiple data sets – including advance passenger information submitted when booking an airline ticket, historical travel records, flight manifest data, and information on individuals in databases of known undesirables – it’s important to be able to match a passenger with the information on them held across those databases.

Since 2016, Tamr has been working on improving the entity resolution capabilities of the Global Traveler Assessment System (GTAS), a passenger screening system produced by the USA’s Customs and Border Protection (CBP), the country’s primary border control organization and the largest agency within the Department of Homeland Security (DHS). GTAS is freely available on GitHub for any country to use.

Tamr’s solution to improve entity resolution uses a variety of tools

**We will soon be able to incorporate machine learning into all the passenger and cargo vetting systems.**

**Alan Bersin**  
Altana Trade



source ©: Transverse City International Affairs Forum

to clean data, including trigrams to work around typos, and techniques to improve matching of a passenger’s data between different databases to ensure passengers aren’t incorrectly matched (for example, if their name is the same or similar to one on a no-fly list), to build a clearer picture for border agents.

Thorough cleansing and collation of detail gives border agencies an enhanced understanding of who is trying to enter their country, allowing faster detection and identification of known threats. It should also mean less unnecessary extra screening at the terminal and potentially shorter queues through the improved information sharing. “By including more data sets in an evaluation, agents can go multiple levels of information deeper to identify potential threats,” says Gormley.

**Perfect match**

With targeting centers able to access multiple data sets – including advance passenger information submitted when booking an airline ticket, historical travel records, flight manifest data, and information on individuals in databases of known undesirables – it’s important to be able to match a passenger with the information on them held across those databases.

Recent improvements in techniques means that the use of AI in border security globally is on the threshold of further large improvements in the next few years, says Alan Bersin, a senior fellow at Harvard’s Belfer Center and executive chairman of Altana Trade, an AI platform for improving international commerce. “I think we’re on the cusp of real breakthroughs in terms of big data analytics and machine learning,” he says.

Bersin, a former US CBP commissioner, thinks one of the big problems with targeting will be overcome by federated learning. Agencies and companies in the private sector have always been reluctant to share their data, because of either privacy or proprietary concerns. Federated learning addresses this by allowing machine learning algorithms to access individual data sets without having to comingle them with others or download them to a central store. Keeping each learning source discrete negates the privacy issues that have made organizations unwilling to share data in the past. “That is a revolution in data processing,” Bersin says.

Currently, the CBP’s National Targeting Center operates on a rules-based system, but increasingly AI’s predictive powers will be used to generate new rules, processing massive data sets in real time and adding an additional layer to the existing targeting intelligence. “Eventually there will be a transition to a full AI solution and we will be able to incorporate machine learning into all of the targeting functions and also the passenger and cargo vetting system,” says Bersin, noting that “It’s a work literally in progress now.”

He believes this approach will eventually be adopted by many countries. “I think you’re going to see these AI, fully automated [targeting] systems increasingly show up in border management over the next two to five years,” he predicts.

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| Responses                | Dataset       | full_name                       | dob      | gender | cc_country_cd |
|--------------------------|---------------|---------------------------------|----------|--------|---------------|
| <input type="checkbox"/> | nv2 derog.csv | MAURICIO REYES                  | 1966000  | MALE   | US            |
| <input type="checkbox"/> | nv2 derog.csv | JIRI FERGLUSON                  |          |        |               |
| <input type="checkbox"/> | nv2 derog.csv | MARHEDI ABBI                    | 1983000  | MALE   | PK            |
| <input type="checkbox"/> | nv2 derog.csv | HADI SAMI KAYED MOHAMED HOURTAD |          |        |               |
| <input type="checkbox"/> | nv2 derog.csv | MUHAMMAD KAMAL JASEM ALIPOURI   | 19820426 | MALE   |               |
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FinTech

# BANKING ON IOT

Smartphones, automation, and artificial intelligence are helping revolutionize how banks deliver services, but **these technologies may also prove the undoing of the traditional players.** Will today's big banks retain market dominance, or will upstarts and apps fragment the banking sector?

■ By Stian Overdahl



**B**anking, one of the largest and most profitable industries in the world, is at a turning point. The 1,000 biggest lenders have combined assets worth around \$123 trillion, with an average return on assets (ROA) of 0.9 percent. Despite all this heft, the future is uncertain as technology upends their industry.

At the heart of this shift is the smartphone. From the banks' viewpoint, these ubiquitous IoT devices have provided direct benefits. Apps bring banks closer than ever to their customers, who can make payments or international money transfers via their phones. Previously, these transactions would have required them to visit a branch office, make a telephone call, or write a check. New technologies can also offer immense savings for banks, allowing them to close local branches and automate many worker functions.

With the rise in functionality and popularity of banking apps, desktop and laptop banking is stagnating and traditional telephone banking is dying out, while visits to branches are becoming less common, says Max Flötotto, a partner at McKinsey & Company. In the German market, for example, 20 percent of customers account for 90 percent of branch visits. Increased smartphone usage generates new pools of customer data and this creates more sales opportunities for banks. "There are a lot more opportunities to create sales leads and to interact with customers if they look at their banking app four times a day than if they come to a branch

every 12 weeks or once a year," says Flötotto.

Smartphones have also flung open the door to all kinds of competitors – challenger banks, big tech, and startups – all chasing after their piece of the financial world's immense profits. In Europe, a wave of online-only banks, neobanks, such as Revolut, Monzo, and N26, have seen massive growth in customer accounts in just a few years. Part of their value proposition is lower fees – Revolut, for example, offers currency transfers at the inter-bank rate – but much of their success can also be attributed to a superior user experience, through slick apps, utilitarian sign-up processes, and showy marketing campaigns. Neobanks have also showed that banking relationships are far less "sticky" than they used to be. The old joke that a banking relationship often lasts longer than a marriage no longer rings true.

To date, the biggest growth by fintechs has been in emerging markets where many consumers are un-banked, or under-banked, and hungry for new digital services. In the Asian markets, growth of digital payments has risen sharply, epitomized by Alibaba spin-off Alipay and Tencent's WeChat in China, or the fast growth of mobility apps, such as Singapore's Grab, that have built-in digital wallets. These apps have further squeezed banks by diversifying into related sectors, including products for the credit market, investment services, and insurance.

Will a similar upheaval take place in developed markets like Europe and



**There are a lot more opportunities to interact with customers.**

**Max Flötotto**

McKinsey & Company



source ©: McKinsey & Company

the US? For all the marketing savvy of neobanks in developed markets, many are only used as a second account by customers still choosing to pay their salaries into traditional bank accounts. Some neobanks still lack core banking products such as personal finance or mortgages (and the familiar questions about the profitability of well-funded start-ups lingers in the background).

Many experts believe that change in developed markets comes at a slower clip. In China, it was the failure of retail banks to effectively meet the needs of a growing and increasingly wealthy middle class that set the stage for the rapid growth of digital payments, says Kevin Kilty, the CEO of Hubpay, a digital wallet service targeting Asian workers in the Gulf states. He sees a possibility for rapid growth of fintech in other emerging markets but is doubtful that financial services in developed markets will be similarly disrupted, given that most Western banks already offer →

#### **What's in the Cards for Banks?**

Apps are diversifying into related sectors, including products for the credit market, investment services, and insurance.

#### **Personalization of Services**

### **A New Look at Existing Clients**

Chatbots are increasingly being used as a customer service tool by banks, especially online-only neobanks. As in any industry, AI-powered chatbots can provide information to customers, allowing banks to employ fewer call center workers. AI can also be used to comb through a bank's customer base to look for miscategorized, high-value clients, or to identify appropriate clients for new products, such as savings plans.



consumers efficient payment technologies – such as tap and pay on their credit and debit cards.

That said, the steady growth of fintechs and shifting consumer behavior may contribute to a steady erosion of profits for banks in developed markets. “It’s a critical time [for banks] but I don’t think it will be an overnight shift to a new model,” says Flötotto.

Philipp Baecker, expert vice president at Bain & Company, says that banks in developed markets do have a battle on their hands – and a crucial part of that is about ownership of the customer relationship. The worst-case scenario for retail banks is that fintech and tech companies become so successful in offering financial services through their own platforms that banks are relegated to a back-end role, processing products for tech players that control the customer relationships, he says.

“What makes this so fundamental is that in the future a lot of the services offered today that we know as financial services will be integral parts of a customer experience that may cut across industries. The question is: what is the role of banks and how visible will they be to the consumer?” Owning the customer relationship is not only important from a brand and revenue perspective – it also means potentially owning customer data, which itself is increasingly valuable.

### Hipness Counts

While banks can have immense profits, they also have colossal costs.



source ©: Hubpay Ltd



**What is the role of banks and how visible will they be to the consumer?**

**Philipp Baecker**  
Bain & Company

### Credit Scoring

## Keeping Score by Smartphone

Evaluating credit risk is one of the most fundamental activities for a bank, and AI is increasingly being used to gauge credit risk. In developed countries, traditional credit scoring companies with large data sets are using AI to score customers more accurately. In emerging countries, where some first-time borrowers have no credit history, different methods are used, such as using smartphone metadata or social media information to create a credit score. Singapore’s monetary authority has even launched a framework to ensure fairness in AI credit scoring methods.



source ©: Bain & Company

need for banks to digitize massively and, in some cases, made what was believed impossible to be possible within the shortest time frame,” says Dave Murphy, a managing partner at business transformation specialist Publicis Sapient. Companies have become willing to implement digitization measures they have been delaying for years within just weeks. Whether this will result in a permanent shift remains to be seen. Neobanks, meanwhile, are well-positioned to take advantage of new technologies in banking, includ-

JPMorgan Chase, the largest bank in the United States, has been spending around \$11 billion per year on technology, while Spain’s Santander Group announced, in 2019, that it would spend €20 billion over four years on its digital transformation. Reducing costs via technology, specifically automation, is therefore a major opportunity for legacy banks. However, it’s not as simple as spending money to get results. Experts caution that one of the biggest obstacles that banks face is legacy mindsets among managers and staff, with a tendency for bank projects to overrun budgets and schedules. Moving bank staff into a start-up-style hipster office won’t have any effect if they bring with them traditional working styles, such as a strong aversion to failure that limits their willingness to take risks.

Still, the restrictions that arose from Covid-19 and the need for contactless banking have “accelerated the





**JPMorgan Chase**, the largest bank in the United States, has been spending around \$11 billion per year on technology.

ing big data, cloud services, robotic process automation (RPA), and artificial intelligence (AI). Newly minted banks are often able to integrate these in their systems from day one, rather than struggling to transform or merge outdated legacy systems, a thorn in the side of many banks which not only affects the adoption of new, data-driven tools but also inhibits the ability to control costs via digitization. Sarah Kocianski, head of research at 11:FS, a UK-based financial consultancy, says banks can face a raft of challenges, such as customer data siloed



source ©: Publicis Sapient



### Covid-19 has accelerated the need for banks to digitize.

**Dave Murphy**  
Publicis Sapient

within individual systems (between a checking and credit card account, for example) – and even data that hasn’t yet been digitized. By contrast, tech companies and neobanks are more likely to have managed their customer data from the start to ensure it’s clean, efficiently stored, and easy to access in data lakes.

“Many banks didn’t react early or quickly enough to the ideas of how important data could be, to ensure that they were a good place to use the data they had,” she says. Not only can this hamper their implementation, it can also make banks less attractive as an employer for AI specialists because they don’t have clean data sets to work with, Kocianski adds. This is significant as the development of tech capabilities in the financial world is as much a battle for talent as for anything else.

While RPA can be used to automate existing processes in many banks, total redesign of a bank’s systems may be required to gain full advantage of new technologies, especially AI, says Bain’s Baecker. “You can’t simply take your existing processes, your existing products, existing service models, and your existing mindset, and put AI on top,” he says. “That is the edge many of these new challenger banks and even larger technology companies have – they don’t have to deal with as much legacy and can rethink everything from scratch.”



### The Robot Will See You Now

New banks, especially, are taking advantage of new technologies in banking, including big data, cloud services, robotic process automation (RPA), and artificial intelligence.

### From RPA to AI

Michael Berns, director of AI and fintech at PwC, says that many of →



the European neobanks have been built on microservices with RPA included, while some of them have AI components as well. Revolut, founded in 2015, is UK-based and now has almost four million active users each month. It has built a chatbot for viral marketing which it is using to good effect to generate additional customer contacts, says Berns. "I doubt they would have been able to do that in a scalable way without fully leveraging automation, RPA, and AI," he says. Berns sees the beginnings of AI in banking as a response to the series of massive fines slapped on banks following the financial crisis for a host of wrongdoings, including money laundering and market manipulation. Prominently, HSBC received a \$1.92 billion fine in 2012 for failing to act on suspicious transactions going through its books, many of which were related to Mexican drug cartels. Scandals such as this



**Banks had little choice but to resort to AI to prevent massive regulatory fines.**

**Michael Berns**  
Director of AI, PwC



source ©: PwC

put US banking licenses for a number of European banks under threat. "Banks had little choice but to resort to AI, to fulfill the urgent requirement for new methods and complex tools to prevent further massive regulatory fines," says Berns. "AI is a key tool in these areas to analyze communication and gain more control over internal proceedings."

The aftermath of the financial crisis has seen the use of AI spread and it is now used in areas including the detection of payment fraud, suspicious transaction reporting, credit scoring, contract analytics, and a host of applications around lead generation and customer-service personalization and response. A classic use case is the combing through customer data to look for high-value clients that a bank might unknowingly have on its books. Behavior such as dining out at expensive restaurants in London and Paris might be a tip

that the bank has an affluent client, perhaps using a secondary account. Identifying such a client within a bank's existing customer set is far more cost-effective than acquiring new customers in this segment on the open market, says Flötotto at McKinsey's.

One company providing white-label AI solutions to banks is Personetics Technologies. Dorel Blitz, the Israeli company's vice president of strategy and business development, describes its product as an "AI-based proactive and personalized engagement platform that is designed to help banks to better analyze their customers' financial behavior in real time at a very granular level." Personetics can be used by banks to engage with their customers through a digital or physical sales channel, for example to suggest that customers take advantage of an automated savings plan. "The problem that we are trying to solve is helping banks to stay relevant, to stay in the center of their customers' financial lives," he explains.

Personetics' goal is to help banks fully personalize their offerings to customers, in real time. Blitz believes banks will shift from the current passive approach to a fully proactive one and evolve into having "full automated money management capabilities, where your bank will be able to think and act for you, instead of just nudging you and telling you where you should actually put some money aside."



**Many banks didn't react quickly enough to how important data is.**

**Sarah Kocianski**  
Head of Research, 11:FS



source ©: Fintech Finance

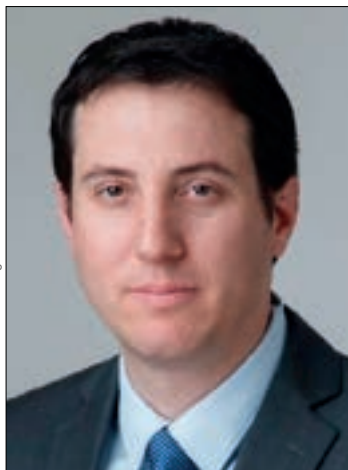
## Anti-Money Laundering

### Learning to Spot Suspicious Signs

With some of the world's biggest banks having received multi-billion-dollar fines for money laundering, anti-money laundering (AML) compliance is a significant cost for the industry. Machine learning techniques can help banks sort through transaction data for signs of suspicious activity. Nevertheless, adoption of AI technologies for AML in North America has been relatively slow and is often limited to proof of concept, according to a report by Accenture. One downside is the notion of machine learning as a "black box" where the inner workings are not understood by compliance officers or the regulators who require them to understand and validate how AML outcomes are derived.

The platform can work with any kind of structured data available to the bank and, while it's typically focused on core banking data, such as checking deposits, loans, and credit cards, it can also incorporate external data the bank is collecting, such as geolocation, or rewards and loyalties data. "We're able to help banks to dramatically increase the data enrichment and categorization to have a much better understanding of their customers' financial behavior," Blitz says.

Currently Personetics' solution doesn't make use of social media data (though as a white-label solution it can make use of any structured data, notes Blitz), but this is a growing area of focus in some markets – and also a controversial one. Differing attitudes around the world as to how companies use customer data, and political realities, are expected to result in significant differences in how AI is adopted, given the need for training, validation, and test data sets to develop algorithms. Take for example AI-powered credit scoring. Though AI is used to enhance traditional scoring methods, in an under-banked market where the applicant doesn't have a financial history, an alternative solution is to scrape personal data from social media to build a credit score. Even though some applicants willingly give permission for an algorithm to scan all their activity on social media, the concept doesn't sit well with everyone. Attitudes to privacy tend



source ©: Personetics Technologies

to be cultural and, as a result, what is permitted varies greatly between regions.

In much of Asia it is permitted to scrape social media and then come up with a credit score or sell products, such as insurance, based on this. But in Germany, for instance, it seems less likely for the regulator to accept AI factors as part of a credit-scoring model. "The focus here is on transparency as well as explainability," says Berns.

In particular, with China reckoned to be a global leader in AI, the fact that citizens' personal data is routinely collected by the state is seen by many experts as likely to give it a further edge, as Chinese consumers are more likely to be willing to give up personal data if they see an advantage in doing so.

"In the end, it is a global race and the winners are the ones who have the most diverse data set. From a



**We're able to help banks to increase their data enrichment and better understand their customers.**

**Dorel Blitz**

Personetics Technologies



**Banks need strong strategic approaches around business, data, and vendors.**

**Ron Shevlin**

Cornerstone Advisors

maturity perspective in terms of removal of blockers, it certainly helps if the government and regulations are fully aligned with regard to collection and use of data," concludes Berns.

### A Means Not an End

The overall business environment for banks is also likely to play a role in determining how aggressively banks are willing to make big investments in tech like AI. On this front, profitability of US banks is much higher than European banks.

When it comes to investment decisions, size matters, too. Ron Shevlin, director of research at Cornerstone Advisors in Boston, Massachusetts, says that, while he is bullish on AI, in the longer term the reality is that thousands of smaller banks will be unable to develop their own technology and will rely on vendors. Picking a vendor that fails to keep up with developments could be costly, he says.

Shevlin says he is fond of pricking the "AI hype bubble": "Too often AI is talked about as if it's a technology that's going to solve all problems. What it really comes down to is that [banks] need strong strategic approaches around business strategy, data strategy, and vendor strategy." That view is echoed by Blitz at Personetics, who cautions that for a bank to effectively use AI it must first have clear notion of its business goals and strategy: "AI is just a means, it's not the goal."



source ©: Cornerstone Advisors



## AI and the Future of Retail

# DONE DUNNING

Amazon has thrown down the gauntlet to the classic retail trade with its “Just Walk Out” high-street stores. This scared traditional traders but, while China is mobilizing billions to compete, **Europe is relying on its culture of regionally fissured markets that has grown over centuries.** It is a weakness and a strength at the same time.

■ By Bernd Schöne

In the first few months of 2020, the retail sector experienced an unprecedented surge in digitalization, forced upon them by the Covid-19 outbreak. As many European shops were closed by order of the authorities in all countries except Sweden, the companies affected had to find a second foothold by offering their goods online and then sending them by post or making them ready for socially distanced collection. This should lead to a permanent expansion of the distribution channels.

For the food retailers not affected by the closures, the pandemic led to a sudden increase in demand which could not be met as a result of panic-buying customers. Interest in using service robots in the future for the provision of goods on the sales floor has now increased noticeably.

Time is pressing, as China and the USA accelerate the pace. The Chinese Alibaba Group has been deliberately building a bridge between online and offline purchasing since 2016. Alibaba founder Jack Ma says that if 80 percent of retail sales are still being made in local retail outlets, his company must accommodate its customers. This is especially true of fresh products such as fish which are so popular in China. The customer can choose the fish and have it prepared in the shop, or have it delivered within three kilometers of the store.

In Alibaba's Freshippo (formerly known as Hema) supermarkets customers can scan the goods themselves as all products have machine-readable labels, and then pay for their purchases by face recognition and Alipay using their smartphones. The superstores cover the full range of a supermarket, including sex toys. The giant marketer opened its first store in 2016, and there are now hundreds of them, with a five-year goal to establish 2,000 outlets.

## Pioneers and Latecomers

Without doubt, the technological pioneer is Amazon's "Just Walk Out" store. The customer registers at the entrance with their smartphone using a QR code. The store is equipped



source ©: World Economic Forum / Claram McCrickard

with an extensive array of cameras, light barriers, and sensors for pressure, infrared, and volume changes, backed up by image analysis, sensor fusion, and deep learning. All this makes it possible to assign a selected product to a specific person or remove it if they take a product out of their basket and put it back on the shelf. Audio monitoring also helps to detect when products are passed from one person to another, for example when someone asks a friend to pass a product to them. Once a customer has all the products on



**If 80 percent of sales are still being made in local retail outlets, our company must accommodate its customers.**

**Jack Ma**  
Founder of Alibaba

### Just Walk Out

Image analysis and deep learning combine to track purchases. The price is debited to a customer's account so there is no need to stand in line at the cash register.

their shopping list, they can leave the store with their trolley without queuing to pay. The smart infrastructure records everything and the purchase is automatically debited.

Amazon's test setup is not yet perfected and the presence of too many people confuses the cameras, so access is limited. Ironically, customers have become used to such restrictions during the coronavirus pandemic, but analysts see this kind of future shop as problematic among privacy-conscious Europeans, especially in Germany. One does not wish to be permanently observed.

China and the USA may be ahead of the pack when it comes to big data and AI but Europe has not been idle. In the 2000s, for example, numerous research departments developed mobile service robots up to production readiness. They were intended to relieve the strain on employees, especially in monotonous and dangerous work, but commercial success was extremely moderate, partly because the robots had to be permanently controlled or monitored by humans. Today, thanks to advances in AI, their use is possible →



in a completely autonomous manner while, at the same time, much more powerful data networks are available to integrate the robots very closely into the retailers' merchandise management systems.

Europe is also countering by sponsoring projects, such as the EIT Digital program (<https://www.eitdigital.eu/>), which are then supplemented by national research projects. Everything is not as homogeneously organized as in China or the US – but the Europeans have learned to live with it and still somehow keep up. They are relying on the strong medium-sized companies that manufacture shelves and shopping trolleys to future-proof their products for IoT through networking and sensors.

## Europe's Race to Catch Up

In contrast to Amazon, which is aiming for a shop without staff, the Europeans want to relieve their employees of less productive activities in order to increase the value-add. Consequently, shop work is shifting. Small but time-consuming tasks, such as invoice printout, become



**AI is no better than a good employee, but it supports inexperienced staff members.**

**Frederic Kerber**  
Innovative Retail Laboratory



source ©: DFKI

superfluous with the use of smartphone apps, and the ability to use dynamic pricing ensures the timely sale of fresh produce. At the exit, self-checkout means only one cashier would be needed for supervision and information, allowing the others to devote time to other tasks.

Near Saarbrücken, technicians are researching the European answer to Amazon and Alibaba in the 500 sqm Innovative Retail Laboratory operated by the DFKI research institute (the German Research Center for Artificial Intelligence). The system is based on

sensors on product shelves which are connected to the AI in the office and back office. With German thoroughness, the researchers are looking at the entire purchasing process: from the planning at home using a smartphone, the walk to the store, the actual shopping, and finally the payment process. Everything should become more modern without scaring the customer.

Developing the system means working out the correct balance between technology and usability. "Retail is not only used by technology freaks, so as little as possible should change for the consumer to keep the learning curve flat," explains Frederic Kerber, head of the Innovative Retail Laboratory. "We use technology that is not yet available commercially, so we are always a step ahead of the market."

AI plays an important role in this shop of the future. "Take the fruit counter. If AI uses camera images to determine that a product is being put back again and again, then it may be spoiled. In such a case, the AI informs the staff to refill with fresh produce. The AI is no better than a good employee here, but it supports inexperienced staff and is always present so that employees can focus on other aspects, such as customer service," says Kerber.

### Take Your Pick

The smart fruit stand uses camera images to determine if a product is spoiled. AI informs the staff to refill the counter with fresh produce.



source ©: Deutsches Forschungszentrum für Künstliche Intelligenz GmbH, DFKI

## Outlook for AI

The DFKI project is financed by the German government and contributed to a recent report from the German Federal Ministry of Economics and Technology called *Perspektiven der Künstlichen Intelligenz für den Einzelhandel* (Prospects of AI in the Retail Trade). DFKI operates closely with other important EU states – after all, its base in the Saarland is located on the border between Germany, France, and Luxemburg, a stone's throw away from Belgium or even the Netherlands. The researchers working on this answer to Amazon's challenge are correspondingly international.

"Small businesses are slow to respond to new technologies, but →



# Competing Digitally

# TWIN INTERACTION



**D**igital twins can play a vital role in improving the customer experience by optimizing security implementation, in-store planning, and energy management. According to Challenge Advisory, a strategy consultancy, digital twins can play a significant role in enhancing customer service by designing a virtual model of customers. Growing and retaining a substantial customer base is essential to achieving success in retail. Digital twins can provide this by creating a unique customer experience, such as providing ideal fashion apparel products to customers based on their digital twin model. Digitization of products, although hardly revolutionary, can have a big impact on marketing segmentation

and the supply chain. The diminishment of in-store sales coinciding with the rise of online shopping and subscription services will cause major disruption to distribution. As a response to this retail companies will customize distribution to fit the consumer's pattern of interest. Characteristics of the supply chain would change from long-term-focused production plans to short-term production plans which are based on measurements of recent consumer demand. This would result in the expansion of marketing segmentation with a more precise focus on individuals. Digital twins can provide a copy of an actual product on the Internet which can be monitored, edited, and updated as the real physical

**A Better Fit**  
Digitization of products can have a big impact on marketing segmentation and the supply chain.

product goes through different stages of its life cycle. As products go from being manufactured to being consumed, digital twins will continue to develop as a product's identity evolves and eventually moves to its disposal.

By observing data from digital twins, you can work out what discounts have been applied, what products in certain instances have been added, which supply chains products have moved through, where they are currently located, and when the packaging was last updated. This creates a more efficient retail process for consumers while reducing marginal costs and allowing better-detailed analysis of data to improve the customer experience.

"In the competitive field of modern retail, companies should look to gain any competitive edge possible rather than just primarily competing on product or price. Digital twins will enable a much more personalized interaction which will work toward higher levels of satisfaction, engagement, and customer loyalty," says Carlos Miskinis, digital twin research expert at Challenge Advisory.

**Digital twins will enable much more personalized interaction.**

**Carlos Miskinis**  
Challenge Advisory



source ©: LinkedIn Corporation



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**Due to Covid, even retailers who only ever sold over the counter are now acquiring an online foothold.**

**Niels Will**  
DFKI

the Covid-19 pandemic has massively strengthened a trend among retailers that was already noticeable before. Even retailers who only ever sold over the counter are acquiring an additional online foothold and selling by post. During the shutdown, this was the only way to get money into the cash register at all in many industries,” says Niels Will, research assistant at DFKI and co-author of the study.

Small to medium-sized retailers, often family-owned for generations and specialized in a limited range of goods, have a long tradition and significant market power in Europe. Such shops deal in locally produced

food or tools and semifinished products for craftsmen or other tradesmen. Most of them sell high-priced goods that require a certain degree of advice. Mutual trust is crucial for the long-standing relationships between these traders and their customers. Such businesses have a number of employees, some branches, and a considerable customer base, all good prerequisites for making them fit for the future with a little extra know-how.

“We wanted to give small and medium-sized businesses a guide on how to integrate AI into their business. The very small retailer, the famous ‘mom and pop store,’ is probably simply too small for such projects but shops with maybe two or three branches that have a certain amount of local market power are interesting,” says Will. Two thirds of the shop owners interviewed by the researchers consider AI an important new technology, but only one third have any experience of it.

While Amazon is planning a major innovation push, Europeans are as down-to-earth as ever and typically address the small problems of everyday life. In the retail trade, personnel costs make up the lion’s share of the operating expenses incurred, up to

75 percent in some cases. Employees should therefore work as productively as possible and not be distracted by having to check for incorrectly or unclosed refrigerator doors, to search for goods that customers have left in the wrong place, or to look for gaps on the shelves – all of which are unnecessarily time-consuming.

This is where additional sensors and a central data acquisition system could help. Antennas scan for RFID tags attached to the goods and specifically alert employees to incorrectly placed goods; intelligent sales shelves automatically detect gaps appearing and order replenishment to ensure they are refilled as quickly as possible.

Germany’s software giant SAP has jumped on the bandwagon and is getting its Leonardo Retail Innovation Kits middleware ready for IoT. “Sensors account for only a third of the effort, the rest is middleware and processes. These must be learned and mastered,” reports Kerber. The new applications also enable retail companies to carry out predictive maintenance of all systems. To do this, they bundle not only the information from refrigerated counters and chests, but also the data from baking machines and electrical empty-container collectors. Repairs can be optimally planned and unforeseen breakdowns due to defective parts can be prevented. The software also compares a company’s branches with each other to detect outliers, such as detecting highly excessive energy costs, which may indicate incorrectly installed or aging refrigeration units.

**Keeping Track**

AI will bring a better understanding of processes to optimize the supply chain along the entire value chain – from the manufacturer to the wholesaler, the retailer, and finally to the end consumer.



source ©: SAP Deutschland SE & Co. KG

A further starting point for automation is the provisioning of goods in the store by AI-controlled autonomous vehicles. "Already today, there are automatically moving, low-level vehicles that can bring goods safely from the warehouse to the shelves. AI will optimize the routes and the positions of the goods in the storage area to ensure the fastest possible access," says Will. The smart shop's middleware independently ensures that goods needing to be replenished most quickly are located near the exit.

The DFKI researchers consider inadequate and undersized data sets to be one of the main obstacles to the successful introduction of AI and IoT in the retail trade, followed by insufficient competence in one's own business. Large amounts of data are required to train an AI system and this causes a number of medium-sized companies problems. Not all of them have a complete data set of sufficient volume. In addition, the researchers have found that data records are supplemented with information based on the owner's memory – often incorrectly.

Despite the need for large amounts of data, the computing power of the existing IT is usually sufficient to run the system. "More than an average PC is not necessary," explains Will.

## End of the Queue

The RFID tags widely used today are to be supplemented by NFC technology in the business of the future. Modern smartphones can read the RFID tags via NFC and this allows the customer to download additional information directly to their phone when deciding on a purchase. Buying will only require a command from the smartphone and this will make queuing at the checkout a thing of the past, much like at an Amazon store.

The researchers are thinking beyond this and want to put a digital twin of the store on the smartphone so that the customer can better plan and organize their next visit. "Then there is no need for long searches and im-

portant information about all the products appears on the customer's smartphone. For example, the customer could see at a glance which allergenic substances a food product contains," says Will.

Already implemented in some stores is digital screening of behavior on the shop floor. AI systems analyze the pose, dwell time, and viewing times of customers at specific shelves to optimize the sales area. These AI systems complement the evaluation of purchasing behavior by target groups and product category.

In the future, the smartphone apps of the customers or intelligent labels incorporating display screens on the shelves will provide references to products that are often bought with

### Right Connections

Smartphone apps of the customers or intelligent labels incorporating display screens on the shelves will provide references to products that are often bought with the customer's current purchase.

the customer's current purchase. This service could be sweetened for the customer by offering a discount, very similar to the bundles offered by mail-order companies.

The wholesaler Metro, one of the largest cash and carry operations in Europe, is experimenting with an app that provides information on prices, offers, and, above all, on the availability of goods. This is especially important in times of pandemics because wholesalers like Metro were unable to supply toilet paper for weeks and soap was available but subject to quotas.

The researchers warned that customers often find unsuitable offers a nuisance. Personalized advertising is only accepted by customers if the →





## Intelligent Stock Management

# THE NETWORKED SHELF

Empty shelves, masses of customers in the store, and no supplies in sight: the nightmare of every retailer. Customers are not very tolerant of so-called “out-of-stock situations,” as they can also purchase their products through other channels, for example online or in other stores, or switch to alternative products. Losses for manufacturers and retailers due to empty shelves, studies show, amount to around one billion euros per year in Europe alone.

To make empty shelves a thing of the past, Reply, an Italian IT developer, is offering an intelligent networked shelving system that provides fast and accurate inventory data. Through its subsidiary 4brands Reply, a specialist in the

optimization of business processes between companies and retailers, the company has created the “Connected Shelf” – an intelligent, fully networked shelf. In addition to reducing gaps in the shelf, the Connected Shelf opens up opportunities for stationary retail to target shoppers in a similar way to online retail and to generate new insights about shoppers.

Gaps in shelves can be prevented with intelligent monitoring tools, and inventory data is based on real-time stock levels on the shelf. In addition, reliable inventory forecasts are made possible with predictive analytics tools and cross- and up-selling potentials can be generated, and new shopper insights gained. By using IoT technologies, gaps

in the shelves can be detected before they occur, and countermeasures can be adopted early by moving products from storage to the shelves. Using the SAP HANA cloud platform, store managers are provided with a cockpit that displays current and imminent shelf gaps. This platform-as-a-service is used to process data in IoT scenarios. Here, too, the mass data is processed in real time. In this case, sensors report shelf withdrawals and replenishments. Prediction algorithms enable reliable forecasts for imminent shelf gaps. The information from the cockpit solution can also be integrated with an enterprise resource planning (ERP) system to optimize replenishment processes, the manufacturer states.

retailer follows rules. People interested in buying cheese and wine expect offers in the same area and not information about office supplies.

## Intelligent Dunning

Even payment reminders and order for payment procedures, called dunning, are to be made more efficient by AI. At present, these tasks are often still handled by mailing standardized letters. AI-based intelligent dunning procedures in the future will supplement the classic method and, for example, use digital channels to address debtors. The customer in question will be contacted by SMS, e-mail, or messaging apps in a proactive way and problems or open claims can be identified and processed at an early stage before they become critical. In this way, people are also reached preventively, where unwillingness to pay or lack of liquidity is not the reason for a delay in payment. With the help of AI, a management process can be provided that decides when, through which channel, and with what tonality a person should be addressed. The system also optimizes and identifies the optimal time for the first contact, as well as the most effective channel for different customer groups. Later on, AI will further support the service center in an ongoing dunning process, until the final stage where lawyers become involved.

Another major step will be the use of mobile robots to support the employees. Apart from acting autonomously within buildings to help replenish the goods, they could also be used to ensure continuous monitoring of the building, acting as AI-controlled guards. Equipped suitably, systems could use their sensors to detect unusual activity and trigger an alarm if necessary. Researchers suggest pan-tilt cameras could be used as well as passive infrared and additional radar sensors. The latter would detect movements of people over long distances and through walls. In addition, the robots could be equipped with laser scanners. The digital security guard would then

patrol autonomously within a self-generated map.

With the possibility of map-based navigation, targeted or intelligent routing can be realized. In addition, the robots would then be able to safely approach a loading station and thus guarantee 24-hour security monitoring. Systems like this that enable seamless integration of the robots into existing safety systems and concepts have a clear advantage. Should they be implemented, Europeans would be one step ahead of the competition.

This advantage also applies to another future scenario. The researchers in Saarbrücken want to use AI to coordinate the purchasing behavior of customers, under various weather and road conditions, with transport capacities. In this way, notoriously congested motorways could be relieved and empty runs minimized. At the moment, it is estimated that every third truck is driven empty through Central Europe, so any reduction would be an improvement.

## Trading Futures

Robots could also be used to automate pick and place processes by independently handling product

reshelving and sorting as well as for removing faulty or surplus goods and preparing them for return shipments. Such systems already work in the laboratory but they are still far too expensive and slow. The researchers' wish list also includes drones that monitor room temperature and humidity in large warehouses, record inventory levels, and detect packaging damage.

Scientists are striving toward complete transparency of the process chains and automatic detection of weak points. This is where optimization takes place. To this end, the entire logistics area, pallets, packages, and containers of loose goods would be equipped with sensors connected to the Internet of Things and the merchandise management system. In this way, AI would bring a better understanding of processes to optimize the supply chain along the entire value chain – from the manufacturer to the wholesaler, the retailer, and finally to the end consumer. Forwarding agencies and parcel services providers should also be included, but that will only happen if an international standard for data exchange between the various trades can be agreed and implemented.

### Moving Around

Mobile robots will work autonomously within buildings to help replenish stocks, but they could also ensure continuous monitoring of the building, in effect acting as AI-controlled watchguards.





## Compliance Certification

# CONTROL IS BETTER

The right security and privacy safeguards can help businesses realize the potential of IoT but **how do companies know if their privacy and security safeguards are sufficient?** IoT compliance certifications can help as standards evolve.

■ By Oliver Schonschek

The majority of US executives consulted by the accountancy firm PricewaterhouseCoopers (PwC) said their businesses already have one or more IoT projects in the works – but not without trepidation. The annual PwC 2019 IoT Survey shows that 48 percent worry about cybersecurity issues and 46 percent have privacy concerns, while 45 percent claim an uncertain regulatory environment has slowed or thwarted their IoT progress. It's clear that decision makers need to feel they can have trust in IoT's data being accurate and secure.

Can decision makers really trust in IoT solutions? As Lenin famously said, "Trust is good, but control is better." To help organizations get a better understanding of IoT activity and security in the enterprise, the ThreatLabZ research team from the security provider Zscaler analyzed IoT traffic across the Zscaler cloud during a one-month period.

The report, titled *IoT in the Enterprise: An Analysis of Traffic and Threats*, showed that the vast majority of IoT transactions were occurring over plain text channels, instead of using the encrypted Secure Sockets Layer (SSL) protocol. While a major security vulnerability, the use of unsecured channels is just one vulnerability within IoT devices.

### Holistic Standards

"A major challenge in defining security measures for IoT is the entailed complexity that is brought by the diversity of application areas for IoT," says ENISA, the European Union Agency for Cybersecurity.

At the end of 2018, an ENISA analysis, called *IoT Security Standards Gap Analysis*, mapped existing standards against the requirements of security and privacy in IoT. Its conclusion was that there was no significant gap; every requirement could be met by existing standards.

Security standards may exist for many individual elements within IoT but it's not just a collection of individual devices and services, ➔

## The Internet Society's IoT Trust Framework

### Core Requirements

The Internet Society's IoT Trust Framework identifies the core requirements manufacturers, service providers, distributors and purchasers, and policy makers need to understand, assess, and embrace for effective security and privacy. It covers security, privacy, and long-term sustainability (life cycle) issues and it holistically addresses the ecosystem. This includes devices and sensors, mobile apps, and backend services.

Most frameworks focus on just the devices but a system is only as strong as its weakest link, says the Internet Society.

- The Internet Society is a global, cause-driven organization, governed by a diverse board of trustees, dedicated to ensuring that the Internet stays open, transparent, and defined by the users.



# Internet Society

source ©: Internet Society

## The ETSI TS 103 645 Standard

### Security Baseline

The ETSI Technical Committee on Cybersecurity released ETSI TS 103 645, a standard for cybersecurity in IoT, to establish a security baseline for Internet-connected consumer products and to provide a basis for future IoT certification schemes. As more devices in the home are being hooked up to the Internet, cybersecurity is becoming a growing concern. People entrust their personal data to an increasing number of connected devices and online services. In addition, everyday products and appliances are now coming online and need to be designed to withstand cyber threats. Poorly secured products threaten consumer privacy and some devices are exploited to launch large-scale DDoS

cyberattacks. ETSI's new specification addresses this issue and specifies high-level provisions for the security of Internet-connected consumer devices and their associated services. IoT products in scope include connected children's toys and baby monitors; connected safety-relevant products, such as smoke detectors and door locks; smart cameras; TVs and speakers; wearable health trackers; connected home automation and alarm systems; and connected appliances, including washing machines and fridges.

- ETSI is a standardization body for information and communication technology (ICT) standards.



## World Class Standards

source ©: Internet Society

## GSMA IoT Security Guidelines

### Flexible Framework

The GSMA IoT Security Assessment provides a flexible framework that addresses the diversity of the IoT market, enabling companies to build secure IoT devices and solutions. The requirements are laid out in the organization's IoT Security Guidelines, a comprehensive set of best practices which promote the secure end-to-end design, development, and deployment of IoT solutions.

Building on the expertise of the mobile industry, the security

assessment scheme ensures "security by design" and enables companies to identify and mitigate any potential security gaps in their services, allowing the market to scale to its full potential, according to the GSMA.

A number of security labs are offering the IoT Security Assessment as a personal service, providing IoT security capability to a wide range of companies that require unbiased third-party certification. These services can also help companies without the necessary resources or expertise to complete an assessment and test their IoT solutions to ensure end-to-end security.

- GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with almost 400 companies in the broader mobile ecosystem.



source ©: GSMA

## IoT Security Framework from the IoT Security Foundation



source ©: Secura

### Testing Guide

As a member of the IoT Security Foundation, Dutch consultancy Secura offers an assessment of IoT products' security compliance. Secura bases its evaluations on the internationally recognized framework from the IoT Security Foundation but, as an active standards-development member of other recognized cybersecurity organizations, it complements this with other schemas. These include the Internet Society's Online Trust Alliance's IoT Frame

work, the GSMA IoT Guidelines and Assessment, and the OWASP Foundation IoT Project Testing Guide. After each evaluation, Secura collates the results into an Assurance Report, which complies with internationally recognized assurance standards, such as ISAE 3000.

- Secura is an independent, specialized advisor, providing security advice, testing, training, and certification services.

## CTIA IoT Cybersecurity Certification Test Plan

### Levels of Sophistication

CTIA manages a cybersecurity certification program for IoT devices, establishing an industry baseline for device security on wireless networks. The IoT Cybersecurity Certification Test Plan supports a variety of implementations and levels of device sophistication.

The program is designed to improve security for connected devices. It helps to protect consumers and wireless

infrastructure while creating a more secure foundation for smart cities, connected cars, mobile health (mHealth), and other IoT applications, in addition to encouraging growth in the IoT marketplace. The creation of an IoT security baseline also addresses a growing global concern over potential cybersecurity issues and policy implications related to IoT. While the certification

covers a wide range of requirements, CTIA's clients can also receive assistance with additional specifications and tests to satisfy their specific security requirements.

- CTIA is a trade association representing the US wireless communications industry.



source ©: CTIA

## BSI Assurance Service for IoT Connected Devices



source ©: The British Standards Institution

### Comprehensive Assurance

The British Standards Institution (BSI) provides a comprehensive assurance service for IoT connected devices. It applies some of the latest best practices, including the ETSI (European Telecommunications Standards Institute) technical specification for consumer IoT security, ETSI TS 103 645. This builds on the UK government's Code of Practice for IoT Security and the Future, which addresses the cybersecurity of consumer IoT devices.

- BSI is a global service provider for standards development, training, auditing, and certification.



## TÜV Rheinland Protected Privacy Certification

### ■ Network Evaluation

TÜV Rheinland has developed its Protected Privacy certification in-house. The data protection and information security test program focuses on hardware and firmware, and how they communicate with the outside world. The set of audits examine both important formal data protection and the implementation of technical and organizational measures to protect personal data. This includes, for example, evaluation of the network architecture, the service, and access management. On passing the tests, product owners receive a certificate which can be shown to customers to demonstrate that the service satisfies the requirements of TÜV Rheinland and provides protection for the customers' personal data.

- TÜV Rheinland AG is an international, independent testing service provider based in Cologne, Germany.



source ©: TÜV Rheinland

## Eurosmart IoT Certification Scheme

### ■ Security by Design

Eurosmart devised the first IoT certification scheme based on the requirements of the EU Cybersecurity Act. Eurosmart describes the scheme as follows: "The scope of the Eurosmart IoT Security Certification Scheme (Eurosmart, 2019) is the 'IoT device' with a focus on the substantial security assurance level as defined by the Cybersecurity Act."

The certification aims to minimize the risks of successful attacks that commonly take advantage of poor design in IoT devices, which can have severe consequences. It is vital that IoT devices have security designed in and

verified from the outset. Low-end IoT devices, in particular, may have security features constrained by cost, processing power, size, or power source. Eurosmart's certification scheme considers the trade-off between such constraints, the risks, and the cost of certification.

- Eurosmart is a digital security trade association which advocates a strong and comprehensive approach to strengthen cyber resilience. Eurosmart funded the first European ethical hacking group on hardware devices.

## TÜV Trust IT Test Catalog for Evaluation of IoT Devices

### ■ Independent Evaluation

TÜV Trust IT and the German Research Center for Artificial Intelligence have developed a test catalog that allows for an independent and objective evaluation of IoT devices. After passing the assessment and certification process, the product owner can use the test and quality seal: TÜV Trust IT: Trusted IoT Device.

- TÜV Trust IT, part of TÜV Austria Group, is dedicated to the identification and assessment of IT risks, and certification.



source ©: TÜV Austria Group

it's an ecosystem. In addition, IoT's high scalability and other features call for a more flexible approach, says ENISA. The real gap in IoT security standards stems from the fact that the ecosystem is not treated holistically.

The current situation means that it's possible to introduce a device that can authenticate its user, can encrypt and decrypt data transmitted and received, and can therefore provide proof of its integrity, yet it still remains unsecure as part of the wider IoT ecosystem.

ENISA points out that elements of a holistic approach toward IoT security can be found in some series of standards, but further work in standardization is needed to achieve an overarching approach that protects the entire ecosystem.

The overall purpose of IoT standards is to provide interoperability and to instill confidence. To satisfy both, standards should be used when developing technical specifications for all products that also provide a framework for the security evaluation of complete systems.

Both are needed for a successful IoT, for reliable functionality, and for trust in IoT. Certification schemes are particularly needed because they increase consumer trust and open up new business opportunities.

### Certification Is Evolving but More Work Is Needed

Cybersecurity and privacy certifications require the formal evaluation of products, services, and processes against a defined set of criteria and standards by an independent and accredited body, and the issuing of a certificate indicating conformance. There are already several cybersecurity and privacy certifications for IoT standards and frameworks but there is still a need for international harmonization. Only when that is achieved will the needed trust in IoT be won internationally on a broad scale. To be prepared, it helps to examine examples which point the way toward more holistic approaches for certification.





## Data Exchange Standards

# WIRELESS WARS

IoT is all about connecting things and enabling them to communicate, but **communication is only possible when standards exist** for the exchange. Currently, several systems are fighting for supremacy. Can we expect a common language for IoT?

■ By Rainer Claassen

**T**o enable verbal communication on a more than basic level, a common language is needed. Even if there is one, the chances of misunderstandings are very high. It's no different in technology. It has become rather simple and inexpensive to enable all kinds of "things" to communicate but there has to be an infrastructure that is able to "hear" them, to understand what they are saying, and to transfer the important results to the places they are required – and to talk back when action is necessary. Currently, many different standards are used in general IoT and industrial IoT applications, including home and building automation, and mobility services. The range of things that can be involved makes it clear that requirements vary vastly. For example, a sensor installed in a freight container should be able to communicate even in the remotest areas – but usually it will be sufficient if it reports its location only once a day. Conversely, for a sensor reporting the conditions of a machine in a factory there is no need for long-range connectivity – but a lot of data may be involved and the information will probably be time-sensitive.

Many other aspects have to be considered, such as expenses, scalability, reliability, energy consumption, lifespan, the possibility of updates, and, of course, data security.

### LPWAN – One Name, Many Standards

The technology most commonly used to connect IoT devices wirelessly is known as LPWAN (low-power, wide-area network). The name is self-explanatory – but it is not a standard. The two most well-known names under which LPWAN technology is marketed are Sigfox and LoRa. Lately, Mioty, a German development from Fraunhofer, has gained importance, while other players, like Weightless and Ingenu, so far have not fulfilled the hopes invested in them.

To use the license-free LPWAN networks, new dedicated wireless infrastructure has to be built. As the frequencies that are used are shared, the risk of interference, from Wi-Fi, for example, is rather high. And in many areas, including the EU, there are regulations governing its usage. Also, the maximum amount of data that can be transmitted for upload and download is limited.

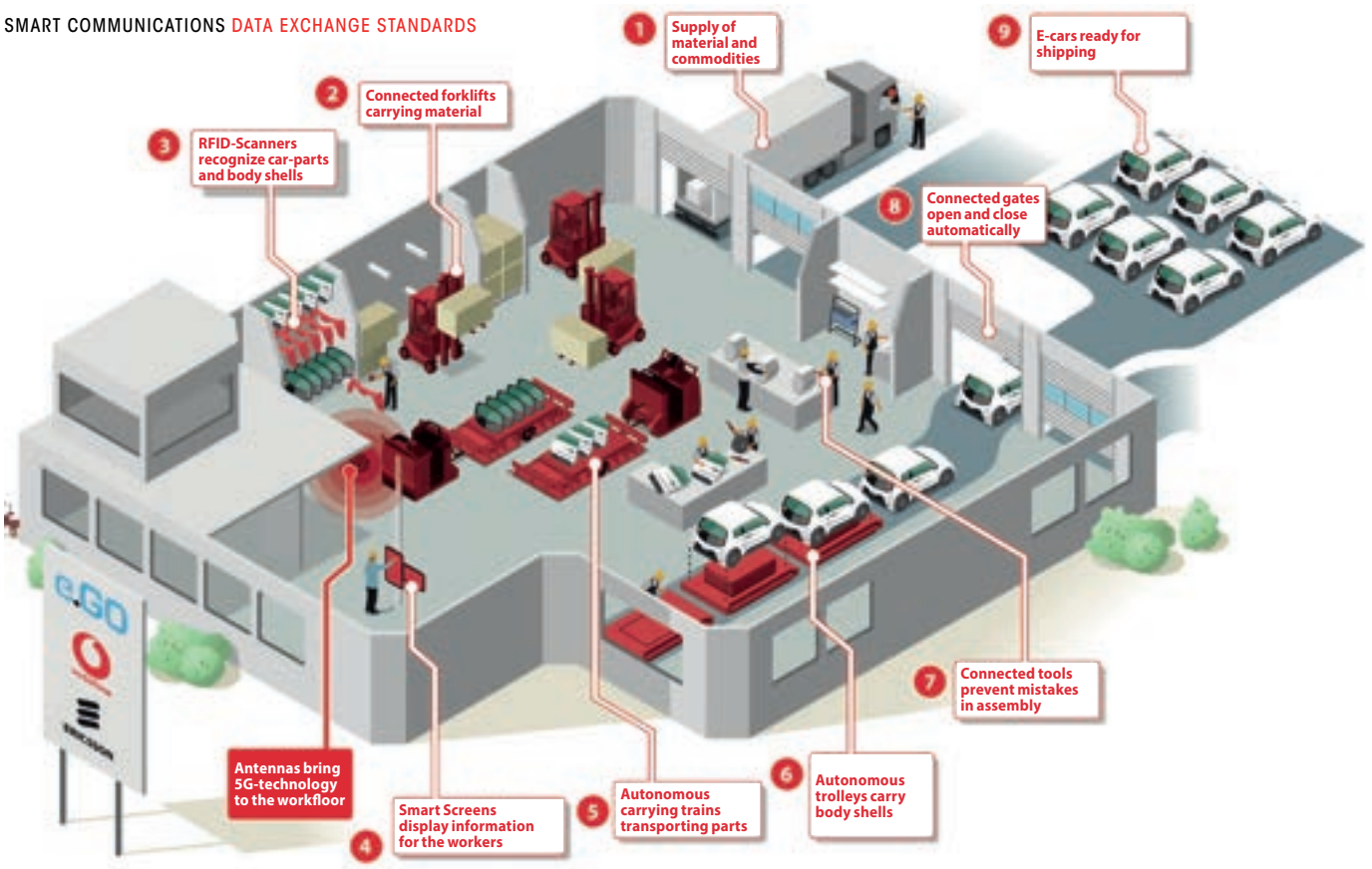
On the positive side, LPWAN ecosystems are quite accessible. Organizations may build their own, customized infrastructure in areas where there is a lack of coverage – or have one built by a contractor. Reliable coverage can also be achieved in remote areas or deep within buildings. All this is possible with small and cheap sensors that consume little power. Online statistics portal Statista.com expects that the global number of LPWAN devices →



With LoRaWAN, entire cities or countries can be covered with a few base stations, no longer requiring the upfront rollout and maintenance of nodes as in traditional mesh networking.

**Olivier Hersent**

Chairman and CTO of solution provider Actility



source ©: Vodafone

**The Factory that Does It All by Itself**

e.GO Mobile in Aachen is the first manufacturer to integrate a Vodafone 5G-based infrastructure into automobile production. Materials are identified automatically after delivery via RFID interface and directed to the vehicles under production.



source ©: Mobile Marketing



source ©: Mobile Marketing



The vast majority of IoT applications are viable on currently available technology. Implement it correctly and you'll be ready to transition to 5G once its coverage is more ubiquitous and hardware is more affordable.

**Mirko Benetti and John Candish**  
SAP Digital Interconnect

will reach around 3.4 billion by 2021. The most important reasons for the success of LPWAN are:

- Long geographical range: devices are designed for wireless data transport over distances in the range of kilometers
- Nonconstant transport of small amounts of data
- Battery life of several years with little power consumption

**Cellular Technology**

LTE-M and Narrowband IoT (NB-IoT) are competing with LPWAN for the high ground. These two use the licensed spectrum of cellular technology from existing telecommunication infrastructure, so the frequency bands are owned by the operators. This means there is low interference but the ecosystems are closed – you have to partner with one or more operators to make use of the cellular technology. The main advantages of LPWAN have caused traditional cellular operators to try to catch up. LTE-M is one response to the success of LPWAN, put forward by standards developer 3GPP (Third Generation Partnership Project). It is used as an addition to standard LTE connectivity while preserving resources. NB-IoT is also a 3GPP construct concurring with LPWAN technology but using a subset of the LTE standard

of 5G use in industry, the IoT penetration is said to be superior to LTE-M. NB-IoT is well suited to static assets like smart meters while LTE-M has benefits in roaming applications such as transportation. US service providers tend to push LTE-M because they have invested heavily in LTE technology; the rest of the world is more likely to prefer NB-IoT since GSM is often the norm. Traditional cellular options like 4G and LTE networks consume much power and they don't fit well with applications where only a small amount of data is transmitted infrequently. This is where 5G will probably turn out to be a big game-changer.

**5G Is Arriving**

The new cellular standard 5G is being deployed in an increasing number of countries. It is the first cellular network technology that was designed with IoT applications in mind. Advantages of 5G for consumers – like higher connection speeds and greater capacity – do not play an important role for most IoT cases. Compared to former standards, the power usage can be very low, correcting a disadvantage of current cellular IoT solutions. This can result in smaller batteries or longer battery life – very important for IoT and connected devices. 5G has only started to roll out and it is still unlikely to be ready for many IoT

use cases at the moment. Infrastructure, devices, and system integration are still under development. Mirko Benetti and John Candish, both executives at SAP Digital Interconnect, make a clear statement on the blog IoT For All: "The vast majority of IoT applications are viable on currently available technology. Implement it correctly

and you'll be ready to transition to 5G once its coverage is more ubiquitous and hardware is more affordable."

### No War!

With the rapid growth of IoT, there is currently enough space for all these technologies. Although it is likely that 5G will revolutionize the market, this

will probably be the result of a long skirmish than a short battle. While the different players will try initially to gain advantages over each other, we will see a time when anyone who can speak the "languages" of all the parties involved in this struggle will, ultimately, have the best chance to stand on the winner's side.

## Interview



source ©: Sigfox

around the globe. Another example is the tracking of large portions of the supply chain of the French automotive group PSA – but we are also active in the area of smart buildings.

### How can companies that want to gain experience with tracking technology start deploying your technology?

It does not make much sense to get involved just because it's possible. First, you must find out which problems – for example in the supply chain – really bother you and then develop a tracking solution. We work with partners who are experienced in different industries, who can offer a fitting solution at reasonable cost. Our so-called Bubble device, a beaconing solution offering indoor and outdoor

geo-positioning with one to ten meter accuracy, is available for less than €5. A really basic entry may be made with an investment of less than €1,500 – but, in most cases, an individual solution will be necessary and the cost for this may vary strongly.

### Do you expect the introduction of 5G to roll up the whole market?

5G will be an important supplement to the technologies that are currently in use. Its advantages lie in areas where large amounts of data have to be transferred in real time. The strength of our technology lies in a completely different area – and that is true for many other competitors as well. I don't see a reason why the technologies should not coexist for a long time.

### No Touch Needed

Sigfox has launched a proximity detection service via a device called the "Bubble" that allows users to detect the presence of nearby assets without any actual physical contact.

### Interview with Klaus Hoffmann, Key Account Manager at Sigfox, Germany

#### What are the goals of Sigfox?

We want to establish a globally unified wireless network – we have already deployed it in more than 70 countries, with priorities in Europe, Asia, and South America, so far.

#### Which projects demonstrate the potential of Sigfox technology the best?

Within six months, we have retrofitted all 250,000 DHL trolleys with trackers. The company can now track and trace all these containers in remote places



source ©: Sigfox



## Data Ownership

# YOUR DEVICE. YOUR DATA?

Greater openness across IoT data ecosystems will result in **a broader range of services being offered to end users.**

■ By Stian Overdahl

**W**ho owns IoT data? It's a question at the heart of the modern data economy. At its most fundamental, and from a legal standpoint, data can only be owned once they are gathered into a database or platform. "As a thumb rule, whoever owns the title to the data processing platform owns the data," says Somjit Amrit, country head at AM Technologies. But just as important as outright ownership are data privacy, security, and subject data rights and access.

Data ownership can play out very differently in individual applications, while there are also broad distinctions across consumer and commercial use cases. Meanwhile, in instances where equipment is leased, data ownership will typically be determined by a contractual clause.

## Different Types of Data

Types of data matter too: personal data is a special case, especially since the introduction of the European Union's General Data Protection Regulation (GDPR) in 2018, which granted individuals robust data rights, including portability and the right to deletion. The situation is made more complex by techniques such as data anonymization, de-identification, or aggregation, whereby an organization may want to store and use data in a form untraceable to individuals.

However such approaches are controversial, given that it has been demonstrated that in some cases "anonymized" data can be traced to an individual using just a handful of data points.

Given that an IoT ecosystem will often have multiple stakeholders, including manufacturers, end users, third party solutions providers, and even the public sector, often the situation can best be characterized as "give and take" says Amrit. "Data could be owned by the owner of the data processing platform, but it could be shared with the ecosystem in exchange of discounts, incentives, or the price to be paid for curating



source ©: IQ Data Group Limited

the raw data into processed and usable data to generate insights," he says.

As data become more valuable, organizations are having to invest more in the asset, as well as facing increased scrutiny from the public and regulators. But it wasn't always this way. When computing power was emerging among corporations, many companies saw data as a poor relation to hardware and software, which were considered to be the tangible assets, observes Fedelma Good, a director in PwC UK's Data Protection Strategy, Law, and Compliance Services team. But that is changing, she believes, as elements of the GDPR, especially transparency and accountability, force companies to be more circumspect about how they gather and store data, while incurring greater costs to ensure compliance. "The [next stage] will be



**The next stage will be when we get to a way that you can assign a real value to data in the context of an organization.**

**Fedelma Good**

PwC Data Protection Strategy Team

when we get to a way that you can assign a real value to data in the context of an organization. And we have it to a certain extent already in goodwill. I still think that what is missing is an element about the quality of the assets and the lifespan of the asset, which becomes even more important with GDPR," she says.

## Conflicts of Interest

Just as fundamental as questions about ownership are questions about access. The classic example is of an IoT device – say a construction machine or a car – that generates large volumes of data, but within a closed ecosystem which only the manufacturer can access to deliver services such as telematics. That means any third-party solutions providers may have to install additional hardware if they want to provide services. This situation is especially acute in commercial operations where a company runs a large vehicle or machinery fleet with multiple brands. In some cases they will be forced to rely on multiple telematics systems or use additional hardware in order to view their fleet data via a single ERP. Those in the industry note that the interests of original equipment manufacturers (OEMs) and purchasers are often not aligned: the OEM wants to maintain a closed ecosystem where they alone can provide services, while the owner wants freedom to choose their service providers. →

### Rule of Law

Privacy laws such as Europe's GDPR will force companies to pay more attention to how they gather and store data.





**Closed Shop**

OEMs often want to maintain closed ecosystems where they alone can provide services.

Closed ecosystems point to the importance to OEMs of maintaining long-term relationships with equipment buyers, especially given the revenue and profits generated by maintenance and spare parts. It's also a way for OEMs to differentiate their product, says Lasse Paakkola, managing director at Aplicom, a telematics device manufacturer and developer. "When products get more similar, the only thing that differentiates them is services, and for telematics these are an important platform for providing customer satisfaction."

Even then, the line between what constitutes an open or closed ecosystem may be blurry. Take the example of heavy commercial vehicles, where in Europe most comply with the Fleet Management Standard (FMS), an open system. But in order to access onboard data

**“**  
**The trend is toward greater openness, though there is significant variation between industries.**

**Hendrik Nieweg**  
 Device Insight



source ©: XING | NewWork SE

ing manufacturers unable to recoup their costs.

Nevertheless, the overall trend is toward greater openness, though there is significant variation between industries. Within the agricultural sector, where the typical use case is a machine using an implement from a different manufacturer, the industry has developed open data standards, says Nieweg. Contrastingly, the construction equipment market is largely comprised of closed ecosystems, though that may change in the future, with organizations such as the Mechanical Engineering Industry Association (VDMA) in Germany in the process of developing global standards for worksite interoperability.

The automotive sector has become increasingly open over the last five years, says Dr. Ben Miners, chief innovation scientist at IMS, part of Trak Global Group, which offers telematics and insurance products. He notes that for a company like IMS, being able to deliver solutions to a full fleet requires a range of technical approaches, including normalizing onboard data and installation of additional hardware. But onboard data is becoming more available and more standardized. In the longer term, there may also be demand from governments to use telemetry data to price transportation or roads costs, he says. "This is primarily driven by governments, and so may actually drive standard-

a fleet owner may have to purchase a gateway that can cost as much as €500 per vehicle, which may be more expensive than simply installing additional third-party sensors to use in a telematics system, notes Paakkola.

Hendrik Nieweg, VP of Solutions at Device Insight, an IoT specialist, sees numerous reasons why OEMs may want to use closed systems, including retaining control over the platform to offer services to end users, and ensuring that the services offered are high quality. A significant reason too is the huge investments that companies must make in developing data platforms, and the potential additional costs that could come from making systems open. The fear is that if the systems were entirely open it would allow start-ups or other players to profit by offering their own services, leav-

**“**  
**When products get more similar, the only thing that differentiates them is services.**

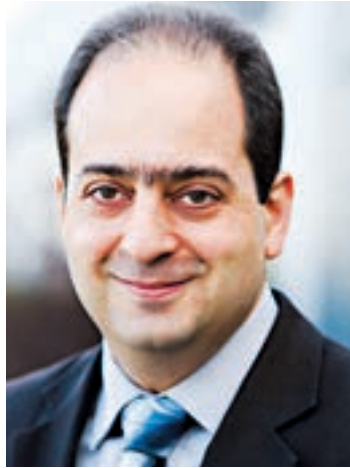
**Lasse Paakkola**  
 Aplicom



source ©: Aplicom Oy



ization faster than privately driven fleet and insurance programs,” says Miners. Nevertheless, even greater openness doesn’t entirely remove the need for the use of additional hardware, for example in the case of older vehicles, or for applications such as insurance where more precise data can be received by using fitted sensors, he notes.



source ©: Fleet World



**Onboard data is becoming more available and more standardized.**

**Dr. Ben Miners**  
Trak Global Group

open up the industry to a broader group of companies, resulting in new products and services for end users. “Already we are seeing that companies which have no experience with car data are interested now that it’s possible to digitally retrieve data via a single API. Of course it will be even more usable when there are more OEMs on board,” says Scheibel.

### Off-Board Data Access

The development of neutral servers may also herald an era of greater openness in the automotive data market, ultimately resulting in enhanced services for drivers. High Mobility, a neutral server and data marketplace based in Germany, allows third-party applications to source vehicle data via an application programming interface (API), allowing off-board data access to the extended vehicle interfaces (ExVe) of the OEM. It currently has contracts with Mercedes-Benz, MINI, and BMW, but plans to add an

additional three to five OEMs by the end of 2020, says Manuel Scheibel, the company’s director of sales and business development. Charging for data access brings revenue to car companies: in most cases automakers are open to working with neutral servers, it’s just a question of technical maturity rather than fearing an open data marketplace, he says. As they add additional brands, meaning wider coverage of the total vehicle fleet, he’s expecting they will see a marked increase in clients, and believes API access will also



**For most auto-makers, working with neutral servers is a question of technical maturity.**

**Manuel Scheibel**  
High Mobility



source ©: The Car Data Company

## Insuring Databases



### Cyber Insurance

In *Fight Club*, a popular movie from 1999, the protagonist uses explosives to destroy bank records in a bid to erase records of debt, an attack that would have been devastating for business. These days the threat is no longer fictional, but is more likely to come via a cyberattack. In the United States, a handful of medical clinics have seen their databases – including patient records – deleted as a

consequence of ransomware attacks. In one case, two elderly doctors decided to speed up their retirement after their clinic had all its files deleted. This is the realm where cyber insurance could make a difference – whether to provide specialist help in the case of a ransomware attack or hack, or to pay out to a company for data and software reconstruction and business interruption costs. Yet while cyber risk insurance is one of the fastest-growing areas in the insurance market, it’s also one of the most complex. It suffers from a lack of reliable data due to the newness of the field and the rapidly evolving set of threats that companies face, explain Steve Whelan and Eduard Alpin of Verisk, a data analytics and risk assessment company. Limited past events and a plethora of “unknown unknowns” is bad news for a sector that relies on data to make predictions about future events and price that risk accordingly. Insurers are pricing their premiums to make the sector attractive from their standpoint, but also pricing in that uncertainty. The worst-case scenario would be some kind of mass event affecting many of their clients at the same time.

The means most cyber insurers will cap or limit their exposure to very large companies, building towers with different layers of coverage. And while a Fortune 100 company may be able to obtain coverage from multiple insurers, it’s unlikely a company will be able to receive multi-billion dollar coverage commensurate with potential losses if they were to suffer a devastating attack that destroyed their database. “There’s been a challenge for a lot of these Fortune 100 companies where they can’t get enough cyber insurance limit,” explains Alpin.

That means that frontline defenses, cloud backups, and secure backups of those backups are the order of the day to protect data and databases.

## Connectivity

# FROM BABY STEPS TO GIANT STRIDES

IoT connectivity is growing by leaps and bounds, promising amazing changes ahead. Experience is rapidly bearing out the predicted trend of **a stunning number of “smart” devices appearing in businesses, at home, and in the public sphere.** Despite the scale of growth, or because of it, predicting change can be difficult.

■ By Alan Earls



We are the ones who stir things up to construct something better.

**Jayanti Katariya**  
CEO, Moon Technolabs



source ©: Moon Technolabs Pvt. Ltd.

**A**s the Internet of Things reshapes process industries, speeds and strengthens the creation of drugs and biologicals, and further refines manufacturing, transportation, and almost every aspect of daily life, one of the aspects that will ultimately be most significant is simply related to scale. The coming wave of sensors, controls, actuators will flow into every aspect of life and, when married to artificial intelligence (AI) and machine learning, is destined to be transformative.

The future of IoT springs from human curiosity and restlessness, according to Jayanti Katariya, the founder and CEO of Moon Technolabs, based in Ahmedabad, India. We are the ones, he says, who stir things up to construct “something better.” Smart devices form one such construct, each one designed to help us “catch and use” all the information that surrounds us daily. As this trend continues, the result will rocket beyond the changes wrought by PCs and cell phones and lead us toward “associated vehicles, shrewd homes, associated wearables, keen urban communities and associated medicinal services; essentially an associated life,” he predicts.

Certainly, IoT growth is becoming explosive, according to figures from market researcher IoT Analytics:

- The number of IoT devices in use has grown from four billion →

source ©: University of Advancing Technology



**IoT will be used in ways not yet imagined.**

**Dave Bolman**  
University of Advancing Technology

and unobtrusive, and will be used in ways not yet imagined. That's particularly true when IoT is combined with cloud and artificial intelligence technologies, potentially offering insights into nature, cities, and human behavior in real time and "much more nuanced than what has ever been available before."

This model of ubiquitous IoT technology could help us navigate and solve the current Covid-19 pandemic and future pandemics, Bolman conveys. "With the use of IoT, the

need for critical medical and sanitation supplies could be anticipated and routed in a much more nuanced way," he continues. "The result is that what is needed gets to where it is needed – just when it is needed."

### Applications and Opportunities

Similarly, the puzzle of contact tracing could be solved using an IoT network of devices. Gathering ongoing micro information about human interactions, infections, and other related factors allows IoT plus AI technologies to identify patterns drawn from what we are learning about pandemics. "Knowing these patterns in focused and early ways provides a completely new way for health officials to use IoT to anticipate the direction of outbreaks and respond early before they grow," Bolman adds.

Alyssa Simpson Rochwerger, vice president of data and AI at Appen, a data and video annotation company based in New South Wales, Australia, points out that one of the most visible adaptations spawned



**I expect further investments in robotic automation, big and small.**

**Alyssa Simpson Rochwerger**  
Vice president of data, Appen



source ©: Silicon Valley Forum

in 2015 to eight or nine billion worldwide today

- The growth trajectory is heading toward 22 billion devices in 2025

Dave Bolman, provost at the University of Advancing Technology in Tempe, Arizona, comments: "I would place IoT alongside the Internet and streaming media for the role it will play in disrupting existing approaches and providing positive new solutions."

He adds that IoT devices are becoming powerful, low-cost, connected,

## Haptic Interactions

# TACTILE IOT

Among the trendiest topics in IoT these days is "tactile IoT." The idea is to use robotic hardware, sensors, and actuators to allow operators to perform manual tasks at a distance or in unsafe environments. Although not an actual application of tactile IoT, telesurgery shows the

same kind of thinking by allowing surgeons to perform operations remotely by manipulating robotic arms.

According to a section of a report, titled *The Next Generation Internet of Things – Hyperconnectivity*, from the European Research Cluster, the

key to implementing tactile IoT will be ultra-low latency, highly reliable and highly available computing with "haptic" interactions. Haptic refers to a technology that can use vibration and movement to remotely simulate and stimulate the human ability to perceive through the tactile sense.

The authors of the report suggest that this additional dimension of interaction with humans – allowing people to "feel" – will lead to new IoT uses and improve existing ones, including training or working with robots. The vital enabling technology, they say, will be the widespread availability of the greatly increased bandwidth of 5G in the near future.

source ©: Domino's Pizza, Inc.



### Help from Above

Flirley is an independent drone delivery service that works with NASA and the Johns Hopkins University of Medicine to conduct deliveries of medicine to rural health-care clinics, ship-to-shore deliveries of medical samples, and deliveries of retail and e-commerce items to consumer homes.

operations, as its assets are aging at a time when its expert technicians were retiring and there was a short-fall in skilled labor to replace them," says Raghavan. This issue was compounded by the fact that JR-E's operational budget was under pressure with shrinking revenues due to the population dynamics in Japan. Working with PARC, JR-E was able to deploy algorithms using a hybrid physics-with-AI model rapidly on their commuter train systems to help them make sense of their →

by Covid-19 is the sudden rise of IoT-powered contactless delivery as restaurants and stores get more creative delivering goods to customers with as little human contact as possible. "I would expect further investments in robotic automation, big and small, from companies like Domino's," she says. "Likewise, autonomous delivery services, like [robotics specialist] Nuro, could also see an uptick in business, possibly even beyond food delivery, to enterprise transport use cases like supply

chain and inventory management." Most of IoT's growth predates Covid-19 and will continue long after it is just a memory. Ajay Raghavan, strategic execution director for the Systems Sciences Laboratory at Xerox Palo Alto Research Center (PARC), says his organization has been focusing on IoT and AI and has had a long and ongoing relationship with East Japan Railway (JR-E) to develop AI for predictive maintenance. "There was a huge opportunity to streamline its train



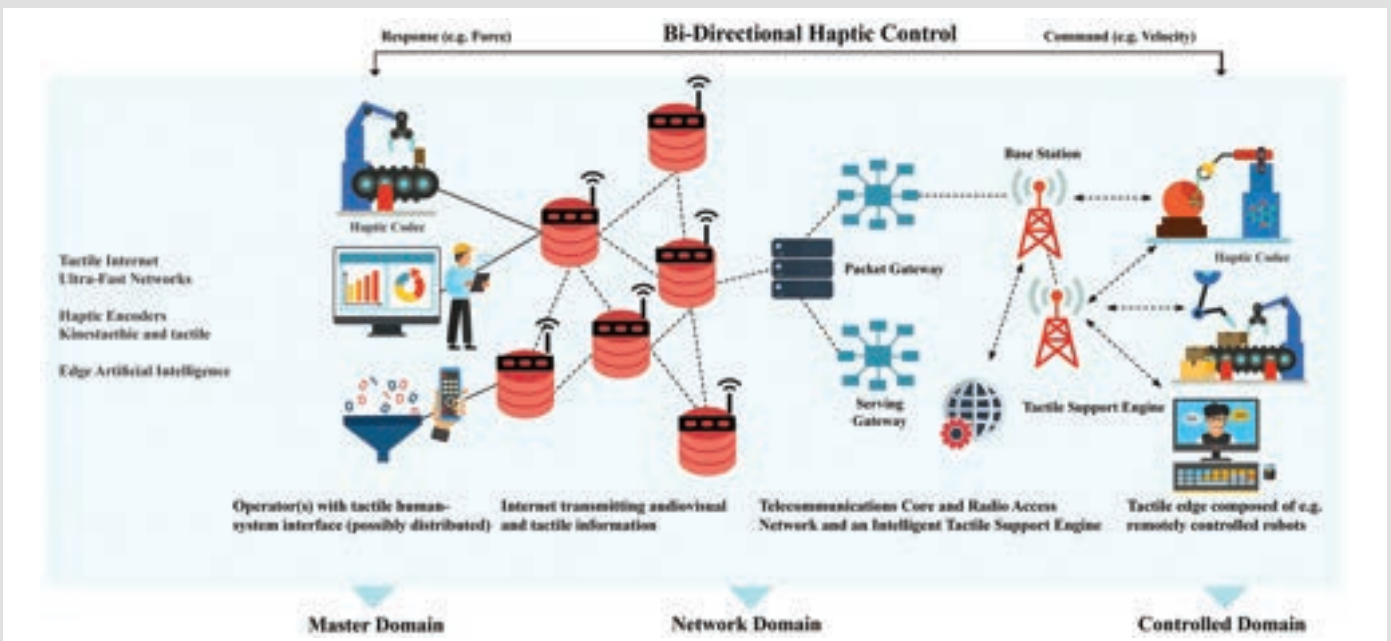
Assets were aging at a time when its expert technicians were retiring.

Ajay Raghavan  
Xerox Systems Science Lab



source ©: CIO Techie

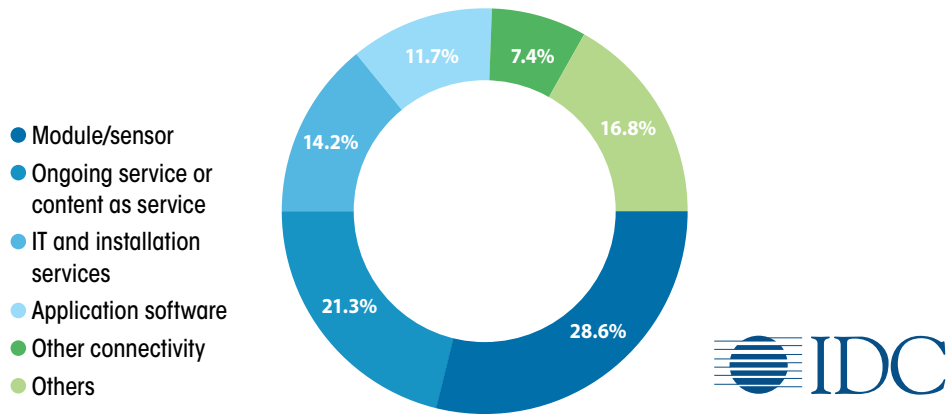
source ©: IERC Cluster SRMA 2018



# IoT SET TO REBOUND QUICKLY BIG SPENDERS

According to market intelligence firm International Data Corporation (IDC), worldwide spending on the Internet of Things (IoT) has been slowed by the Covid-19 pandemic, growing by only 8.2 percent instead of the forecast 14.9 percent. However, the firm expects global IoT spending to return to double-digit growth rates in 2021 and achieve a compound annual growth rate (CAGR) of 11.3 percent over the 2020 to 2024 forecast period. Currently 28.6 percent of that spending is for modules and sensors, the largest category of spending in the survey.

Top Technology Category Based on 2020 Market Share (Value (Constant Annual))



source ©: IDC Worldwide Internet of Things Spending Guide 2020 | May (V1 2020)



source ©: Z-Wave Alliance

**The context-aware smart home is a distributed system.**

**Mitchell Klein**  
Z-Wave Alliance

systems and proactively maintain them in an efficient manner during off-peak hours.

PARC has also worked with other enterprises on similar initiatives, including:

- Panasonic on its smart factories initiative, where PARC's Moxi IIoT System Analytics suite helps to support continuous and remote monitoring of system state using

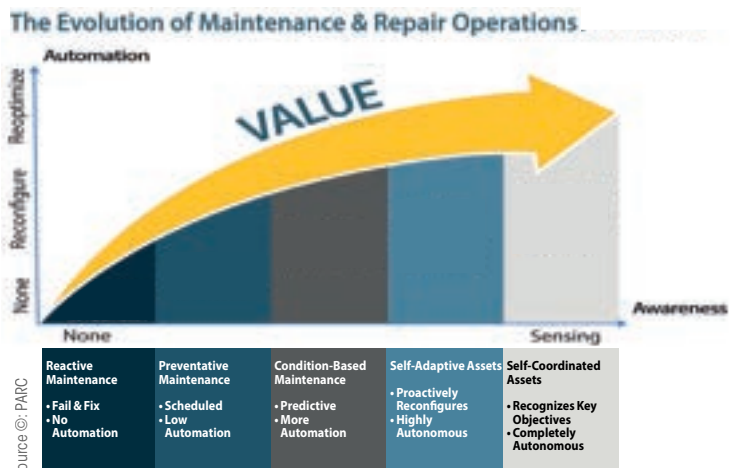
low-cost embedded sensors and model-based algorithms

- VicTrack is using PARC's low-cost fiber-optic sensors for the continuous monitoring of bridges, especially for critical components
- Con Edison and GE Grid Solutions are also using Moxi for power grid asset management in a phase-two field trial to demonstrate the robustness of the technology for

a cost-effective scale-up toward truly smart grids

## Building Blocks of a Better World

The means of interconnecting IoT elements is one of the most critical challenges in making IoT seamless and pervasive, and for empowering richer applications. Mitchell Klein, executive director of the Z-Wave Alli-



source ©: PARC

### Looking Ahead

PARC's MOXI IIoT suite can predict the need for maintenance and repair.



ance, is sure connectivity is undergoing rapid evolution. The consortium is a group of over 300 companies using the Z-Wave wireless protocol, one of a number of competing RF-based communications protocols for control, monitoring, and status-reading applications. He says two of the top trends Z-Wave hopes to address that will impact the smart home and larger IoT market growth are AI and contextual awareness and the continued emphasis on open standards, network interoperability, and ecosystems to support continued growth.

Klein says that, in an IoT application of a neural AI network, the sensor is at the heart of the system, working to continuously gather data that can then be executed upon directly without having to call to the gateway or cloud. The sensors baked into smart devices on the neural network are the catalyst for data, power, and memory that can then make the context-aware decisions. "Essentially, the context-aware smart home is a distributed system, perfectly aligned with the architecture of a mesh network," he adds.

Z-Wave's power, range, and bandwidth are optimized specifically for smart home applications. Additionally, its combination of technological agility, low cost, ease of integration, product-level interoperability, and



source ©: Sched

mature mesh networking makes it ideal for control applications, he claims. Another technology aiming to boost the ubiquity of IoT sensors and actuators is LoRa (Long Range), a low-power wide-area network (LPWAN) protocol developed by Semtech. LoRa Alliance ambassador Daniel Quant says the technology is ideal for many sensor and actuator roles up to ten kilometers from a base station. One area where LoRa applications appeal is in the petroleum industry, particularly fracking, where distributed activities involving pumping and pressurizing water have traditionally required lots of hands-on labor to monitor, supervise, and coordinate.

It takes more than just communication to make sophisticated IoT im-

### In Control

The Z-Wave protocol is a wireless communications technology for control, monitoring, and status reading applications in residential and light commercial environments.

plementations a success. That's the thinking behind the concept of digital twinning. "We think of a digital twin as a unique instance of a digital model that represents an entity like an asset or a plant," explains Pieter van Schalkwyk, co-chair of the Digital Twin Interoperability Task Group, sponsored by the Industrial Internet Consortium (IIC). He says digital twins are typically created to solve a specific business problem and are a key part of the future of IoT "because they provide organizations with better situational awareness and enable real-time monitoring, control, and visualization."

In short, he notes, digital twins are becoming the user interface for IoT. Other researchers are on a similar path – but IIC is taking it one step further with "tactile fidelity," which allows humans to handle some of their traditional functions remotely (see "Tactile IoT").

Digital twins get their data from multiple sources, with IIoT being a critical data source, says van Schalkwyk. "IIoT-enabled digital twins provide situational awareness to people like reliability engineers and plant managers who need to make decisions based on real-time data," he adds.

The future is bright, says LoRa Alliance's Quant: "The truth is that we, as individuals, are often better at adopting digitalization than industries – and companies know it, so there is a pent-up demand among them to modernize and become more relevant."



**There is a pent-up demand to modernize and become more relevant.**

**Daniel Quant**  
LoRa Alliance



**Digital twins can represent any entity like an asset or an entire plant.**

**Pieter van Schalkwyk**  
Industrial Internet Consortium



source ©: XMPro

## The OS switch

# WHERE TO GO FROM WINDOWS 7

The support for Windows 7 Professional and Ultimate for Embedded Systems (FES) **ended on January 14th, 2020** and the support for Windows Embedded Standard 7 (WES) **ended on October 13th, 2020**.

**B**ased on that, we want to show you some paths to update your projects to a newer Microsoft operating system. A 10 year old operating system is still working, but there might be some security issues and some conditions missing for future requirements.

It should come as no surprise to anyone that more and more "things" are being equipped with intelligent sensors: household appliances, running shoes, manufacturing equipment, bracelets that monitor vital signs, practically everything in the modern automobile, and so much more.

Seamless from IoT Edge to Cloud

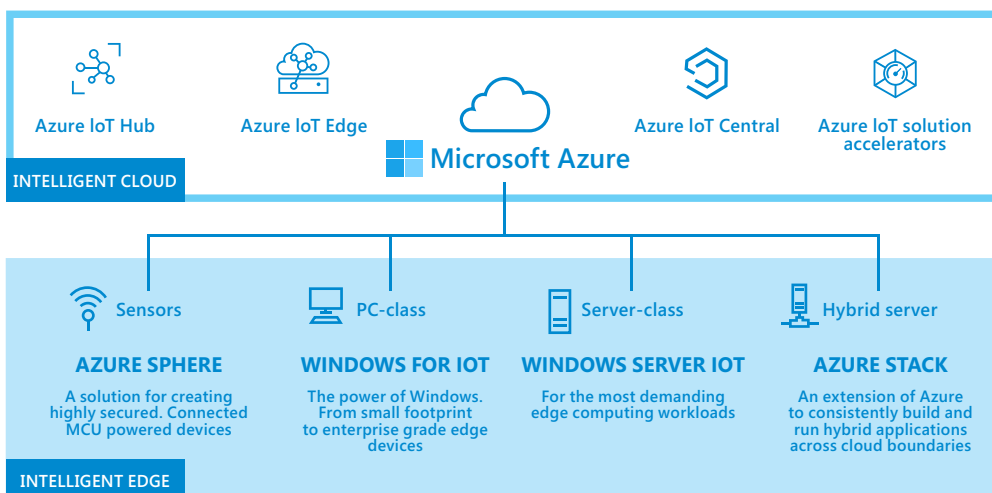
The kinds of things that can be (and are) embedded with intelligence are virtually endless.

Just as the Internet vastly improved our ability to take advantage of computing power by increasing connectivity between our systems, IoT connects these myriad devices to the Internet, giving people the power to build better lives and allowing organizations to transform the way they do business. To help make sense of IoT, industry analysts often divide the discussion along two lines: consumer and industrial. Consumer IoT looks at consumer devices, such as household appli-

ances, that can be connected to the Internet to help people live better. Industrial IoT focuses on how businesses can use intelligent devices and the data they collect to streamline and improve operations.

Buzz words are predictive maintenance, avoid unplanned downtime, reliability, connectivity, artificial intelligence, security, ....

IT organizations have long recognized the productivity and security benefits of using Microsoft throughout the organization. The same benefits accrue to organizations that run Windows 10 IoT on their embedded and mobile devices, too.



### Microsoft IoT: Accelerating digital transformation

Microsoft offers a comprehensive IoT portfolio on the market as well as 25+ years of experience working with embedded devices builders. One common platform. With one universal app platform, one security model, and one deployment and management approach, Windows 10 IoT Enterprise makes it easier for your IT organization to manage these devices and incorporate them into their strategic plan.

**Empowering users.** Windows 10 IoT Enterprise delivers a friendly, familiar



Visit us now at [www.membedded.biz](http://www.membedded.biz)

experience across a range of devices, making intelligent devices easy to learn and use.

**Security.** Windows 10 IoT Enterprise introduces a number of advancements in security and identity protection, including access controls with biometrics and multifactor authentication.

**Connected devices.** Windows 10 IoT Enterprise is designed to work with the devices you already own-as well as the next generation of devices you deploy. This ensures interoperability across your device fleet and allows you to incorporate new devices easily and seamlessly.

**Consistent device management.**

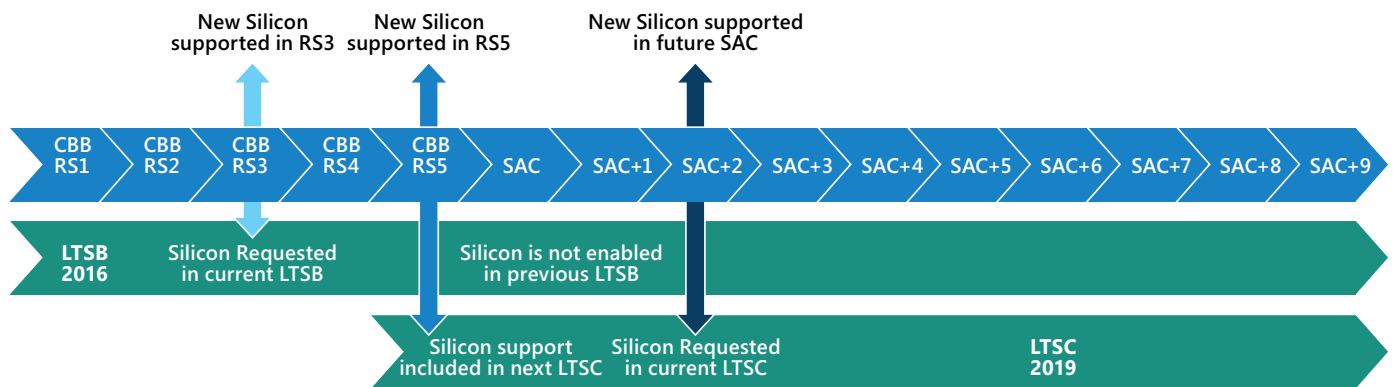
Common device management tools allow you to manage all your Windows 10 IoT Enterprise devices with the same tools you use to manage your PCs, smartphones, and tablets.

**In comparison to Windows 7, Microsoft offers Windows 10 IoT Enterprise in two different options:**

In the Semi-Annual servicing Channel (SAC) version, function updates are provided twice a year by Microsoft. There are servicing tools available, so you can delay the installation up to 365 days. When Microsoft releases an official feature update

for Windows 10, it will be immediately made available for installation on any PC that is appropriately configured and installed on the device. The Long-term Servicing Channel (LTSC) prevents Windows 10 devices from automatically installing feature updates. Microsoft offers so-called quality updates for this license option in order to update the security standard. OEMs can choose whether these updates should be installed or not. There is an additional change to older versions, Windows 10 IoT Enterprise LTSC will be able to support future CPUs through specific updates.

**SAC and LTSC update cycle**





## IoT in Sports

# THE NUMBERS GAME

Excessive collection of statistical data is at the heart of a huge sports trend. As if **crunching and interpreting vast amounts of performance-related information will allow you to look into the future**. Where humans seem to be limited, artificial intelligence might actually do the trick.

■ By Jürgen Kalwa

In some of its best moments, the game of basketball transcends its skillful grind to become something beautiful. It looks like an unchoreographed dance in squeaky sneakers. Its rhythm and movements drawn from the art of improvisation: impromptu, unprogrammed – and, yet, deliberate.

This has taken some time. The early game, invented a hundred years ago, was a fairly rigid, static, and structured pursuit. Only recently has it reached what psychologists call “flow state” – and only because of the men who shaped it over time. The players had roots in the same ethnic enclaves as jazz, and it was Black America that turned a team contest into an entertaining show of masculinity.

At the same time as black players ascended, the game branched out intellectually into another dimension. It became a laboratory for mathematicians who like to measure all that creativity and spontaneity and break the aspirations down into calculations, probabilities, and outcome predictions. That is why the National Basketball Association (NBA), one of the most successful sports leagues in the world, is in possession of a massive archive of individual performance data. What the league started to put on a website a couple of years ago is updated constantly and becomes available to the general public five minutes after each game.

The sophisticated statistics platform was created by software giant SAP but, initially, a few usability issues had to be solved. How can you serve tens of thousands of users at the same time? How do you present and help navigate billions of different data combinations? How do you make this stimulating for the regular fan?

Apart from interesting the fans, the service is also a valuable toolbox for coaches who like to see indisputable facts which they can study for patterns, interpret into strategy, and convey to their players. The game has provided a vault of untapped secrets, ready to reveal unexpected insights into opponents and their weaknesses and into options to build better teams.

### Deep Blue Yonder

The early influencers in basketball were talented mavericks with playful nicknames like Julius “Dr J” Erving, Earl “The Pearl” Monroe, and Earvin “Magic” Johnson. Until a certain Michael (Mike) Jordan came along and convinced the masses that his show was no act at all – it was the real deal. A force of personality which personified ambition and artistry in one.

Today’s generation of players might have never heard the slogan “Be Like Mike” but they understand its meaning. To be a true superstar in sports you have to be you. You can’t just be a number or a “showboat,” the



With a computer like Deep Blue, the fascination with sports would be lost.

**Holger Geschwindner**  
Basketball player and manager



source ©: tagesspiegel.de

unflattering nickname the late, great Kobe Bryant was given by his peers when he began playing in the NBA. Interestingly most of the coaches were white and were not only trying to master the art of winning but were also concerned about their role as authority figures in a sport of self-aware, confident black players.

The coaches’ main interest was, and remains, in plain numbers, such as points gained or lost, throwing attempts, rebounds, assists, and blocks. Adding them or dividing them by games played or by minutes elapsed allowed them to distill a few key messages related to individual players’ performances.

Curiously, especially in the US, ardent fans, driven by a similar analytical mindset, have become interested in this kind of data and their coach-centric viewpoint has been packaged and sold in the form of sports video games, such as the annually updated NBA 2K series, which first came out in 1999. The gameplay simulates real-life NBA basketball games, with the players using their consoles to control entire teams or selected athletes. Holger Geschwindner, the basketball mentor and manager who guided the 20-year career of Dirk Nowitzki, one of the best players in the history of the league, has never shied away from an analytical approach. Hardly surprising as he has college degrees in mathematics and physics. He was also a pretty good basketball player himself and captained the German national team at the 1972 Olym- ➔

**Total Control**  
The NBA 2K game-play series simulates real-life NBA basketball games, with the players using their consoles to control entire teams or selected athletes.



source ©: pcmgamers.com

pics in Munich. He doesn't want sports to go "in the direction of robots" but to become even "more beautiful and more artistic."

"There has to be such a combination. I can't imagine that it would be exciting for spectators to watch games that look more like chess. With a computer like Deep Blue [the famous IBM chess-playing supercomputer], the fascination with sports would be lost."

This has not been much of a concern for Alan McCabe, who works at the School of Information Technology at James Cook University in North Queensland, Australia. He started to explore the statistics from a betting viewpoint by modeling elements of sporting contests. "We get better and better at it over time," he says – to the point where he was able to outperform most of the expert punters.

His work has gained quite an audience. He started with information from the Australian National Rugby League and then expanded into other fields, including English Premier League (EPL) soccer. In his first EPL run, he claimed a prediction accuracy of 53.2 percent and last season, which was interrupted in April due to Covid-19, saw him push up his outcome success rate to about 60 percent.

Early on, he began to integrate learning algorithms into his calculation models to optimize the weights within a multilayer perceptron, such as back-propagation, the conjugate gradient method, and classical algo-



**We get better and better at it over time.**

**Alan McCabe**

James Cook University



source ©: Roublier

rithms, McCabe explained in one of his papers. These are fundamental practices in neural networks which, crudely put, amounts to learning from your mistakes.

### Luck Be a Lady

The use of machine learning techniques to predict probabilistic events is something the sports betting industry finds just as intriguing as the addicted public. On any given day either opponent can score and win a game – regardless of common-sense expectations, the complex element of "luck" always plays a part. It is what makes the prediction process difficult and attractive at the same time. To sort through the mountains of statistics and cut the data down to reasonable probabilities is tricky and it inspired American sociology professor William Bruce Cameron to coin

#### Faulty Assumptions

There is no truth in this sense. In football and other sports. Those who succeed are those who understand how to combine the numbers with other ways of observing games.

the aphorism: "Not everything that counts can be counted, and not everything that can be counted counts!" It is this conundrum that's at the heart of the statistical craze in team sports. In reference to soccer, two experts in economic theory, social science, and statistics, Chris Anderson and David Sally, laid all of this bare in 2013 in a book titled *The Numbers Game* and subtitled *Why Everything You Know About Soccer Is Wrong*.

Anderson has been thinking about the subject for a long time. The son of a member of the American occupation forces, he grew up in Germany and was a goalkeeper in a fourth-tier German soccer team. At the time the book was published, he was a professor at Cornell University in New York State but he now teaches in the European Institute at the London School of Economics.

Anderson likes to point out "misjudgments" which afflict everybody, especially live-TV broadcasters and the public at large, who seem to perpetuate the myth of categories that are less relevant than they seem. "For example, possession of the ball. This category contains relatively little information on how successfully a team plays. Corner kicks are also a great example. They produce hardly any advantages. We know this from all the statistics," Anderson says.

"The danger is that you really start believing your own statistics," he cautions. "There is no truth in this sense. In football and other sports. Those who succeed are those who understand how to combine the numbers with other ways of observing games." Wrong assessments can have fateful consequences. Take the decision makers at soccer clubs, for example. They spend most of the big bucks hiring promising strikers – an investment which ignores the importance of the role of talented defenders. No wonder – in a game in which statistics are mainly drawn from attacking and pushing forward, evaluations of the qualities of defensive players is hard to come by. How do you measure the success of somebody who chases his opponents, is really fast, and can



anticipate developing situations better than others? "Defense is about preventing things. About warding off moments of danger," Anderson explains. "Goals that you prevent are most important for your success. But these accomplishments are not reflected anywhere in the statistics."

## Beane Counting

The belief system of the numbers nerds borders on religion. Think of Billy Beane, a long-time baseball manager with the Oakland Athletics, who hired players based on a sophisticated evaluation scheme. His ultimate goal was to be competitive against teams that were filthy rich and willing to spend limitless amounts on salaries. The author Michael Lewis labeled Beane's efforts *Moneyball*, turned the story into a bestseller, and was rewarded when Hollywood actor Brad Pitt picked it up and created an even more famous movie. Its mind-opening line was: "The problem we're trying to solve is that there are rich teams and there are poor teams. Then there's fifty feet of crap, and then there's us. It's an unfair game."

What were the flaws of Beane's system? First, he never went on to win a World Series championship. As smart as his system was in finding underappreciated pieces for his puzzle, it wasn't enough. Richer teams constantly sucked enough top-quality talent in to prevail. Second, when the *Moneyball* book made its rounds

most other teams were intelligent enough to study Oakland's statistical approach and copy it.

Data mining became so big in Major League Baseball that, in 2013 and 2014, Chris Correa, the scouting director of the St. Louis Cardinals, hacked the computer system of the Houston Astros, a competing team. The Astros, who had been pretty bad for quite some time, suddenly became really good – which raised a suspicion that the executive might have taken valuable company secrets with him when he left. The scouting director was prosecuted for the hack and sentenced to 46 months in prison.

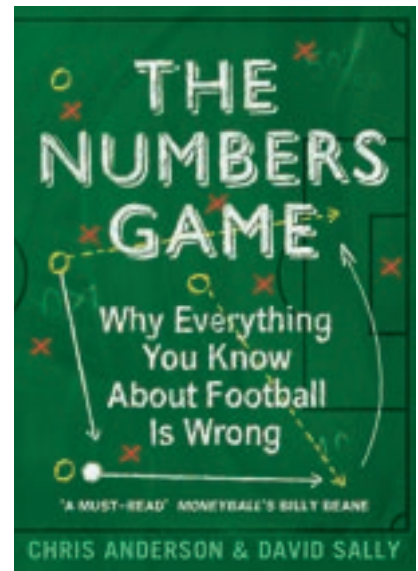
## Worth a Flutter

It is no secret who, beyond teams and their scouting and coaching departments, profits from data mining. The biggest investors in generating algorithms for use in whipping up a secret sauce for predicting games are betting companies. "Artificial intelligence is changing the sports betting game," noted Science101.com, an American website which looks at pioneering science and discoveries.

In June 2019, in a long exposé about the development, Science101 examined Monster Roster, a platform cooked up by Dylan Elder, "a 22-year-old math whiz," who started the company four years earlier when he was still in high school. His thing? Machine learning and artificial intelligence that continuously tracks play-

### Setting Things Right

In their book, Anderson and Sally point out "typical misjudgments" which afflict everybody, especially live-TV broadcasters and the public at large, who seem to perpetuate the myth of categories that are less relevant than they seem.



ers in all professional sports throughout their seasons.

The article also mentioned Israel-based WSC Sports, a company producing sports video content "in a simplified and automated way that can be used for broadcast highlights and social media distribution." The company told 101's reporter Brian O'Connell: "With AI and machine learning technology, you can better target to drive more engagement, which equals more betting." This gave the magazine reason to claim there is an "organic symmetry between gambling and high-end number-crunching and data analysis." Information exposed by these specialty companies will filter into different realms. It is sought after by teams in the big leagues, where billions of dollars are at stake. It trickles down to people on social media platforms trying to keep in touch with any imaginable nuance of the games while they are played. It is also being picked up by TV commentators, often in real time to enhance live broadcasts, and it inspires leagues like the German Bundesliga to do their own research and feed data into fans' handheld devices while the game goes on right in front of their noses.

In return, in places like the US where sports betting, illegal for over a century, has been green-lighted recently, many interested parties have grown an appetite for cashing in on the action. It is not just governments who are increasing their revenues by taxing the betting market; the big leagues are just as greedy. That said, their arguments do sound reasonable when they explain why they want to be rewarded: the games only exist because they put them up – and the games must go on.



The danger is that you really start believing your own statistics.

Chris Anderson and David Sally



## Health-Care Wearables

# BODY SIGNALS

Wearable health-care monitoring devices have taken great strides in functionality but **there is still room for improvement.**

■ By Mark McCoy

**T**he craze for step-counting wrist straps, prevalent during the last decade, seems to have been whittled down to the dedicated few – if social media posts can be considered an authoritative source. It's not that wearable technology is palling, it's more that functionality has increased and the dubious metrics of long walks as a health indicator have been replaced by more meaningful data harvesting. Device applications have ex-

panded from activity tracking to continuous monitoring of heart rate, blood oxygen and blood glucose levels, body temperature, and more.

Despite lockdowns focusing people's attention on more basic needs, like sourcing finances to buy toilet roll supplies, wearable tech sales have increased by five percent over 2019 figures, according to recently updated projections from tech market advisory firm ABI Research. This

may not approach the healthy 23 percent boom originally expected but is still a modest move in the right direction.

The continued growth of wearable health-care products has been enabled by the development of very-low-powered analog body sensors, digital microcontrollers, and innovative power and battery management circuits. ABI predicts that 2020 sales will be 254 million units, a pandemic readjustment from the 281



million units it originally forecast. Nonetheless, a number of issues related to reliability and accuracy must still be addressed before wearables truly pick up the pace to become more ingrained into daily living. Nearly all of the human body signals traditionally monitored in a clinical environment can now be collected by a wearable product, very often with close to the same level of preci-

sion and at much lower price points. These devices now need to be highly reliable, as readings may be used for lifestyle adjustments or as an early warning sign of illness. To do so, biosensors must be designed to overcome measurement challenges stemming from factors such as rugged environments, sweaty skin contact, motion, and interference from ambient light conditions.

#### **Welcome to the Real World**

Reliability under real-world conditions means dealing with environments electronics do not usually have to tolerate.

### **The Right Connections**

A key requirement for any wearable device is connectivity. Seamless wireless connectivity has pretty much become a given for today's wearables. Wireless transfer allows data transmission to larger display screens or to remote data collection facilities. Low-power Bluetooth (BLE) is an emerging standard for this purpose. In addition, near-field communication (NFC) provides limited-range wireless connectivity that is well-suited for short content transfers such as configuration information and logged data retrieval. When faced with developing a product such as a new fitness band, for example, the engineer needs to consider how much data will need to be transferred, how frequently, and over what range it will be sent. If the quantity of data that needs to be transmitted reaches megabyte levels, then the designer might well consider using Bluetooth Classic or Wi-Fi.

Range is the other determining factor. BLE can typically only communicate up to 30 meters in line of sight. This may seem like a limitation but





**Handy to Have Around**

Pulse oximeters have gotten small enough for patients to carry around everywhere.

BLE transmitters are smaller and less of a power drain than the only viable alternatives of Wi-Fi or cellular connectivity. What is more, use case factors come into play, such as communicating through a smartphone to forward data to the cloud for analysis.

**Able to Take Some Knocks**

Many wearable systems are designed to be worn during sports and other rugged activities. "Ruggedness" is relative; the requirements

**Max the Signal, Cut the Power**

The primary mission of a wearable PPG circuit is to maximize the signal-to-noise ratio (SNR) while conserving expended power.

for a life-saving device are different from those of an activity monitor worn by a cyclist.

Reliability under real-world conditions means dealing with environments electronics do not usually have to tolerate. These components include low-power, analog front-end (AFE) modules to convert real-world vibrations and temperatures to digital signals for multiparameter monitoring, plus embedded analog parts, such as op amps, current-sense amps, filters, and data converters,

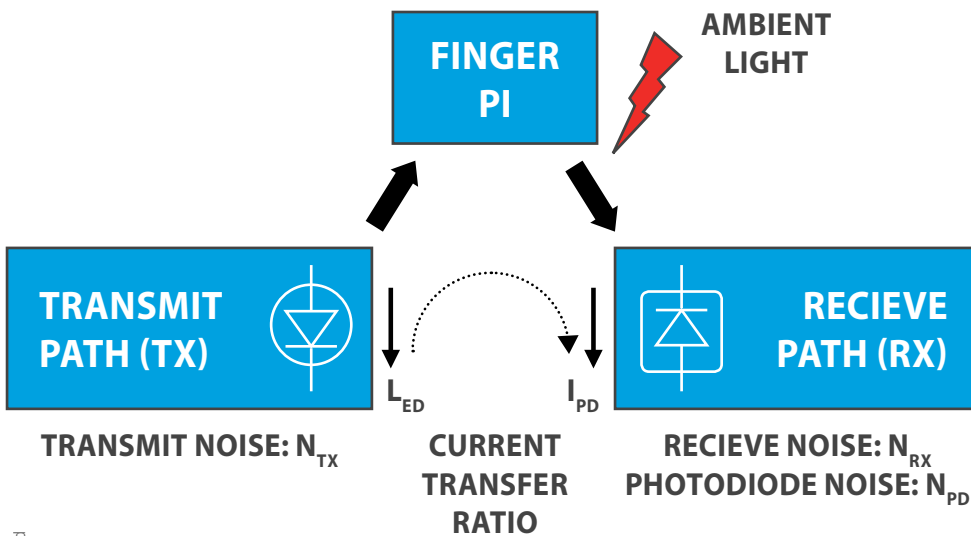
all of which are necessary for interfacing real-world sensors to digital systems.

Electrical outputs from body sensors have very low strength, in the millivolt and microvolt ranges. Many of the sensors used in wearable health applications have to be combined with amplification and conversion circuits within a single die or package so that they emit a higher-level analog signal or a serialized digital signal.

**Dealing with Flickering Lights**

Photoplethysmography (PPG) is actually an uncomplicated and inexpensive optical measurement method often used for heart rate monitoring purposes and pulse oximetry (a test used to measure the oxygen level of the blood). PPG is a noninvasive technology that uses a light source and a photodiode on the surface of the skin to measure the volumetric variations of blood circulation.

In use, the optical sensor can also pick up ambient light. This is particularly troublesome because indoor lighting commonly flickers, and this can interfere with the PPG signal. Depending on the nature of local power supplies, indoor lights may flicker with basic frequencies of 50Hz or 60Hz, a rate close to the frequency at which PPG signals are



$$SNR = \frac{I_{LED} \times CTR \times PI}{1.41 \times \sqrt{(N_{TX} \times CTR)^2 + (N_{RX})^2 + (N_{PD})^2}}$$



sampled. Left uncorrected, ambient flicker can produce variations in each sample taken.

To counteract these effects, advanced PPG ICs now have intelligent signal paths. Algorithms, too, have grown more sophisticated and the net result means PPG devices can be produced in a variety of form factors, including earbuds, rings, necklaces, head and arm bands, bracelets, watches, or on smartphones.

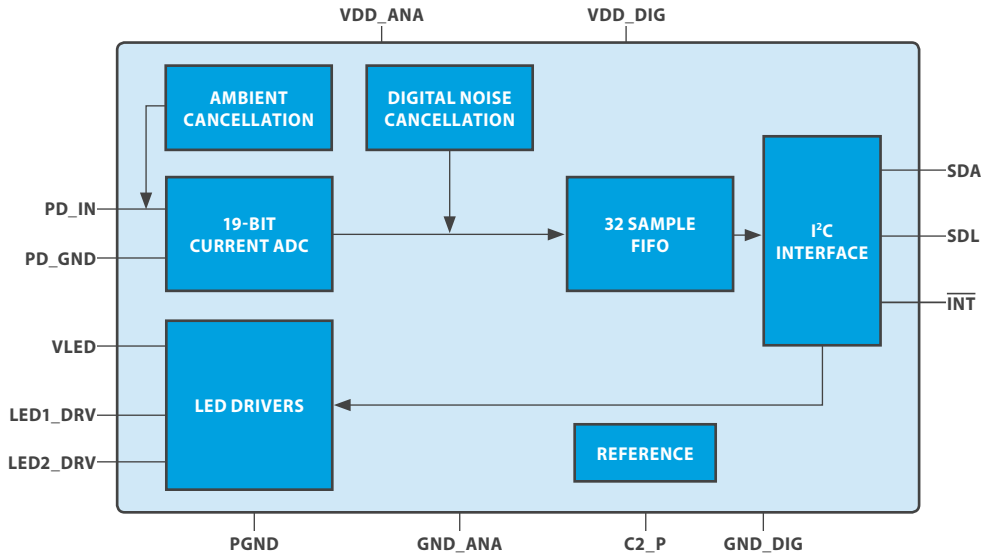
Whatever the form factor, wearable sensors must be able to perform reliably while overcoming the effects of common noise and error sources. Environmental noises for PPG sensors typically fall into two major categories: optical and physiological.

Optical noise refers to changing characteristics of the optical path as seen by the sensor that are unrelated to light absorption by the volume of blood observed, as in the case of ambient flicker. Likewise, a physiological change, such as a sudden movement by the wearer, could cause mechanical displacements of the sensor with respect to the tissue, altering the sensor's perception of blood flow and changing the volume of overlying tissue, which in turn alters the PPG signal.

Maxim Integrated's MAX30112 heart rate detection integrated circuit for wristband devices typifies how noise can be reduced to produce more reliable results. The module features advanced correlated sampling techniques to mitigate any 50Hz/60Hz flickering interference in the PPG signal. The device supports a standard inter-integrated circuit (I2C) protocol interface and requires a main supply voltage of 1.8V. A separate 3.1V to 5.25V supply powers LEDs

**Very Low Power**  
The MAX30112 operates on a 1.8V main supply voltage, with a separate 3.1V to 5.25V LED driver power supply.

**Fits Your Wrist**  
Simplified block diagram of the Maxim MAX30112 heart rate detection solution for wrist applications.



source ©: Maxim Integrated

that shine light through the skin to measure how it is scattered by the pumping of the blood vessels. The software features shutdown modes with near-zero standby current, allowing the power rails to remain on at all times without draining the battery power.

### Time-Saving Tools

A wearable health-care device is an autonomous, noninvasive system that performs a specific biomedical function. These devices track heartbeat, body heat, blood oxygen, and electrocardiogram (ECG) signals. The sensors react to some sort of physical input and respond by generating a signal, typically in voltage or current form. This signal is cleaned and smoothed to make it easier to read, sampled at a suitable rate, then converted into a signal readable by processors.

With all of these requirements, building a wearable health-care product can be challenging and time-consuming. Tools like Maxim's Health Sensor Platform 2.0 bring together all the modules to offer the ability to monitor ECG, heart rate, and body temperature in a wrist-wearable format, saving months in development time. Using tools such as this, almost all the signals that are traditionally monitored in a clinical environment can be obtained by a wearable product.



source ©: Maxim Integrated



## Tracking Systems

# TAKING THE **FRIGHT** OUT OF AIR **FREIGHT**

Detecting cargo damage in transit can help insurers and forwarders to clear claims faster. **Lufthansa Industry Solutions and its partners have developed a novel solution** that uses a combination of sensor, eSIM, and blockchain technology.

■ By Gerhard Kafka

**D**isputes often end up as finger-pointing exercises with nobody willing to take the blame without incontrovertible evidence. “It wasn’t us, it was them” is a difficult and costly tangle for insurance companies or loss adjusters to resolve. With fast turnarounds and multiple points of contact – between cargo handlers and customs officers – it is important to be able to pinpoint and correct the cause of any mishap for the efficient running of the air freight industry.

That’s why Lufthansa Industry Solutions (LHIND) chose to develop a trusted, secure IoT service to detect and document damage, in partnership with embedded SIM (eSIM) data security specialist Giesecke+Devrient (G+D), smart-device manufacturer Sloc, and blockchain start-up Ubirch. Using G+D Mobile Security’s SIG-NiT tracking with Sloc’s Damage Detection Sensors, LHIND’s system offers detection-as-a-service (DaaS) so companies can iden-

tify danger areas and modify their supply chains to prevent future incidents.

Moving freight by air is usually the fastest and most effective method of transporting goods over distance – but it is also very expensive. According to a World Bank report, air freight costs are typically four to five times higher than road transport, and 15 to 16 times higher than going by sea. With higher costs involved, it’s essential that any dam-

age to the goods is easily reported so settlement can be reached quickly.

### The Challenge

As freight passes through multiple hands, placing responsibility for damage can be difficult. The secure, trusted collection and transmission of cargo damage data is necessary to provide a complete picture of when and where it happened. Any data →

#### Eye in the Sky

Lufthansa Industry Solutions turned to Giesecke+Devrient and Ubirch to develop a secure blockchain-based IoT system to detect and document damage during transport.



# Blockchain from the very beginning

## MAKING IOT MORE INDEPENDANT

**G**+D Mobile Security's product uses a novel combination of eSIM and blockchain technology. It forms a scalable framework that can be extended from air freight to encompass land and sea operations. Sealing the damage sensor data cryptographically with Ubirch's blockchain protocol running on the SIM, only milliseconds after it has been measured, removes doubt and engenders trust within the process because:

- No data package can be changed
- No data package can be deleted
- No data package can be duplicated
- Proof of origin is recorded
- Proof of time is recorded

SIGNiT addresses one of the main challenges of digitalization: the dependence of IoT-based business models on the integrity of their data streams. It offers an efficient, scalable, and cost-effective route to undisputable, trusted IoT data,



Our vision is to secure IoT data directly at their source. SIGNiT from G+D Mobile Security takes this vision to a whole new level. The product offers an easily scalable plug-in solution for powerful IoT security.

**Stephan Noller**  
CEO at Ubirch



source @: Ubirch

opening the door to many new IoT business models. Manufacturers of IoT-enabled devices, regardless of whether they are industrial machines or consumer devices, can easily protect connected Industry 4.0 and 5G applications. Insurers can implement scenarios in which IoT data can reliably trigger fully automated payments. In combination with the new 5G standard, SIGNiT has the potential to become a game-

changer for connected industry and all types of business models that rely on trusted IoT data.

Ubirch has developed its Trust Protocol (UTP), to ensure that data from the IoT sensors can't be falsified after being generated. The data packets are sealed with strong cryptography, making it technically impossible to manipulate them once stored in a blockchain. Ubirch claims that this combination of offering blockchain on a SIM card is the first of its kind.

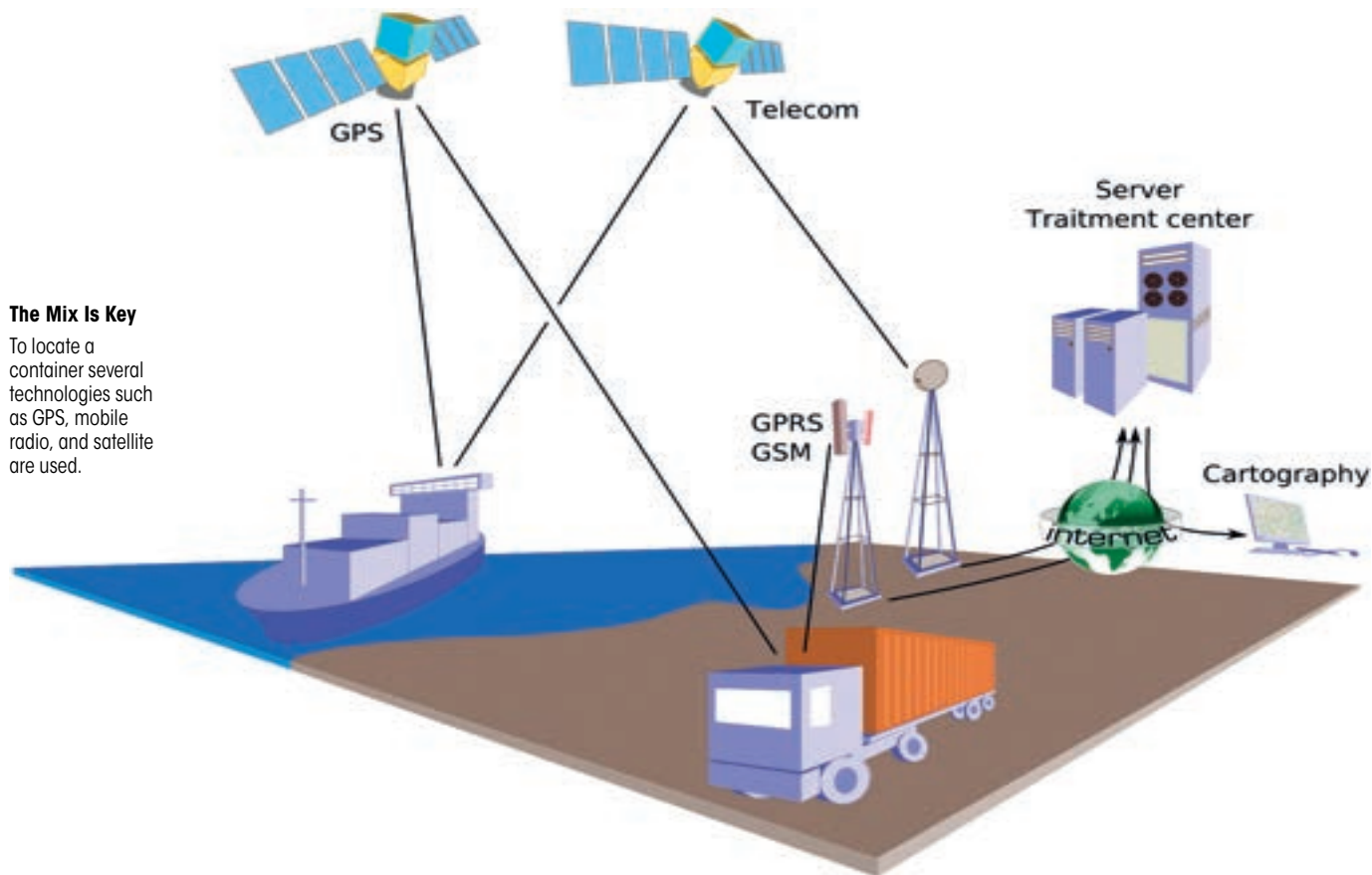
The solution works like a blockchain that starts at the source of data creation – the IoT sensor. IoT data is sealed by a private key that sits on the SIM card. In the back-end storage, these micro-certificates are saved in a so-called Merkle Tree, a hierarchical structure for distributing large sets of data into manageable smaller parts, and anchored in public blockchains, thus creating an immutable and irrefutable record of a sensor's output.

As the protocol is bidirectional, an IoT sensor can verify incoming packets for authenticity and integrity, providing protection against unauthorized commands or unknown sources. The benefits for clients are huge as IoT data can be verified whenever it is processed, or new data-driven business models can be deployed, such as smart-contract insurances. Prevention of hacking attacks, like "man in the middle" or packet duplication/suppression, is also a built-in feature because only verifiable packets are processed.



source @: Ubirch

**The Mix Is Key**  
To locate a container several technologies such as GPS, mobile radio, and satellite are used.



source ©: Wikipedia

collected must be tamper-resistant and irrefutable, especially when insurance claims and business decisions are based on it. For example, if the data shows that one particular company was responsible for a significant amount of damage, it could have a knock-on effect to its relationships with other suppliers and customers. Any tracking solution has to avoid errors and prevent the possibility of data alteration to protect the reputations of everyone involved.



source ©: xxxxxxxxxxxxxxxxxxxxxxx



**With SIGNiT we are solving the most critical challenge of these ecosystems: trustworthy data for all digitized processes.**

**Carsten Ahrens**  
G+D Mobile Security

tion from G+D Mobile Security. It helps companies to use IoT data to reliably track where goods were damaged in transit. Offering totally secure and tamperproof damage reports across the entire transportation process allows companies to understand their supply chains in much finer detail. This insight can transform relationships with transportation providers, highlight weak links, and offer an objective, reliable method of managing global shipping and cargo operations. Although developed for air freight, LHIND's goods tracking system is flexible and, if it takes off and provides the dividends expected, it could easily be adapted to improve land and sea transport.

**The Solution**

A key component in fleet management systems is the cargo container tracking component. This is usually GPS-based but it can also be set up as a cellular triangulation platform. In some applications LPWAN (low-power WAN) technologies, such as LoRa or Sigfox, can also be used to transmit data from a container to a nearby access point. Once container location, direction, and speed are determined, the details can be transmitted to a fleet management application. Users can then see actual, real-time locations of their fleet on a map and respond to events quickly and decisively. The data is usually transmitted across terrestrial networks but satellite tracking, while more

expensive, may be necessary for uninterrupted communication in remote environments. LHIND has combined several technologies into its secure air cargo offering. Sloc's sensors are connected to a unique eSIM card containing G+D Mobile's SIGNiT software, using Ubirch's blockchain to assure integrity. This novel use of secure SIM connectivity with embedded blockchain cryptography ensures 100 percent end-to-end security of the sensor data.

**Business Benefits**

With the damage detection sensors, Lufthansa Industry Solutions provides an innovative DaaS offering that uses the SIGNiT solu-



**Our aim is to achieve significant ROI improvements of 70 percent.**

**Holger Schlüter**  
Lufthansa Industry Solutions



source ©: LHIND

## Power Management

# THE POWER OF NANOPOWER

Changing batteries attached to ampere-sucking devices is a time-consuming, costly bore. **The implementation of low-energy nanopower management not only enables longer battery life**, or the use of free solar energy, but is also becoming a big-bucks market.

**M**any of the trends on the Internet of Things revolve around bright, shiny gizmos – often involving artificial intelligence or blockchain – but one of the most revolutionary parts of IoT involves something designers have to consider every day for their devices. Most components need power, and driving down the amount consumed is becoming a big-bucks market. Research shows that low-power IoT is more than just a tick-box market and could easily command \$2.6 billion in investment over the next five years.



**A quarter of all portable devices will employ energy harvesting within the next few years.**

**Paul O'Shea**  
*EE Times*

“Up to a quarter of all portable electronic devices, including mobile phone handsets, MP3 players, and laptop computers as well as wireless networking devices, will employ some form of energy harvesting within the next few years,” says Paul O'Shea of *EE Times*.

Nanopower brings the total power required to run a system down to a tiny fraction of full-power mode, significantly increasing battery longevity. It does this by managing the power consumption of multiple system components, with almost zero power required for its own operation. It can also add additional

capabilities while keeping the functionality of other components intact. It can switch circuits within a device on and off as required, which means critical components, such as battery monitors and internal timers, stay on while major power drains, like microcontrollers and wireless circuits, either turn off or go into very low power-consumption mode.

### Turning Nanopower on Its Head

It's easy to define a nanopower device simply as one with quiescent current less than one microampere. While this is true, it doesn't quite cap-

ture the entirety of what nanopower means to technological innovation, or its importance in bringing intelligence to the edge – or its contribution in crossing the next frontier of analog.

What really defines nanopower? The answer is its ability to spur innovation by enabling the development of applications for a new generation of ultra-low-power devices through higher efficiency and longer battery life – without sacrificing performance. This includes all the ingredients of a SWaP (size, weight, and power) reduction initiative: smaller size, lower heat dissipation, and other features inherent in developing next-generation technology on such a small scale.

Nanopower has been hailed beyond its ability to extend battery life for its ability to decouple functions to improve efficiency, and to enable enhanced system control. At this early stage, opinions abound as to how it will truly impact innovation in the future.

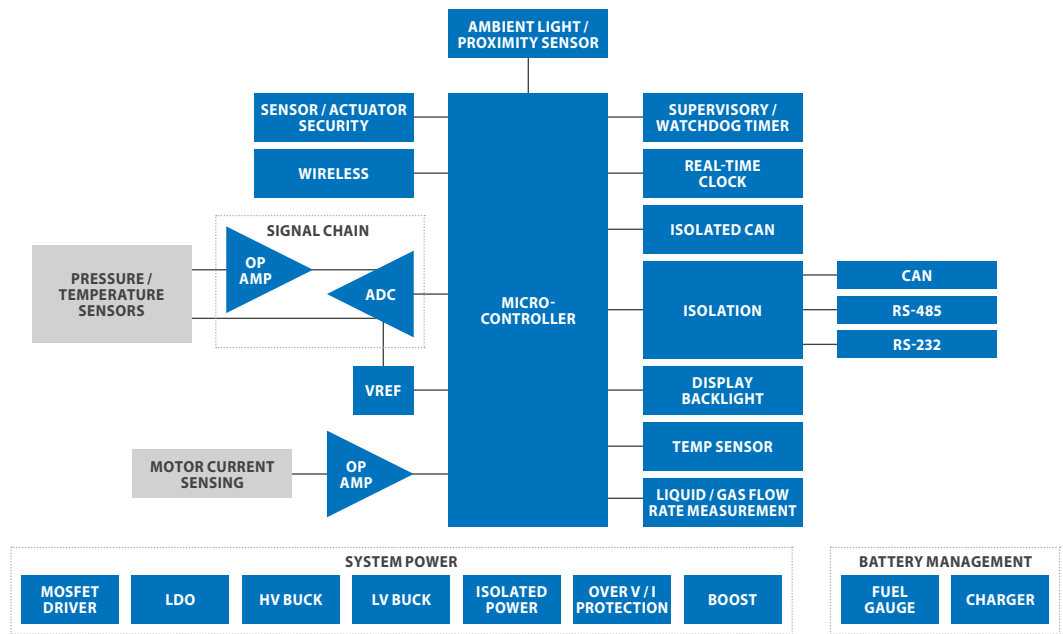
## Technology for New Applications

As we look at industry trends, we see more devices that can, or have to, use nanopower to function. This is even more applicable to the Internet of Things, where there is a wealth of everyday actions that can be made “smart.”

Take a smart lock, for instance. The number of times it needs to operate, possibly only a couple of times in a day, is quite small but the impact of a malfunction would be quite large. Nanopower and its leveraging of a nominal quiescent current at rest ensures devices are always ready to spring into action.

This puts rest mode high above the relatively comatose sleep mode induced by a shutdown current which can render technology asleep and not readily available when it is needed most.

Where before the battery would have been the largest and heaviest component on the board, selecting when a device operates, as well as



adding parameters around particular sleep, measure, and transmit periods, allows smaller, lighter batteries to be used – or the same battery with much-enhanced longevity. The ability for designers to take these kinds of decisions into their own hands means that nanopower empowers a wider variety of applications.

## Impacting Connected Technology on a Wide Scale

Take the previous example of a smart lock and scale it up from one home to one block, to an entire city of smart buildings. The impact of nanopower on smart cities is astounding, including:

- Smart buildings where nanopower tech can help to optimize the intelligence and efficiency by connecting together safety equipment; environmental sensors; heating, ventilation, and air conditioning (HVAC); lighting; and a host of other facilities
- Smart environments that monitor temperature, principal air pollutants, barometric pressure, light, vibration, ambient sound intensity, plus pedestrian and vehicle traffic to make more livable ecosystems
- Smart parking schemes that can alleviate traffic congestion while improving facility efficiency and the user experience

Add to all this the influence of artificial intelligence where low-latency, real-time decisions reduce data bottlenecks and efficient power consumption ensures that edge devices can not only make existing assets smarter but can also predict failures

### The Role of Analog

Analog parts play a critical role in bringing connected technology like building automation to market.

and outages or provide even better usage with more efficiency than ever before.

## Game-Changing Analog Power

Extending operation time through nanopower is just one of the ways analog is pushing innovation forward. Consider direct current (DC) power controllers like buck or boost converters and buck-boost regulators which offer high performance along with smaller size and lower operating temperature, or low-drop-out regulators (LDOs) which balance high accuracy with low-noise operation.

The harmonizing of all of these modules with needs is critical for successful adoption of next-generation IoT applications – and there are strong analog partners available to help create a unique blend of features to bring innovative ideas to life.

### Power Consumption

## The Benefits of Nanopower

- The ability to monitor sensors and process data at much-reduced power consumption
- Components, or elements within them, can be put to sleep and woken up based on different rules
- Deep sleep with almost zero power consumption
- The ability to wake up the device within a few microseconds according to scheduling, event triggers, or on demand
- Dedicated API for defining different operating modes depending on preferences
- Compatibility with both digital and analog sensors and peripherals

**Can you explain to our readers what Hackster.io is all about and how managers, businesses, and start-ups stand to benefit?**

Hackster is a large community for developers and engineers. It has about 1.5 million developers from about 150 countries around the world that come together to our site to share instructions, projects, source code, and in-built materials of all sorts of IoT projects. They can range from home automation to autonomous vehicles to IoT, industrial IoT, and so forth. In fact, they have shared over the years over 24,000 complete, open-source, ready-to-replicate projects that anyone can go and decide to learn from, copy, replicate, and in-build forward.

**Hackster.io has been described as an “ecosystem for developers.” What does that mean?**

We have about 200 partners and they create the ecosystem, together with the independent developers and big companies that come together to share their software and hardware knowledge through workshops, webinars, and by creating tools to help developers all over the world build the things they need to build, as simple or as complex as they may be. This is an ecosystem of collaboration, an environment where people can interact and share information.

**With 1.5 million members in more than 150 countries, that sort of makes you the UN for developers, doesn't it? In fact, you recently conducted a contest with the United Nations, the Covid-19 Detect and Protect Challenge, to create open-source technology that developing countries can leverage in the fight against this global pandemic. How's it going so far?**

Extremely well, actually. We're very proud to have the United Nations, including UNICEF, working with us. They tell us that they see this pandemic hitting the developing world even harder than anyone



Adam Benzion

## Interview

# THE ART OF TECH

*Smart Industry* talked with **Adam Benzion, a cofounder of Hackster.io**, which bills itself as the world's largest and fastest-growing open-source hardware community.

It was acquired by Avnet in 2016.

■ By Tim Cole



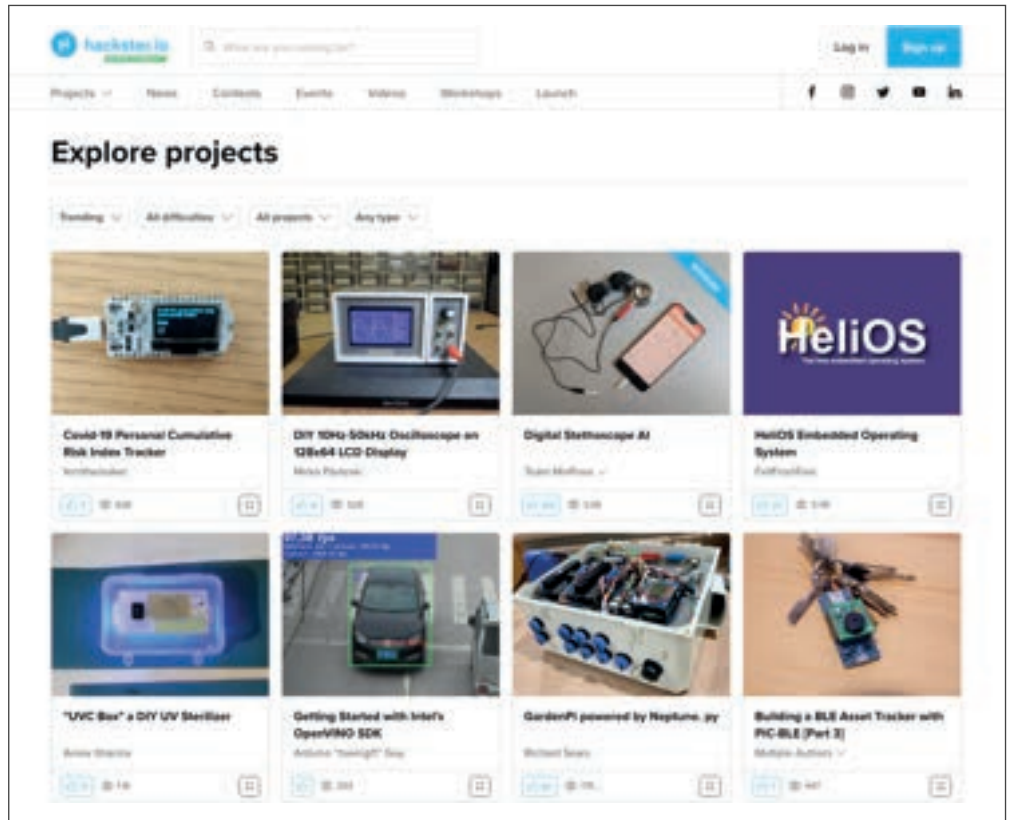
thought. This is mainly because of the lack of resources. Through our developer ecosystem, we have been able to come up with simple, easy-to-use, and easy-to-replicate technologies that can help these communities detect Covid-19 spread and protect people. So far, over 2,470 developers have registered, and so far 358 project ideas have been submitted.

We have complete projects now up and running, including materials, electronics, 3D printed parts, CAD files, and instructions on how to assemble and build these components and these solutions. But the problems go far beyond the pandemic. We're not just proud to be working with the United Nations and UNICEF, but with companies like Amazon, Microsoft, Google, Avnet, Arm, Nvidia, NXP, and others, that came together to support this contest.

**Are there other projects you, personally, are just as excited about?**

We run a lot of contests on a monthly basis and some of them have been really, really interesting. One that I love the most involved the Amazon Alexa device. Some of the very first skills that were developed for the Alexa ecosystem came from the Hackster.io community.

Another super-interesting design challenge was conducted with a division of GE that does smart home lighting systems that enable you to switch lights on and off through voice control. They wanted to see what else you could do with lights so they set up a design challenge to ask developers to build an end product they can actually sell and make something special of it. The winning design, out of hundreds submitted, came from our community and the developer got a lot of money for it. You can buy it today in stores. It is called the GE Soul Light and, ironically, Alexa was integrated into it. It's a beautiful design and we are really proud that a company like GE would come to Hackster to crowdsource ideas.



**Okay, so you bring developers together and help them create exciting new project ideas. But surely mistakes are also made. How do you help developers avoid them?**

Mistakes are part of the learning process, so our developers are free to make mistakes on Hackster. We have message boards where we help them answer questions. We have webinars on a weekly basis where they get to ask questions and engage in Q&A with developers from headquarters of large companies that build products. And guess what, big companies make mistakes, too, and we often see companies releasing products first to the Hackster community to find errors in their firmware, in the instructions, or in the documentation. The big companies get feedback and are able to fix either the product itself or just some part of the technology. The faster you help people learn and shorten the feedback, the better the products get.

**Your mantra is “share, learn, and earn.” In fact, many start-ups aren’t that good at the earning part. They’re techies. They’re in it for the fun of creating new stuff – but first, they need to make money, don’t they?**

I’ve learned that the sooner you figure out your business model, the better. Of course, not all of

**Lots going on**

Projects Hackster members work on range from home automation to autonomous vehicles, IoT, industrial IoT, and fighting the global Covid-19 pandemic.

us are going to become the next Google or Facebook but, even so, you need to figure out how to create revenue fast because you can’t just keep going through round after round of fundraising. Yes, start-ups are important to job creation but people need to take profitability seriously. The business model has to be baked in early, not sometime later on.



**Start-ups are important but people also need to take profitability seriously.**

**Adam Benzion**  
Cofounder of Hackster.io

**You once said that tech is a form of art. Could you explain?**

Sure. In tech creation there’s a lot of fluidity, while in engineering, on the other hand, you need to be extremely precise. Ideation, the stage where you think hard and find out what it is you want to build, is truly more of an artistic process. You have to imagine and understand what something will look like, how it will feel to the human touch.

There are lots of things [in tech creation] that are very abstract and much closer to the art world than to the engineering world. Later, during the execution, it’s all about precision and excellence. Steve Jobs was famous for saying that tech is the intersection between the humanities and science and that you have to blend both to really get great products. He was right. You have to have the artistry baked into a product before you can design and build it as an engineer.

# DOCUMENTATION DAMN THE COST!

**H**ave you ever wondered how old the most important software packages in the world are? Spoiler alert: they're very old. Like aging populations, aging software systems are becoming a major problem all over the world.

When Covid-19 struck in early 2020, the US government ran into deep trouble. The computers running the US unemployment system, it turns out, were written decades ago in a language called Cobol. Unfortunately, virtually no one has used Cobol for years and most of the veteran programmers still fluent in it retired long ago.

The government sent out a call for help and IBM, eager to port the programs to a more modern system, tried to find enough old hands to do the job. It turned out most of them have already passed away. Houston, we have a problem!

Government agencies aren't the only ones. Banks and financial institutions still run hundreds of antiquated systems. Ninety-five percent of ATMs still use Cobol. About 80 percent of all in-person bank transactions are conducted on Cobol mainframe systems. It is believed that an estimated 220 billion lines of Cobol code are currently in use today. And, if that's not bad enough, most of these old clunkers are either poorly documented – or not at all.

If good mechanical engineers can get their hands on the original blueprints, they can build replicas of old ocean liners, vintage airplanes, or ancient steam engines. It's not so easy in the world of computers. Yes, guidelines for software documentation exist – but is anyone sure they're correct? Every time a computer program needs to be redesigned because of changing legal requirements, for example, or to access a new piece of hardware, who remembers to update the documentation? Anyone? Very, very rarely, I assure you!

Holger Hermanns, a professor in computer science in the CPEC Center for Perspicuous Computing at the University of the Saarland, Germany, has been calling for years for what he describes as "self-explanatory computer languages." Currently, even the author



**Who remembers to update the documentation? Anyone? Very, very rarely, I assure you!**

**Bernd Schöne**

is a German veteran in Internet journalism and an expert on data analysis.

of a piece of software often can't tell after three or four months which comment refers to which statement in the documentation, he argues. Computer code should be like a well-written novel. Anybody can read *Gone with the Wind* without having to refer to notes and commentary, but there is no such equivalent in IT today, he says.

Right now, Boeing is learning the hard way how challenging (and expensive) troubleshooting in software development can be.

Following two tragically fatal crashes of their 737 Max airliner, the plane's Maneuvering Characteristics Augmentation System (MCAS), which is said to have played a significant role in the accidents, needed to be reviewed and revised from top to bottom. In the meantime, the Federal Aviation Administration refused to let Boeing's bestseller take off again until the software bugs were fixed. The lack of proper, self-explanatory software documentation must have cost America's biggest plane maker extra billions.

An even more embarrassing mistake, at least for the programmers involved, was NASA's Mars Climate Orbiter (MCO), which was supposed to soft-land on Mars in 1999. Two teams wrote the code independently of each other but one, based in Europe, used the metric system while the other, in the US, used imperial units. The result was a huge pile of smoldering junk on the surface of the Red Planet.

Programmers certainly need to take more care with their homework. Detailed documentation at every step of development and revision should be a given. Even more important, at least in my humble opinion, is a requirement familiar to every architect who has designed a skyscraper: all designs have to pass muster under the scrutiny of a structural engineer. What we need in software development is a similar system of routine and obligatory checks by external, certified experts.

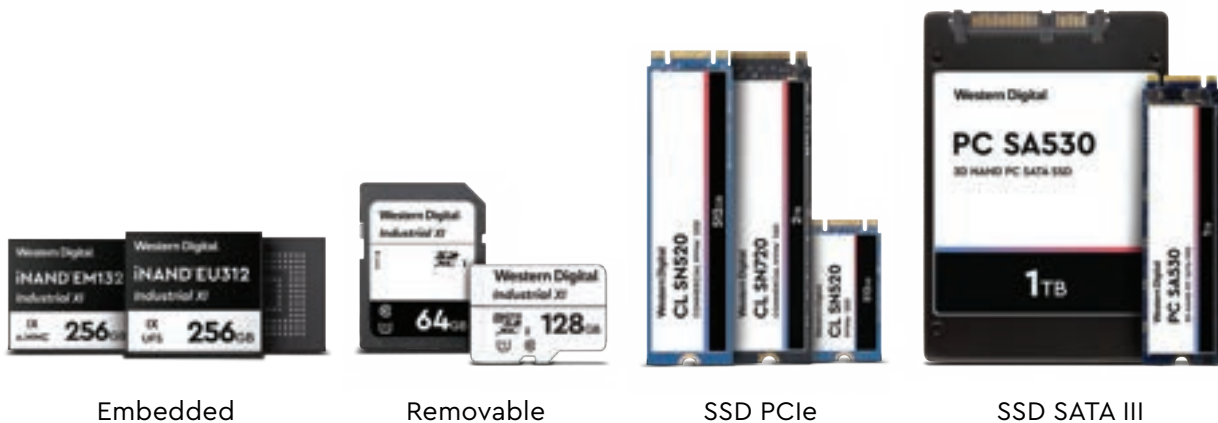
Will this cost money? You bet! Will it mean software projects will take longer? Certainly – but if it means major saving in lives, property, and reliability, then damn the time and the cost, I say!

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## Microsoft Azure

# CONNECTING STUFF ISN'T ENOUGH



**B**y 2025, the amount of data on the Internet will reach 175 zettabytes according to Node-Graph, a multinational data intelligence platform. That much data would take one person 1.8 billion years to download at the fastest current Internet speeds.

And now think of this: A single jet airplane engine generates around 20 terabytes of data per hour. So with two engines per plane and 200,000 planes in the air around the world for an average of four hours every day of the year, you end up with 12 zettabytes of data just from passenger airplanes.

Now add billions of other IoT devices, from elevators in smart buildings to your connected coffee machine at your smart home, and you start to get a feeling for just what the impact of IoT on the world of data will be.

There is simply no way corporations and organizations will be able to store these kinds of data locally. There is no alternative to the power of the cloud data centers – none!

Microsoft for years has been following an interesting strategy in order to enable customers to connect IoT devices to the cloud in a simple but secure way and to provide them the tools like artificial intelligence and machine learning. They call it Azure, and we at Avnet Silica are actively partnering with Microsoft to make this happen.

There are an awful lot of IoT devices already available today, from a simple connected button-battery sensor to high-end machines, PC-based gateways, or digital twins to provide sophisticated, real-time simulation models of just about everything. Getting all these devices to talk with each other is a huge challenge. Making this as simple

as possible is crucial. Azure Plug & Play is such a solution – a very simple, effective way to connect stuff. That way, companies can focus on the data and what it tells them, in effect taking their value to the cloud.

But simply connecting stuff isn't enough, of course. Companies also need to know how to set up cloud services and implement vital security protocols, as well as how to handle cryptographic keys and certificates.

Working closely with Microsoft, we here at Avnet have developed a really cool solution called IoT Connect, a highly scalable solution based on Microsoft Azure to address all the common industry needs and challenges, especially scalability. After all, every cloud solution for every customer is unique. One size doesn't fit all.

That's why the IoT Connect platform is a modular system that covers the connectivity, security, deployment, provisioning, up to database realization, cloud dashboards, and adaptation of further business data analytics. We think this is an excellent choice for companies that want to focus on their product, not on cloud development.

Of course, Avnet is best known as one of the world's leading distributors of components and sensors and stuff, and all this sounds very far away from our core business. But in fact, we have one great big exception in our line, and this is Microsoft. Together we make a perfect fit, because when we talk about IoT, we don't always talk about hardware, sensors, or microcontrollers. We also need to talk about security standards and protocols. By joining Microsoft in developing solutions based on Azure at an early stage, we can both offer customers a better way to handle all those zettabytes of data – and make money in the process!



**There is no alternative to cloud data centers – none!**

**Martin Grossen**

Supplier Business Manager at Avnet Silica, for Microsoft Europe

# Power Electronics

# SILICON CARBIDE AND GALLIUM NITRIDE MAKE INROADS

source © Getty Images

Semiconductor technologies based on Silicon and Gallium Arsenide have dominated the electronics industry for more than five decades helping to give us innovative and pervasive devices that have impacted our lives. Industrial equipment, car electronic systems, personal and mobile devices, wireless communications, and appliances powered by silicon facilitate tasks in our daily lives in ways that we take for granted.

In recent years the relentless quest for improved conversion efficiency has spurred the development of power semiconductor devices based on new materials such as wide bandgap (WBG) transistors and diodes. These products are based on both Silicon Carbide (SiC) and Gallium Nitride (GaN) technologies and are poised to gradually replace mature Silicon devices such as Power MOSFETs and IGBTs in power and energy-related applications.

The WBG device characteristics enable operation at high voltages and high temperature without compromising on-resistance or, put differently, without the need to enlarge the die area. Furthermore, WBG devices can work at higher frequencies which implies smaller and lighter passive components and therefore more miniaturization possibilities.

Today SiC MOSFETs are ahead of GaN transistors in terms of technology maturity. When used in the range from 650V to 1200V they have proved ideal for battery-operated vehicles pioneering the advent of high-performance electric cars. They are employed in the traction inverter but can also be used in the DC-DC con-



verter, on-board chargers and high-power charging stations.

As an example, let's take a typical 750V-bus car inverter delivering 210kW of peak power. A 1,200V SiC MOSFET solution has a five times smaller chip area and an increase in efficiency of 3.5% to 8% compared to a silicon IGBT solution of same voltage including freewheeling diodes. This is thanks to a drastic reduction of conduction and switching losses. This is key for electric car manufacturers as SiC solutions enable mileage extension for given batteries and more economical cooling systems.

STPOWER SiC planar MOSFETs from STMicroelectronics represent state-of-the-art technology and are available in the range 650V to 1200V with an extension up to 1700V for high-end industrial applications. Today's advanced SiC MOSFET lineup is the result of long-term investments in innovation and development dating back to the mid-90s and to collaborations with academic and research institutes. To drive large-scale adoption of Silicon Carbide ST is investing in



To drive large-scale adoption of Silicon Carbide ST is investing in production capacity and vertical integration.

**Filippo Di Giovanni**  
Power Transistor Division,  
STMicroelectronics

production capacity and vertical integration. This includes the acquisition of substrate-maker Norstel AB, long-term agreements that secure supply of SiC substrates from key manufacturers, as well as a rapid increase of capacity at its own facilities.

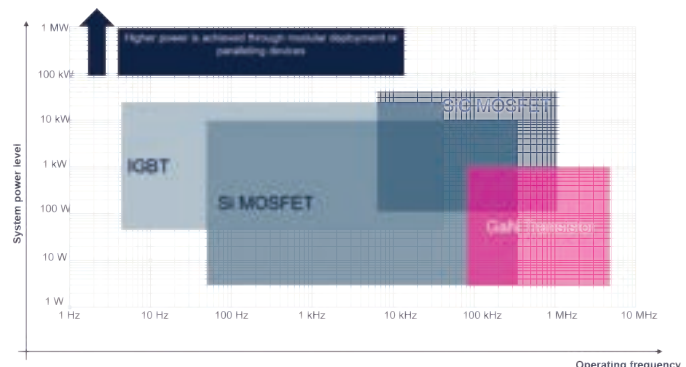
All this has made ST the leader in SiC supporting industry migration from silicon in applications fields including energy storage systems, renewables, and factory automation.

The other wide bandgap technology, Gallium Nitride, is highly complementary to SiC except for a small overlap at 650V. GaN HEMTs (High Electron Mobility Transistor) can work at far higher frequencies than SiC and are also offered at 100V which make them suitable for 48V mild hybrid electric vehicles. GaN is also a perfect candidate to replace silicon power MOSFETs in on board chargers, power supplies, adaptors, USB wall chargers and high-frequency converters in telecom and data centers.

ST complements the SiC MOSFET and diode portfolio with a complete product range of Gallium Nitride devices which will be available at 100V and 650V in a new packaging with low parasitic inductances for high-frequency operation.

### Positioning of power semiconductor technologies

Silicon and wide bandgap power technology positioning



## Smart Sensors

# THE INTERNET OF MEDICAL THINGS



Telemedicine is making a comeback as people become more health-conscious and **reliably accurate technology falls in price and size to allow wearable devices to become more functional.** Just as in wartime, the battle against Covid-19 has also accelerated the development of products that will create a healthier environment. The Internet of Medical Things is upon us with a vengeance.

■ By Bernd Schöne

**A** couple of decades ago, it seemed like everybody was talking about telemedicine – but then disillusionment set in. Today, thanks to powerful data networks, AI support, and lots of new, smarter sensors, the field is booming and giving rise to the term the Internet of Medical Things (IoMT). This new form of medicinal practice is safe, confidential, ubiquitous, and inexpensive, and it ranges from fitness to digital health and all the way to tele-rehab.

Telemedicine looks back on a long history. When Guglielmo Marconi's invention became popular in the early 1920s, radio was used to give emergency advice to doctors on ships. It wasn't until the Vietnam War began in 1955, when qualified front-



**A third of all patients don't need to visit the doctor for further treatment.**

line medical facilities were rare, that the US military thought to combine radio, television, and data networks to deliver specialist advice for injured troops who needed instant attention out in the swamps and jungles of Southeast Asia.

In the 1980s, telemedicine really took off as civilian research institutions became involved and numerous prototypes were developed. Very soon, sparsely populated regions such as Alaska or northern Norway wanted to benefit from the new technology, but implementing such systems was difficult. Costs were prohibitive, data networks were slow and transmission protocols still had to be standardized. Every sensor was an expense and had to be built from scratch; specialized semiconductors

were nowhere to be seen. Information about new applications flowed slowly to the public and general practitioners, so demand was low.

The turnaround came as late as the 2010s, when cheap fitness-tracking smart watches entered the market in droves. In 2017, around 36 million wristwatch devices were sold and this number is expected to surpass 50 million sales in 2022. Even more importantly, thanks to the rapid development of new types of sensors, the industry has been able to add features for things like blood glucose measurement and even electrocardiography (ECG) tracers to smart watches. Today, hundreds of new kinds of intelligent "wearables" are pushing into the market, from smart diapers to intelligent sticking plas-



ters. Caring for aging populations in the industrialized countries is also adding to the demand for devices.

Wearable technology is said to be an emerging trend that integrates electronics with daily activities and fits into our changing lifestyles. Market researcher Mordor Intelligence has estimated the 2019 wearables market at 216 million units and says it expects this to reach 614 million by 2025. Wearables can be worn on many parts of the body and the market divisions are based on product type, such as fitness tracker, smart watch, camera, head-mounted display, smart clothing, and ear-worn, body-worn, exoskeleton, and medical devices. Some companies, like Palmsens from the Netherlands, offer modular systems that allow new suppliers to build their own products. All they need is the sensor for the vital function to be monitored.

The market growth shows that customer acceptance, a suitable product range, plus a suitable market environment are the keys to success. Prices are falling thanks to high volumes and growth is accelerated because customers not only advertise the new product in their person- ➔

## Fraunhofer IPA Deep Breath

A thorax monitoring system from the Fraunhofer Institute for Production Technology and Automation (IPA) is so sensitive it has been used to measure the respiratory volume of a mouse without touching it. It has actually been devised for use with premature babies that need respiratory help from a ventilator. It's extremely difficult to determine the tiny volume of air necessary to keep them alive and conventional sensors are too large and an infant's extremely sensitive skin cannot tolerate these attachments.

The institute, based in Mannheim, Germany, has developed a contact-free sensor based on radio technology. A premature baby is placed with its chest between two antennas, one of which transmits in the UHF range while the other receives the signals which are affected by the baby's respiration. The measurements taken are then used to electronically calculate the breathing rate and volume.

The IPA scientists use the fact that lung tissue contains a lot of water, which has a high dielectric constant that significantly changes and

impedes radio waves. When the child breathes in, the air, which has a dielectric constant close to 1, reduces the overall dielectric value, which also lessens the inhibition of the transmitted signal. The difference in signal strength between inhalation and exhalation is used to calculate how hard the attached ventilator works and sets a rhythm that matches the baby's natural breathing rate rather than just forcing air in and out of the lungs.



source ©: Fraunhofer IPA

## MedWand Solutions Magic Wand



source ©: MedWand Solutions, Inc.

US start-up MedWand Solutions has developed a telemedicine module, also called MedWand, which is designed to monitor fitness and health. It may look more like a big computer mouse than a magic wand but its numerous sensors have no effect on PC operations. Instead, it conjures up the user's key medical data.

MedWand charges a monthly subscription for its service and also provides data access to doctors once they set up an account. Unlike fitness equipment, the highly versatile wand

must be used according to a doctor's instructions so that a diagnosis can be reached step by step.

The wand has several adaptations to allow a fairly comprehensive examination to be made remotely. Placed on the chest, it serves as an electronic stethoscope to listen to the heart and lungs. Move it down to the abdomen and the doctor can listen for anything unusual. It can also measure temperature and the oxygen saturation of the blood.

The electrical sensors can provide a single-channel ECG and the built-in camera can be transformed for use as an otoscope, ophthalmoscope, or dermatoscope by using the supplied accessories.

In addition to remote general health care and acute care for patients living in places where a doctor is not within reach, such as in crisis areas, mountain huts, ships, or on oil platforms, the wand is also intended to be used in postoperative follow-ups or in the rehabilitation of stroke sufferers.

al lives but are also willing to explain to others how to use it.

IoT-supported health care today covers all aspects of fitness, prevention, therapy support, and assistance for sick, disabled, and elderly people. The dividing line between mass-market wellness helpers and genuine medical equipment is now blurring. This is not without problems because almost everywhere in the world the requirements for precision in real medical devices are much higher than for mere gadgets like fitness trackers. Doctors sometimes criticize the gadgets for not being calibrated adequately, but correct use is equally important because only then can the measured values be meaningful.

The trend toward devices seems to be irreversible. Some large hospitals have now recognized the new billion-dollar market and offer the analysis of medical data as a service. A webcam is used to talk to a doctor's assistant, who is assisted by an AI-supported database. First experiences show that this is sufficient in a third of the cases and patients don't need to visit the doctor for further treatment. Middleware provided by the Canadian start-up Dialogue and the Swiss telemedicine group Medgate, for example, means that telemedicine is no longer the privilege of wealthy private patients. In more and more countries, health insurance companies are reimbursing the costs of telemedicine and telerehabilitation. Those who only need a prescription can use the video consultation service on the Kry platform, provided by the Swedish company of the same name.

Chip manufacturers have also recognized the trend and are working hard to develop new, highly integrated components for the next generation of telemedicine. The latest chips can record several vital parameters but have a footprint of only a few millimeters and consume extremely little power.

There are many exciting sensor developments that are building the new Internet of Medical Things.

### AI & IoT in Healthcare

## The Robot Will See You Now

source ©: Bangkok Post Public Company Limited, Luminus



In Thailand, IoT-supported robots have been deployed to help protect shopping center employees and customers from Covid-19. A 'Robot for Care' (ROC) and thermal scanners are employed to identify potentially ill people as they enter the enormous CentralWorld shopping mall in Bangkok. Once inside the complex, customers are kept as safe as possible with the help of automatic disinfectors that use ultraviolet light to keep the escalator handrails sterilised. In addition, a dog-like robot roams the ground-floor area

with an automatic hand disinfectant dispenser on its back to make it easier for customers to keep their hands clean.

The ultraviolet (UV) LED-based sanitizer for disinfecting the escalator handrails can also be used for masks, control elements and medical equipment. In Asia, such light sources are being fitted to AI-controlled robots to irradiate indoor areas when people are not around. A light source of only 1.3 mm to 5 mm in size destroys Covid-19 pathogens completely without chemicals.

The light used is in the UV-C range which, in this case, has wavelengths between 260 nm and 265 nm, shorter than the light used in sunbeds. It carries enough energy to reliably destroy the DNA of viruses, bacteria and fungi and has also been successfully used against MRSA germs in hospitals.

From 2025 onwards, healthcare is expected to be one of the most important applications for AI and IoT in China which has a shortage of doctors. The reasons for this are obvious, especially in rural areas where there are even fewer doctors available and there is a considerable lack of healthcare facilities of all kinds.

### Maxim

## Hearable Wearable

Modern in-ear hearing aids and cochlear implants enable patients with extreme hearing loss to connect wirelessly to smartphones or conference systems. More sensors are now being added to these aids to provide health data. A number of patents have already been applied for which enable electroencephalography (EEG), the electrical measurement of brain waves, using sensors on the hearing device. The measurement of vital functions, such as temperature, pulse, and heart rate, are also conceivable and, if the hearing aids are worn regularly, will open up an expanded therapy spectrum. Size is a limiting factor for in-ear technology and some of the circuit boards have four layers but only have a total thickness of 0.15 mm. The Maxim Integrated MAXM86161 chip, for example, is an optical biosensor that carries a complete optical data acquisition system. The sensor is extremely low-power and is specially designed for medical in-ear applications. It detects oxygen saturation, heart rate, and heart

rate variability to clinical standards of measurement. Its organic land grid array (OLGA) package only measures 2.9 mm × 4.3 mm × 1.4 mm yet it does not fit into a standard in-ear hearing aid. The potential benefits of the technology will put pressure on hearing aid manufacturers to make their devices even more compact.



source ©: Maxim Integrated



## Massachusetts Institute of Technology Smart Diaper

source ©: Massachusetts Institute of Technology



Modern diapers for babies and senior citizens contain a highly absorbent hydrogel and it's not always immediately apparent when a change is necessary. Both target groups are dependent on external help and often have difficulty articulating themselves. Researchers at MIT have developed a technology to inform nursing staff about the condition of the diaper. The system relies on a networked base station that monitors an

RFID chip over a distance of up to one meter. The information is transmitted to the nursing station computer or sends information to a smartphone. MIT is using a type of hydrogel that can act as the antenna element for the RFID tag when it gets wet. The tags costs less than two cents and can therefore be disposed of with the diaper – unlike currently available systems that need batteries and must be reused due to their higher price.

## Abbott FreeStyle Libre Sugar Snapshot

The FreeStyle Libre Sensor adheres to an area of skin on the back of the upper arm. A thin, flexible, sterile filament is pushed directly under the skin and taps off a tiny amount of blood (0.3  $\mu$ L). Within four seconds the sensor determines the exact blood sugar value and sends it to a handheld reader. The patch needs to be changed every 12 weeks. The values collected and stored by a proprietary reader provide a snapshot of a typical day's levels but long-term average values are also calculated. The software thus helps the patient to understand patterns and fluctuations in sugar levels better. The sensor is waterproof enough to survive when taking a shower or even a short bath (maximum 30 minutes).



source ©: Abbott

## Withings Heart Flutter



source ©: Withings

One of the most beautiful IoMT digital applications comes, ironically, in an analog wristwatch from Withings. The Move ECG watch has a built-in, one-channel ECG for detection of heart palpitations. It re-

records tiny glitches in pulse rates with the help of a medical-quality ECG and sends the information to a smartphone. One in four adults suffers from atrial fibrillation but it occurs episodically and is therefore difficult to detect. It would be pure coincidence if it occurred precisely when the patient was with the doctor and connected to ECG equipment. Move ECG has two electrodes on the back of its case which can record the ECG results as soon as the patient touches the watch's front bezel if they feel unwell. The record stays on the watch until it can be transferred to the smartphone app for analysis. If the attack is considered serious enough, the wearer is recommended to visit their doctor and, in preparation, a PDF document is sent so the doctor is aware of what happened.

## SteadySense Fever Patch

femSense reliably detects the increase in body temperature associated with ovulation and can also be used for patient monitoring during an illness or after surgery. SteadySense, an Austrian start-up, has come up with a tiny sensor in a patch that is attached under the armpit to continually measure temperature, for example in postoperative care where the system can check around the clock for fevers triggered by infections. The patch continuously stores temperature

values at preset time intervals and uses near-field communication (NFC) to transmit the record to a smartphone. Those medical uses will be a future spin-off because the sensor has been designed as the femSense Ovulation patch. Ovulation is accompanied by an increase in temperature and women can use the information from the patch to determine the perfect days for fertilization. The data is downloaded over NFC to a smartphone where the app delivers its conclusions.



source ©: SteadySense GmbH

# SMART COMPANIES



source ©: autoblog.com

## Toyota Motor Corporation

# Weaving a City

Carmaker Toyota plans to build the “city” of the future on a 175-acre site at the base of Mount Fuji in Japan. Called the “Woven City,” it will be a fully connected ecosystem powered by hydrogen fuel cells.

Envisioned as a “living laboratory,” Woven City will serve as a permanent home to residents and researchers, who will be able to test and develop technologies such as autonomous vehicles, robotics, personal mobility, smart homes, and artificial intelligence, in a real-world environment. “Building a complete city from the ground up, even on a small scale like this, is a unique opportunity to develop future technologies, includ-



**Akio Toyoda**  
President of  
Toyota Motor Corp.

ing a digital operating system for the city’s infrastructure. With people, buildings, and vehicles all connected and communicating with each other through data and sensors, we will be able to test connected AI technology ... in both the virtual and the physical realms ... maximizing its potential,” said Akio Toyoda, president of Toyota Motor Corporation. The company will invite commercial and academic partners as well as interested scientists and researchers from around the world to come and work on their own projects in this real-world incubator. Toyota has commissioned Danish architect Bjarke Ingels, founder of the Bjarke Ingels Group (BIG), to design Woven City. His team have designed many high-profile projects, from Two World Trade Center in New York to Google’s Mountain View headquarters. The masterplan of the city includes designations for street usage

split into three types: for faster vehicles only; for a mix of lower speed, personal mobility, and pedestrians; and for a park-like promenade for pedestrians only. These three street types weave together to form an organic grid pattern to help accelerate the testing of autonomy.

To move residents across the city, only fully autonomous, zero-emission vehicles will be allowed on the main thoroughfares. Throughout Woven City, autonomous Toyota e-Palette buses and trucks will be used for transportation and deliveries and will also serve as customizable mobile retail units.

It is planned to populate Woven City with Toyota Motor Corp.’s employees and their families, retired couples, retailers, visiting scientists, and industry partners. The plan is for 2,000 residents initially, adding more as the project evolves.

## Edico Genome

# A Disease-Slaying Dragen



source ©: Bioinformatics Inc.

Edico Genome's Dragen Platform is changing the way clinicians diagnose and treat deadly diseases by giving them crucial genetic information. Uncovering the links between genetic differences and human disease is the future of medicine, says CEO Pieter van Rooyen – one in which terminal diseases can be treated through immunotherapy and drugs that specifically target tumors, without the side effects of less-focused treatments such as radiation or chemotherapy. This is being made possible by the Dynamic Read Analysis for Genomics (Dragen) Bio-IT processor. "It's been developed specifically for genomic analysis, something that makes it significantly better than any software-based solution," van Rooyen said. The chip provides researchers and clinicians with rapid read analysis. Typically, a physician has to wait for the result of each test before he can order another one. "The great thing about the genome is, we can take on every genetic disease in one test," said Dr. Stephen Kingsmore, CEO of Rady Children's Institute for Genomic

Medicine in San Diego and the holder of the Guinness World Record for the fastest genetic diagnosis, which was accomplished using Dragen. Today's technology cannot yet sequence whole genomes because it involves processing massive amounts of data which must be done piece by piece. Dragen puts these sections back together to



**Pieter van Rooyen**  
CEO of Edico Genome

reconstruct the whole genome sequence.

"It's like shredding 800 phone books and then trying to piece each one together again," explains Gavin Stone, VP of marketing at Edico Genome. "What used to take an entire room of servers and 30 hours can be done by a single server in 20 minutes using our accelerator card with Dragen."

In addition to the obvious time savings, often critical in clinical environments, the solution drastically reduces the costs associated with genome sequence analysis – but IT isn't always a core competency in clinical environments. To get Dragen up and running, the Edico Genome team turned to Avnet for help.

"Avnet has dramatically simplified how Edico Genome deploys Dragen to its customers. For us, the customer experience is key. We want them to have a 'push-button' experience – they get a server that's pretested, preconfigured, and preinstalled with everything. All our customer has to do is plug it in," said Stone.

Dragen is being used in clinical settings to screen for cancer using a simple blood sample and can diagnose the disease much earlier than had been previously possible. "With these new techniques, in ten years cancer is going to become a managed disease and less like the epidemic it is. In ten years, everybody will be getting screened on a regular basis," predicts Stone.



source ©: www.avnet.com



## Interview

# A DIGITAL IMAGE OF THE REAL WORLD

*Smart Industry* sat down with **Prith Banerjee, CTO of Ansys**, a world leader in engineering simulation and product modeling, to discuss digital twins and the future of manufacturing.

■ By Tim Cole

**Digital twins, a kind of digital replica of physical machines and devices, are one of the hottest topics in the world of product development today, but few really understand what they are and what they can do.**

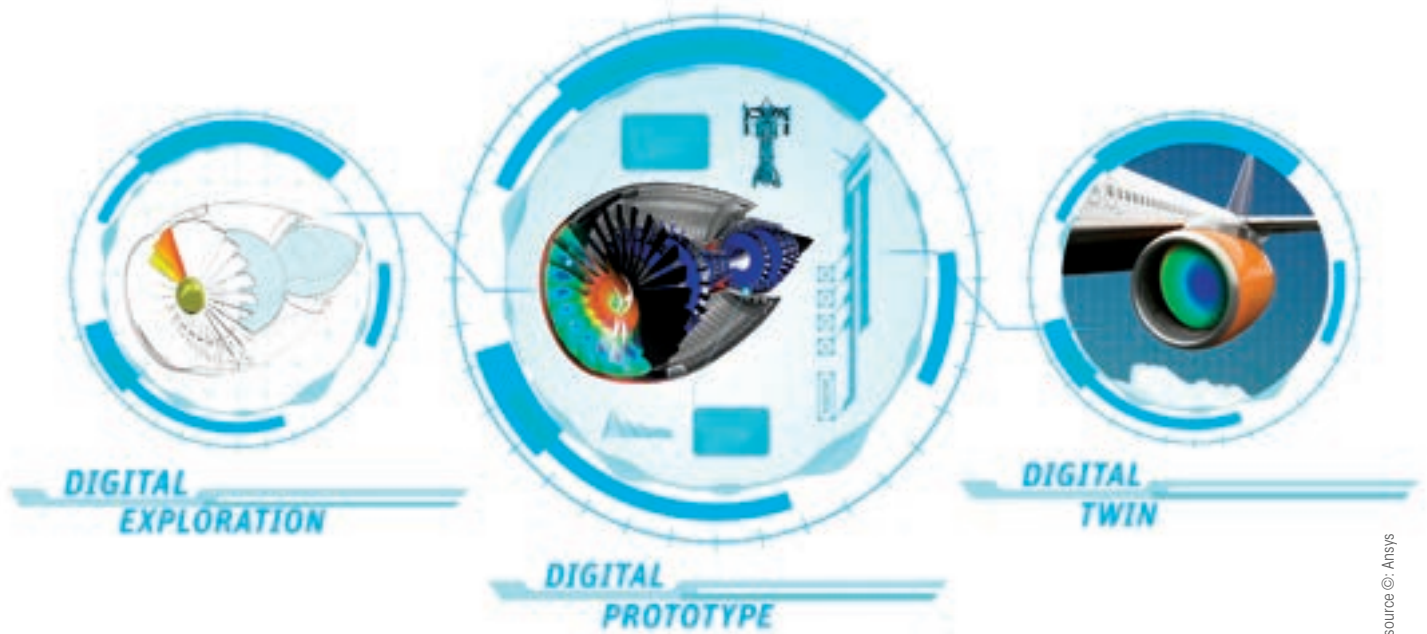
All of our customers who are building large physical assets are excited about digital twins. Before joining Ansys I worked as CTO at ABB and Schneider Electric. These companies have assets, like transformers, and they would like to have a virtual equivalent of that asset. Or, if you build airplanes, you would like to have a digital model of that airplane. If you make aircraft engines, you want to have a digital twin of that. All our customers want to have digital simulation models of their assets but it is important to stress that digital twins are more than that. They are tied to the physical asset through an IoT connection which allows you to continuously collect actual data from the real asset 24/7, and to update your digital model so that it is a completely accurate image of what is happening in the real world.

**Could you give us a few examples of digital twins at work?**

We work, for example, with a large company in France which builds and operates nuclear power plants and huge power generators – multimillion-dollar assets. We help them build digital twins of all their equipment. Or take the motor sports division of a major car manufacturer, who we have helped build electric vehicles using a six-step digital twin model. A third example would be a large industrial manufacturer which uses digital twins to design different types of compressors to help their salespeople show the value of their compressors to the customer.

**At least in theory, digital twins could span the entire life cycle of a product from creation through operation to disposal, couldn't they?**

We're already there. For instance, we are working closely with our many customers in the oil and gas industry



source ©: Ansys

to help them to design, build, and operate their assets, all the way to the end-of-life of those assets. When you design an asset, be it a pump or a valve, a transformer, a piece of equipment, or a data center, you usually use a CAD [computer-aided design] system, either a mechanical CAD or an electrical CAD. You need to analyze how good that asset is and that's where digital twins help you in the design phase. To build the asset, supposing you are using 3D additive manufacturing [3D printing], a digital twin model comes in handy. During operations, using an IoT-connected digital twin means you can exactly monitor what is happening at any given moment. We at Ansys like to call this "pervasive simulation," namely simulation based on digital twins that is being used in every phase of a product's life cycle.

**Where do I as a manufacturer start if I want to employ the digital twin concept?**

A good starting point would be remote monitoring. Suppose you have an asset like a transformer or an engine, or what have you, you first connect it through an IoT platform and you monitor exactly what is happening. This is something called data-based analytics: you measure the vibration, the temperature, or the pressure and try to observe any anomalies that occur and, as soon as you see one, you know the asset is about to fail. This is how you do predictive maintenance but the accuracy of such a data-based analytics sys-

tem is usually only about 60 percent at most. You may predict that this particular transformer will fail next Thursday but you will be wrong 40 percent of the time. If it is a million-dollar asset, you will make a \$400,000 mistake. This is where the simulation-based digital twin comes in because, through time-based accurate physical simulation, you can increase that accuracy to 99 percent. That means if you predict that your million-dollar asset will fail, it really will!

**Gartner says organizations will implement digital twins simply at first, then evolve them over time, improving their ability to collect and visualize the right data, apply the right analytics, and respond effectively to business objectives. Do you agree?**

This is exactly what I mentioned. The first step in digital twinning is to connect up your assets and do very simple, data-based analytics. Over time, you tie that simple, data-based analytics to physics-based simulation, which gives you a much better and more accurate digital twin model. It's a journey – you start simple and add more and more capabilities, for instance by tying in to your CAD or your simulation which, in the end, gives you a highly accurate digital twin model.

**Of course, nobody's perfect. How about digital twins – do they have limitations, too?**

When you build a digital twin, you need a model that is accurate and

**Physical Simulation**

During operations, using an IoT-connected digital twin means you can exactly monitor what is happening at any given moment.

fast. The trouble is that there is a trade-off. You can have a very accurate model but, if it takes 10,000 hours to come up with a model, that is of no use. We have a method we call the "reduced-order model" which is an approximation of a high-fidelity model. If you try to do it really fast, accuracy sometimes suffers. There are situations where the complexity of the multi-physical interactions – say, between the fluid flow, the structural flow, and the electromagnetic flow – may be so big that it becomes hard to get an accurate model. That would be a limitation.



**Digital twins are tied to the physical asset through an IoT connection, which allows you to collect actual data 24/7.**

**Prith Banerjee**  
CTO, Ansys

**How do you make sure your digital twin will fit your business needs today and tomorrow?**

Great question! Today, most of our customers are talking about using digital twins to improve their predictive capabilities in an operational setting. In the future, we will see more service value. Today, a compressor builder sells its customers a compressor unit which is maybe worth a couple of hundred thousand dollars. In the future – if they can guarantee they can provide compressed air wherever and whenever it's needed, and if their compressors are always up – they can provide the compressor as an asset to their customers and monetize it through "compressed air as a service." Air as a service – why not energy as a service, gas as a service? Digital twins will make such transitions possible.

# SMART PRODUCTS



## ElectricBrands More Than a Bus

German developer ElectricBrands has given an odd name to its latest vehicle: eBussy (electric bus system) which it claims to be the most innovative and modular light vehicle in the world. With more than 10 modular, interchangeable bodies and standard or off-road chassis options, eBussy can be transformed into a delivery van, station wagon, pick-up truck, camper van and, of course, a minibus in just a few steps.

The eBussy has a permanent, electronically controlled all-wheel drive and "unique all-steering system", as well as digital exterior mirrors and an

app-controlled communication system. With the help of integrated solar modules and recuperating drives (regenerative braking), it can easily cover a daily range of up to 200 km. The maximum range without charging, when the battery is full and the solar modules are working, is over 600 km. Without batteries, load or superstructure, the weight of the vehicle is 450 kg to 600 kg, depending on the transformation set used, and it is able to carry a load of up to 1,000 kg. Electric Brands plans to start shipping in late summer of 2021 with a starting price of €15,800. [electricbrands.de](https://www.electricbrands.de)



## Bosch Smarter Controls for eBikes

Bosch's Nyon onboard computer will make e-biking significantly smarter. The new controller is fully connected to the digital world of Bosch eBike Systems and automatically synchronizes the ride data using the associated Connect app and online portal. During the ride, the computer shows e-bikers the route to follow, provides fitness data for the workout, and lets them know how much longer they may ride in the selected support mode. The Nyon has a 3.2-inch color display that works even in rainy and dusty conditions. The display brightness and backlight automatically adjust to suit ambient light levels.



[www.bosch-ebike.com](https://www.bosch-ebike.com)



Three-Way Smart Dimmer Switch



Smart Light Bulb

## Treatlife A Lighter Price Tag

Allen Zhong, CEO and founder of Treatlife, has big plans: "My vision is to make smart-home technology accessible to all – we focus on making high quality, easy to use smart-lighting devices at a fraction of the price. We relentlessly keep costs low and sell our products directly so we can pass our savings on to our customers."

The company's products work seamlessly together without the need for a hub and are free of any subscription charges. At \$36.99 for a four pack, Treatlife's Smart Light Bulbs are affordable, easy to set up and completely customizable, the company claims. These can be complemented with a Three-Way Smart Dimmer Switch at \$29. All products can be controlled through Amazon Alexa, Google Assistant or Treatlife's free smartphone app. Currently the products can be ordered in the US and Canada, with distribution in other countries expected soon.

[www.treatlife.tech](http://www.treatlife.tech)



## Neat Subscription Devices for Zoom Rooms

Norwegian company Neat has been a specialist in video communications for decades and it is now offering a subscription service it calls Neat as a Service (NaaS). This allows Zoom video conferencing customers, outside the US, to deploy Neat's hardware devices in their meeting spaces. These tools include Bar, a speaker system incorporating a webcam; Board, a multitouch video screen which doubles as a whiteboard; and Pad, a handy tablet alternative to Board which can also be positioned outside the meeting room as an electronic noticeboard to show conferencing schedule and other information.

Neat claims that a subscription is a good solution for customers with offices and teams scattered throughout different countries because it can ensure a consistent global experience for all users. Video conferencing has proved to be a key tool in supporting continued productivity and driving stronger collaboration during the Covid-19 pandemic.

Zoom expects subscription models like this to be the future of video conferencing by eliminating up-front costs, reducing the complexity of deployment, and simplifying ongoing support. Customers currently paying for Zoom Rooms licenses can now add a NaaS subscription to make the budgeting and managing of their Zoom facility even simpler.

[neat.no](http://neat.no)



## iRobot A Coding Robot for Families

The customizable Root rt0 Coding Robot brings classroom learning into any home for a price starting at \$129. Coding has become a 21st century skill, as fundamental as reading, writing and math, and iRobot is looking for ways to teach children of any skill-level to code. The Root rt0 is a two-wheeled, mobile platform that operates on a flat surface. It comes to life – drawing, making music or exploring its surroundings – through commands given by the user in the coding app. iRobot Coding is designed to be easily approachable for beginners and, when coders gain experience, they may seamlessly 'level up' to more advanced programming. The robot comes with hours of lessons, projects and activities that support both individuals and group participation. The company also introduced its Brick Top accessory for \$20 to turn the Root robot into a mobile catapult, a robotic arm, a roaming music DJ, or even a glowing rocket ship.

[www.irobot.com](http://www.irobot.com)

**Kumpan Electric**  
**Electric Scooters Accelerate Change**

Personal transport is transforming and German startup Kumpan Electric wants to accelerate this change with its range of electric motor scooters. The latest models form the 54i range and for it Kumpan focused on the needs of consumers looking for a high-quality, entry-level model. The company says its scooter is controlled through an intuitive seven-inch touch display with three different driving modes – Comfort, Eco and Rain. The series consists of four models: Inspire, Iconic, Impulse and Ignite. The first two belong to vehicle group L1e with a top speed of 45 km/h. The Impulse (70 km/h) and Ignite (100 km/h) models are L3e class and will be available towards the end of 2020. The Inspire and Iconic are available now and prices start at €3,999.

[www.kumpan-electric.com](http://www.kumpan-electric.com)



**Samsung**  
**An Even Smarter Watch**



Korean tech-giant Samsung, one of the most successful manufacturers of smart watches, has hailed its Galaxy Watch3 as "a next-generation smart watch that combines timeless craftsmanship with cutting-edge health and wellness features." The standard version is made of stainless steel and high-quality leather but a premium titanium model is also available. This third generation device is 14 percent thinner, eight percent smaller and 15 percent lighter than the original Galaxy Watch. The Watch3 uses a rotating bezel to toggle between widgets, open apps or to scroll through notifications. Among the new features is the option to measure blood oxygen saturation and the new Health Monitor app also allows blood-pressure monitoring and electrocardiogram readings to be recorded in markets where these features are authorized. For older and unstable users, an automatic SOS-notification can be sent to chosen contacts if the wearer should fall. The watch will seamlessly interact with other Samsung Galaxy devices and calls may be received by hand gestures like clenching and unclenching a fist. The watch is available at prices between \$400 and \$500.

[www.samsung.com](http://www.samsung.com)

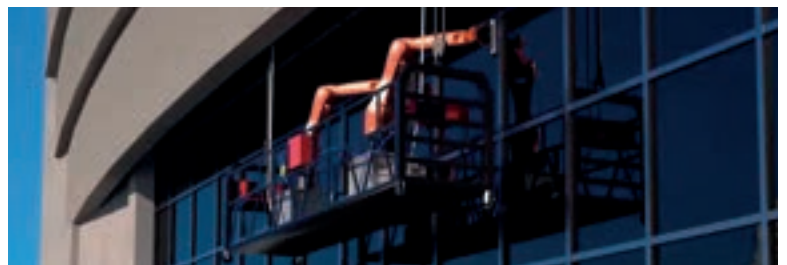
**Descript**  
**Typing Your Podcast Speech**

Descript, known for its AI-powered audio editing software, has added a tier of subscription for its podcast creation system, under the name Descript Pro. In addition to a basic recording environment, Descript Pro includes a synthesis tool with which users can create their own AI voice double – the company compares it with creating an audio-only "deep fake." This puts audio editing on a par with collaborative word processing apps, like Google Docs or Microsoft Word, by allowing a team to edit the text

of a transcribed audio recording. The entered changes are then automatically voiced in the audio playback by seamlessly inserting the original author's synthesized voice. The software also allows filler-word handling, which detects and deletes words such as "um," "you know," "like," and "kind of," to make recordings sound smoother and more professional. The subscription price for Descript Pro is \$30 for one month, reduced to \$24 per month if billed annually.

[www.descript.com](http://www.descript.com)

**Skyline Technologies**  
**Tall Order for Window Cleaning Robot**



While some companies have already come up with window-cleaning robots for houses or flats, Israeli startup Skyline Technologies has higher aspirations. With a combination of artificial intelligence and state-of-the-art robotics and sensors, Skyline's Ozmo is able to clean buildings up to the height of skyscrapers without the need to change or add to any existing cradles. The robot learns the building's façade, detecting nuances of complex

architecture, to enable it to devise the most-effective cleaning path. The service is aimed at maintenance companies, property managers and owners. Skyline claims that its service is up to six times faster than traditional window cleaning – as well as being safer and cleaner. There is still the need for staff to set up the system and Skyline claims it is employing former window cleaners to do the job. [www.skylinetechnologies.com](http://www.skylinetechnologies.com)



# Heterogeneous Memory and Storage Are Essential to Edge Success

## The Intelligent Edge

The hype of billions of devices connected through IoT sounds promising. Connected, sustainable factories will help industries thrive, while collaborative health care systems, and a highly personalized consumer experience will improve our quality of life. But getting zettabytes of data from these endpoints and pushing that intelligent information through a constrained network infrastructure requires a new approach that brings compute and analytics closer to the source of data.

IoT Edge solutions will bridge these endpoints to the cloud to bring compute and artificial intelligence (AI) closer to where the data is captured, where data aggregation and real-time response must occur. To win the race to the network edge, new workloads incorporating new software paradigms and business models will inspire new collaborations with traditional OEMs and IoT platform providers to develop new strategies.

## Evolving Architectures

The use of hobbyist gateways will evolve to more sophisticated architectures that pack more compute and storage for on-site processing of information, and will need:

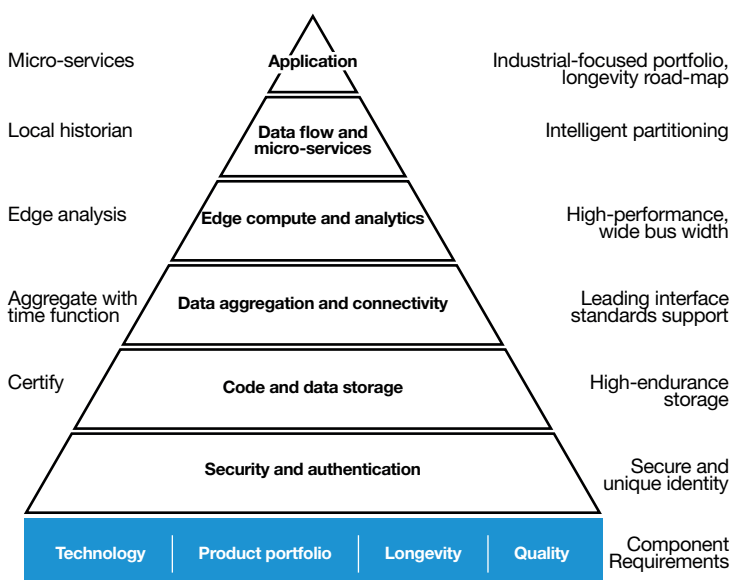
- Data aggregation and connectivity in real-time
- Multicore processor systems with hardware AI accelerators that support deep learning inference and higher compute requirements
- Embedded local storage for on-premise data management
- New software middleware and APIs to support network virtualization and containers for microservices

## Memory and Storage for the IoT Edge

This new breed of edge devices will require high-performance DRAM to support AI, managed NAND solutions with features and densities to support code size and complex OS functions, and high-endurance storage for on-premise data logging and historian systems. Micron memory and flash storage have been foundational for collecting, processing, and sharing the data that unlocks business insights and outcomes for industrial IoT devices.

### Edge Functions

### Memory Requirements



## Micron Intelligence Accelerated at the IoT Edge

As the leader in industrial and automotive applications, Micron offers the industry's broadest memory and storage solutions to support the essential demands of the IoT edge:

- High-performance DRAM/LPDRAM and modules for compute and deep learning at the edge
- Broad NOR/NAND portfolio for code and data storage versatility
- Multichip package (MCP) solutions for space-constrained applications and cellular IoT modules
- Industrial-grade e.MMC, PCIe NVMe flash storage SSD, and SD/microSD solutions for on-premise storage



**Wil Florentino**  
Senior Segment Marketing  
Manager for Micron's  
Embedded Business Unit

# A NEW WORLD



**T**here are historical moments when the future changes direction. We call them bifurcations – or deep crises. These times are now. The world as we know it is dissolving but behind it comes a new world, the formation of which we can at least imagine.

For instance, in 2020, we dramatically changed our views on how, when, and where we need to travel. The key question is: can the entire global airline industry pivot faster than any other industry has before?

Airplane manufacturers are in serious trouble but are finally beginning to dedicate much or even most of their resources to fast-tracking R&D on carbon-neutral airplanes. The next wave of disruption is already visible on the horizon: mandatory carbon taxes for every single flight ticket purchased, and for every means of transportation that isn't carbon-neutral. Cruise-ship operators and shipping companies are still suffering, scrambling to pivot away from combustion engines.

For those that still can't or don't want to fly, in the future, airports will be busy adding virtual travel and holographic teleportation options. Soon, I will be able to go to the "airport" and step into a \$2 million holographic studio to give three talks in three different parts of the world, all in a single day. Nice.

In 2019, I hopped on over 300 flights to give keynotes all over the world. No matter how hard I pushed and pulled, I just couldn't get my clients (or their agencies) interested in remote appearances. Less than a year later, remote and virtual working has finally become a realistic, even desirable, option for many of us.

No matter what business you're in or where you're based, working from home, remotely, virtually, or digitally, has become completely acceptable, as well as technically feasible for almost everyone. A whole new "remote working" industry is unfolding, and new technologies like holograms and mixed-reality applications are being rolled out quickly. Even Second Life is rumored to be planning a comeback (no thanks!).

In 2020, digital conferencing became as normal as chatting on WhatsApp. Once everyone learned how to do it, there was no stopping it. Zoom has become the new YouTube and this is only the beginning as the rising tide of

#remoteeverything will float all boats. Yes, we continue to struggle with significant "digital divide" issues because fast Internet access is still not available everywhere and good mics, cameras, and software are still way too expensive. But due to the Covid-19 crisis the global 5G rollout is now going into warp drive, with waves of new investments coming in, and governments clearing the regulatory hurdles even faster. Seven billion people are expected to be connected at high speeds within the next five years.

Sure, real-life human contact and face-to-face interaction was never, and will never be, replaceable by virtual meetings – au contraire, during the 2020 crisis we realized how important personal and social interaction is. As we suffered through the tough period of "social distancing" during those three terrible months in the spring of 2020, many of us (me included) started to crave for actual human contact more than anything else. Yet, we adapted because we simply couldn't go, and now meeting, talking, collaborating, learning, and conferencing remotely is the new normal.

Unprecedented scientific collaboration is one of the most positive outcomes of this crisis and has now become the default approach to solving global scientific challenges. This represents a hugely positive change, with the potential to save millions of lives going forward. What happened in this crisis will also become a blueprint for hyper-collaboration for tackling our next big challenges: artificial general intelligence (AGI) and artificial super intelligence (ASI), geo-engineering, and human genome editing (among others).

In March, my colleague Azeem Azhar proposed that this crisis will reinforce the importance of genomic technologies: "We're able to use rapid sequencing techniques to start to understand the epidemiological characteristics of this outbreak, by tracking genetic drift." Today, this is on top of the global agenda.

These are only a few of the world-shaking changes that are happening in the wake of Covid-19. As the famous economist Milton Friedman once wrote: "Only a crisis – actual or perceived – produces real change."

This crisis is a precious opportunity. It would be a shame to waste it.



**Working from home, remotely, virtually, or digitally, has become completely acceptable and technically feasible for almost everyone.**

**Gerd Leonhard** is the founder of The Futures Agency (TFA) and author of the bestseller *Technology vs Humanity*. He is based in Zurich.

# SMART INDUSTRY PODCAST






## WE TALK IOT, THE SMART INDUSTRY PODCAST



Welcome to We talk IoT, a regular series of podcasts from the editors of Smart Industry – the IoT Business Magazine. Our podcast keeps you up to date on the most important developments in the world of IoT, IIoT, Artificial Intelligence and Cognitive Computing. Listen to leading industry experts, business professionals and experienced journalists as they discuss some of today's hottest tech topics and how they can help boost your bottom line.

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