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COMMENT  
Europe needs to wake up to the problem of illegally exported electronic waste, according to a new report

Virtual sound bubbles could herald the end of traditional headphones, according to researchers

CEA-Leti develops prototype next generation optical chemical sensor using mid-infrared silicon photonics

Companies partner with the Digital Catapult to launch the UK’s latest facility dedicated to network technologies

At this year’s Toy Fair STEM and coding took centre stage as exhibitors responded to a new school curriculum

COVER
Securing our airports
Following the drone intrusion at Gatwick airport calls are growing for more effective counter measures. By Neil Tyler

EMBEDDED SYSTEMS SPECIAL
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When development never sleeps
Development techniques from the cloud promise much faster updates for embedded firmware, as Chris Edwards explains

RESEARCH & DEVELOPMENT
Removing the guesswork
imec’s Rudy Lauwereins looks at how artificial intelligence could be helping to transform our lives by 2035

EMBEDDED WORLD PREVIEW
New Electronics takes a look at this year’s Embedded World exhibition

EMBEDDED SYSTEMS
AI options for embedded systems
By using artificial intelligence, embedded developers can look to deliver the smartest solutions possible, as Cliff Ortmeyer explains

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Playing to our strengths
Cypress Semiconductor’s CEO, Hassane El-Khoury, talks to Neil Tyler about addressing current market demands and future prospects

INTERCONNECTION
Improving reliability
Cryogenics plays an increasingly important part in electronics. The components need to be both reliable and well designed. By Neil Tyler

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With the rollout of 5G expected to ramp up in 2019, a complete spectrum of test & measurement solutions will be required

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According to a new report that tracked shipments from 10 European countries over two years, the UK has been found to be the worst offender in Europe for illegally exporting toxic electronic waste to developing countries.

The investigation, which was carried out by the environmental watchdog the Basel Action Network (BAN), used GPS trackers to monitor equipment, such as monitors and computers, that were placed in recycling facilities in 10 European countries. Those items were then tracked and ended up in Ghana, Nigeria, Pakistan, Tanzania, Thailand and Ukraine.

According to the EU, toxic waste is hazardous as it contains a variety of substances such as lead and mercury. The export of this waste to non-OECD or non-EU countries is meant to be illegal under EU law.

Disappointingly, the UK came top of the list of suspected illegal shipments although Ireland, Denmark, Italy, Spain and Germany were also found to be exporting waste illegally.

Shockingly, by extrapolating those illegal exports with figures on electronic waste generated throughout Europe, BAN has estimated that over 350,000 metric tonnes of electronic waste could be illegally being shipped from the EU each year.

That should be a real concern for the electronics industry.

As Jim Puckett, director of BAN said, these illegal shipments perpetuate an EU waste management regime that’s built “on the backs of the poor and vulnerable.” It also suggests that a very significant stream of illegal hazardous shipments of electronic scrap is being shipped, seriously undermining EU claims that it is working hard to prevent this kind of trade.

This waste is particularly dangerous in some of these recipient countries because, as the report stated, due to a lack of proper waste management there is open burning of e-waste, which then leads to the contamination of local crops as well as having a significant impact on the health of the local population.

The UK Environment Agency has responded by saying that while it takes these matters seriously – as it should – the challenge is vast.

While there are problems associated with tracking this trade, more should be done to prosecute those taking advantage of this illegal trade.

Despite regulation export rates are far too high and, in truth, the figure of 350,000 tonnes could be little more than the tip of a very large iceberg.

More worringly, there is a large business lobby that is seeking to allow low value electronic waste to be shipped because it will be ‘repaired’ in developing countries – the loosest of loopholes!

Hopefully politicians here and in the EU will block this underhand attempt at exporting our electronic waste and focus on effectively tackling this dangerous trade.

Neil Tyler, Editor (neil.tyler@markallengroup.com)
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armStone™ MX8M is a high-performance Single Board Computer in PicoITX form factor. The module will be available for minimum 10–15 years.

The Cortex®-A53 CPU (64 Bit) from the i.MX 8 processor family is available in Dual or Quad, as well as with an additional Cortex®-M4. The processor is very well suited for multimedia applications (video decoding up to 4K, UltraHD is possible) and the Cortex®-M4 core can be used for real-time processing.

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VIRTUAL SOUND BUBBLES

NEWS

Coming in loud and clear

HEADPHONES COULD BE A THING OF THE PAST WITH A NEWLY DEVELOPED SYSTEM THAT CREATES SEPARATED AND MULTIPLE SOUND ZONES. BETHAN GRYLLS REPORTS

A unique sound algorithm that produces isolated ‘bubbles’ of sound so that multiple people can listen to different sound tracks in the same room without disturbing each other has been developed by Taewoong Lee of Aalborg University.

“This sound zone concept is not new,” explains Lee. “The concept has been proposed almost two decades ago. However, there are still technical challenges. One of the biggest is leakage from another zone.”

He elaborates, “It is often clearly audible while you are enjoying your own audio content. We have found some mathematical approaches to solving this problem. In other words, we now are able to make the bubbles more clearly separated.”

It uses “constructive and destructive interference”, continues Lee. “We aim to control multiple listening areas for different audio content in the same space without using headphones.”

Lee explains that there are two steps that need to be taken in order to create multiple ‘listening areas’ i.e. specific spots that produce different audio.

“We create two types of zones, one where the sound pressure level is very high – namely the listening area – and a quiet zone, where the pressure is as small as possible. Once these are defined, the audio content will be played back from loudspeakers to the listening zone while it is suppressed in the quiet zone,” he says.

“The sound pressure level on those zones are controlled by filters. We design those filters for each loudspeaker so that the zones are created as intended. Then we can obtain multiple listening areas for different audio contents when they are added (or overlapped) together.”

Lee admits for now his work remains in the research stage since there are still many practical challenges but adds that there is great commercial potential. For example, in cars so that children in the rear seats can watch movies while parents listen to the radio in the front seat. The team is currently in the process of patenting the technique.

ST acquires stake in Norstel

ST Microelectronics has signed an agreement to acquire a majority stake in Swedish silicon carbide (SiC) wafer manufacturer, Norstel.

After closing, ST will control the entire supply chain for a portion of its SiC devices at a time of constrained global capacity and positions itself for a significant growth opportunity.

ST will acquire 55% of Norstel’s share capital, with an option to acquire the remaining 45% subject to certain conditions, which, if exercised, will result in total consideration of $137.5 million, funded with available cash.

According to Jean-Marc Chery, President and CEO of STMicroelectronics, ST is currently the sole semiconductor company with automotive-grade silicon carbide in mass production.
Data-transmitting light signal

Researchers from Aalto University and Université Paris-Sud have significantly improved the propagation of data inside a microchip. They have developed a nanosized amplifier that is able to help light signals propagate through microchips and shown that signal attenuation can be significantly reduced when data is transferred inside a microchip, for example, from one processor to another.

“Photonics, or light transfer that is already widely used in internet connections, is increasingly being used by microcircuit systems because light is a more energy efficient and faster way of transferring data than electricity,” said doctoral candidate John Rönn.

The researchers made their breakthrough with the help of a Finnish invention: the atomic layer deposition method. According to the team, using this method it is possible to process various kinds of microcircuits, and possible applications also exist in photonics.

The team showed that a light signal can be potentially boosted in all kinds of structures and that the structure of a microchip is not limited to a specific type. The results indicate that atomic layer deposition is a promising method for developing microchip photonic processes.

Raspberry Pi to open high-street shop

Raspberry Pi – the maker of low-cost, credit card-sized PCs – has opened its first bricks-and-mortar shop in the UK. The shop in Cambridge means that it joins a number of e-retailers, including Amazon, who are looking to buck the trend of high street closures.

Raspberry Pi’s first shop is designed to be an experiential space, offering an environment in which visitors can try their hand at programming.

Alongside a large range of existing products and merchandise, the shop will also offer a brand new “Everything you need to get started with Raspberry Pi” kit; this includes the latest Raspberry Pi 3 Model B+, alongside a complete set of official peripherals, and everything a beginner needs to get started with programming their PC.

Eben Upton, CEO of Raspberry Pi (Trading), said, “Opening this shop, and introducing the new kit, are important steps to achieving broader adoption of our products and better understanding the needs of users.”

Next generation mid-infrared optical sensor

CEA-LETI HAS DEVELOPED A PROTOTYPE NEXT-GENERATION OPTICAL CHEMICAL SENSOR USING MID-INFRARED SILICON PHOTONICS. NEIL TYLER REPORTS

CEA-Leti has revealed that it has developed a prototype next-generation optical chemical sensor, using mid-infrared silicon photonics, that could be integrated into smartphones and portable devices.

Mid-IR chemical sensors operate in the spectral range of 2.5µm to 12µm and are considered to be at the cutting edge of innovation in silicon photonics.

Chemical sensing has become a key application for these devices because of the growing potential of spectroscopy, materials processing, and chemical and biomolecular sensing, as well as security and industrial applications.

The coin-size, on-chip, IoT-ready sensors prototyped by Leti combine high performance and low power consumption and enable such consumer uses as air-quality monitoring in homes and vehicles, and wearable health and well-being applications. Industrial uses could include a range of worker-safety applications.

“Mid-IR silicon photonics has enabled the creation of a new class of integrated components, allowing the integration at chip level of the main building blocks required for chemical sensing,” said Sergio Nicoletti, lead author of a paper titled “Miniaturization of Mid-IR Sensors on Si: Challenges and Perspectives”, presented by CEA-Leti at this year’s SPIE Photonics West 2019.

“Key steps in this development extend the wavelength range available from a single source, handling and routing of the beams using photonic-integrated circuits, and the investigation of novel detection schemes that allow fully integrated on-chip sensing.”

CEA-Leti’s breakthrough integrated a mid-IR laser on silicon; developed photonic integrated circuits (PICs) in the mid-IR wavelength range and miniaturised a photoacoustic detector on silicon chips.

Arduino unveils the Arduino IoT Cloud

Arduino, the open-source hardware and software platform, has introduced an IoT Cloud as part of its professional IoT strategy. Targeted at developers, system integrators and maker hobbyists, the Arduino IoT Cloud is an IoT application platform that enables users to develop and manage applications more effectively.

Commenting Luca Cipriani, Arduino CIO, said, “Arduino now provides its millions of users with a complete end-to-end approach to IoT that includes hardware, firmware, cloud services and knowledge. This public beta release of the Arduino IoT Cloud, with automatic dashboard generation, webhooks support, and full TLS secure transport, will be an invaluable asset to users.”

A major benefit is its ability to programme Arduino boards, whereas previously users were required to programme them via Arduino Sketch. The Arduino IoT Cloud can quickly and automatically generate a sketch when setting up a new thing, thus enabling a developer to achieve a working device within five minutes of unboxing a board.

The Arduino IoT Cloud also allows other methods of interaction, including HTTP REST API, MQTT, command-line tools, JavaScript, and WebSockets.
Digital Catapult launches the Future Networks Lab

LEADING COMPANIES PARTNER WITH DIGITAL CATAPULT TO LAUNCH THE UK’S LATEST DEDICATED FACILITY FOR NETWORK TECHNOLOGIES. NEIL TYLER REPORTS

Digital Catapult has partnered with Siemens, BT, PTC, IBM, ServiceNow, Semtech and Texas Instruments to launch the UK’s newest dedicated facility for leading edge network technologies: the Future Networks Lab.

The Future Networks Lab has been set up to provide a place for start-ups, corporations and network platform providers to collaborate through access to technical expertise, innovation support and advanced digital infrastructure facilities including all leading LPWAN technologies (including LoRaWAN, SigFox, NB-IoT and LTE-M), and provides a 5G node that builds on the success of the Catapult’s Brighton 5G testbed launched in September 2018.

The Digital Catapult and its partners will use the Future Networks Lab to demonstrate the practical application of their own IoT solutions and products, showcasing how organisations of all sizes can exploit the potential of these technologies at scale.

To help solve these challenges and provide more opportunities to create network connectivity solutions proven in the field, the Future Networks Lab has been designed to support UK businesses of all sizes to research, develop and adopt the latest network solutions and prototypes in a dedicated space for open innovation.

Commenting Jeremy Silver, CEO, Digital Catapult, said: “Today’s companies need modern, efficient and resilient technological infrastructure. Digital Catapult’s new Future Networks Lab will provide some of the key building blocks to help unlock that developing infrastructure and the new services which will run on it. We’re excited to launch this new facility alongside some of Britain’s leading players.”

“Showcasing the world’s leading Internet of Things (IoT) solutions to developers and early corporate adopters allows the Future Networks Lab to give innovative companies hands-on access to LoRa Technology and IoT expertise,” added Vivek Mohan, Director of IoT in Semtech’s Wireless and Sensing Products Group.

“This cooperative, vendor-neutral space, will help to foster innovation, reduce the time to market for LoRa-based solutions and help in growing the LoRaWAN-based ecosystem in the UK.”

Diodes acquires Greenock fab

Diodes has announced that it has bought the old Natsemi fab at Greenock which was acquired by TI when it took over Natsemi. Diodes said that it will integrate the facility and fab operations, including the transfer of all employees to Diodes.

In addition, as part of a multi-year wafer supply agreement, Diodes will continue to manufacture TI’s analogue products at the site as TI transfers into its other wafer fabs.

The Greenock fab has a potential capacity of up to 21,666 wafer starts or 256,000 8” equivalent layers per month, depending on the mix or product.

Commenting on the purchase Diodes’ CEO Dr. Keh-Shew Lu said that it aligned well with the company’s strategic plan for significant revenue and profit growth over the next several years.

“The Greenock facility offers additional wafer fab capacity to support our product growth, in particular our automotive expansion initiatives, as well as excellent engineering skills and wafer fab know-how to support our technical and operational performance expectations.”

Chip sales top $468bn in 2018

Last year chip sales were up almost 14 percent on the preceding year, hitting a record $468.8 billion, according to figures from the SIA.

Sales in December were $38.2 billion, up 0.6% on December 2017, but down 7% on November 2018. Fourth quarter sales totalled $114.7 billion marginally higher than Q4 2017 but over 8% below Q3 2018.

“Global demand for semiconductors reached a new high in 2018, with annual sales hitting a high-water mark and total units shipped topping 1 trillion for the first time,” said SIA CEO John Neuffer. Although market growth slowed during the second half of 2018, he said that the, “long-term outlook remains strong.”

Memory was the largest semiconductor category topping $158 billion in 2018, and was the fastest growing. Sales were ahead by 27.4%.

Logic ($109.3 billion) and micro-ICs ($67.2 billion) rounded out the top three product categories in terms of total sales.
Worth £3.3billion, the toy market is thriving; and with STEM being the buzzword at this year’s Toy Fair, it’s one to watch. This growing trend can be attributed to the new school curriculum that now incorporates coding, according to a number of exhibitors. “Teacher’s skillsets aren’t at a point yet where they can pick up a robot and design a lesson around it. They need support,” said Binary Bots’ Head of Business Development Tim Hill.

Binary Bots’ ‘Cardboard to Code’ kit is designed to provide basic knowledge of inputs, outputs and how the code interacts with a real-life object. The products were developed around teacher and child feedback, according to Hill, and based on something he describes as ‘integrated and engaged learning’. Coding in school is usually screen-based, he noted, yet the enjoyment and benefits, i.e. retention, children reap when they can see the actual physical reactions of their work is a far more effective teaching technique.

“Approximately 70% of attention is lost with didactic teaching. If you introduce interactive learning, you’ll capture about 90% of class’ attention.” He highlighted the Binary Bot Flat Pack Robot set as a prime example – a toy where the child builds the robot, adds the components, and then codes it in order to bring it to life.

Great Gizmos also identified STEM as driving demand, offering coding kits like Code A Maze which includes a robot, that poses a challenge (e.g. get from point a to b), a mat on which the robot travels, and a set of cards with arrows on. Once a challenge has been set, the child programmes the robot’s route by placing the appropriate (direction) cards against the mat.

According to Judith Dayus, MD of Great Gizmos, this will help children to start thinking about what steps are required to move a robot in a certain direction – skills that can be transferred to coding.

Clementoni showcased a similar toy within its ‘Coding Lab’ range, comprising of ‘PetBits’, ‘Mind Designer’, and ‘RoboMaker’. The latter offers the opportunity to build and code 5 different robots of increasing complexity. The most intricate, ‘X5-Droid’ can pick up objects and sort them according to colour.

Despite coding being a clear objective for many of these toys, it is apparent that the toy sector is also influenced heavily by the technology trends emerging in everyday consumables. For example, wearable devices and augmented reality (AR).

Tech Will Save Us leverages the popularity of such technology with its ‘Creative Coder’, a device that lets children make their own wearable device through manipulation of the accelerometer and LED lights.

While TrendsUK’s stand featured a range of AR-based technology, including its V8 engine kit. In this pack users are provided with the tools to not just build a working motor, but have the opportunity to extend learning with a complementary app that augments the engine through a phone. This means the user can see how the engine works from different angles, pull layers away and read about each component.

“AR is becoming a huge market in the toy industry since phones and tablets have become a bigger part of children’s lives,” confirmed Graham Spark, Sales Director at TrendsUK. “It increases the learning opportunity more because researching about the components themselves is difficult. We’re making it accessible and fun.”

While Oliver Claxton, EMEA Sales for Tech Will Save Us, noted that as a result of increased mobile device usage, it is vital for toy firms to encourage positive screen time. He added that with no obvious “peak” in sight the toy sector is set to see further strong growth. “Coding will become the new language. The only limitation for the toy industry right now is the price point,” he admits. “We’ll never have the most up to date technology in toys. But as tech evolves, the price of integrating it will become cheaper.”

**Toy Fair 2019**

**Toying with tech**

**CODING WILL BECOME THE NEW LANGUAGE, SAYS TOY INDUSTRY EXPERTS.**

**BETHAN GRYLLS REPORTS**

**“Teachers need support to deliver interesting and effective coding lessons”**

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The unauthorised intrusion of a drone over Gatwick airport has triggered calls for more effective counter measures. By Neil Tyler

At the end of 2018 Gatwick airport and the UK authorities were forced to bring in military teams, using advanced techniques developed on the battlefield, to search for an unauthorised drone buzzing the airport’s runway.

Although no drone or pilot was found, the impact on the airport was serious and Gatwick was closed for an unprecedented 33-hours.

The economic impact only came to light in January when the budget airline easyJet said that 80,000 passengers had been caught up in the ‘mayhem’ and that it had to cancel over 400 flights, at a cost to the airline of over £15million.

In total 1,000 flights were disrupted with over 140,000 passengers inconvenienced, suggesting the total cost to the airport and industry was anywhere between £50-100million.

The Chief Executive of easyJet, Johan Lundgren, described the closure as a “wake-up call to airport operators around the world.”

According to Geoff Moore, business development manager at Blighter Surveillance Systems, “The events at Gatwick really didn’t come as a surprise. The industry has been talking about this kind of event for some time.

“Airports are a commercial operation and most of the regulations concerning them are not mandatory, there is nothing currently in place to defend airports against drones.”

Richard Gill, CEO of Drone Defence added, “All airports face various demands on limited resources when it comes to mitigating risk. Up until easyJet’s impact assessment, which worked out at around £1.5million per hour, the industry didn’t have a benchmark figure to work with. Now with actual figures they can start to create a realistic budget to counter this threat and invest accordingly.”

Moore said, “Managing an airport is about managing risk and now we can put a cost on disruption caused by drones.”

As drones become more popular more are now being fitted out with high quality photo/video sensors and can operate with considerable power reserves, giving them a much wider field of action.

“While the number of commercial flights in the air at any one time totals around 15,000, there are millions of drones in operation,” said Moore, “and as more piloted and semi-autonomous drones enter our air space so there will be more accidents or near misses.”

British and US authorities have recorded a growing number of collision alerts but, while the risk of collision may be growing, of greater concern is the payload capabilities of certain drones which could be used for terrorist activities.

As a result, securing airports against unauthorised intrusions by drones is now being taken more seriously.

“While the number of commercial flights in the air at any one time totals around 15,000, there are millions of drones in operation,” said Moore, “and as more piloted and semi-autonomous drones enter our air space so there will be more accidents or near misses.”

Much of the focus with anti-drone technology tends to be on specialist radar and thermal imaging techniques - the aim being to detect, track
Jamming implementations
Drone Defence has developed a range of solutions to combat drones that target radio communications.
“We focus on the link between the drone and its pilot,” said Gill. “We have developed a RF detection system and can offer real-time awareness and, where required, we can enhance the system with other sensing technologies like radar, cameras and acoustics.”

The company has developed SkyFence, an electronic countermeasures system which prevents drones from flying into or close to a protected location by disrupting its command and navigation radio transmissions.
“We can use multiple low-powered radio transmitters which are strategically placed around a protected site – for example, on the perimeter fence of an airport. These devices would be placed every 40 feet along a fence and when activated would transmit a signal which is designed to overwhelm the drone’s radio transmissions. This breaks the control and video link between the drone and its operator,” explained Gill.

Jamming signals can be transmitted on GPS to force the remote pilot to navigate the drone themselves, provide the aircraft with an incorrect GPS solution (forcing it off course), disrupt communications which removes control from the remote pilot and possibly force the drone into a controlled landing.

The limiting factor on these types of counter-drone systems is that many countries have laws in place that restrict the use of jamming capabilities and jamming may only be undertaken with express permission from specific agencies.

Drone deterrence and detection is being affected by the growth in autonomous drones that, “Don’t transmit much because they can be pre-programmed. As a result, there’s little traffic between the pilot and the drone,” explained Moore.

Detection, at present, is primarily achieved by using radar, said Moore.
“The B400 from Blighter was designed to provide long range ground surveillance and can detect moving vehicles and people over a wide area.

“It uses Blighter’s passive electronically scanned array (PESA) radar technology which uses digital beam forming on both transmit and receive to help reduce unwanted detections from clutter, so reducing the number of false alarms which is crucial when you’re dealing with what is a very cluttered environment like an airport,” Moore said.

The company’s Anti UAV Defence System (AUDS) was developed to detect drones up to 10km away using electronic scanning radar and uses precision infrared and daylight cameras and specialist video tracking software to track the device before disrupting the flight using an inhibitor to block the radio signals that control it.

“This detect, track, disrupt, defeat process is very quick and typically takes less than 15s,” explained Moore.

The ideal solution, however, would be to use all relevant systems in a given area and merge the data to isolate the identified non-problematic drones from more dangerous intruders.

The ease of obtaining drones or unmanned aerial vehicles (UAVs) has bred a vast associated industry, and many industries are using drones owing to their ease of use, availability, cost savings and their ability to perform dangerous tasks.
As a result, drones are becoming an increasing threat to aviation and in the United Kingdom, in the second half of 2017, there were 35 drone-related incidents reported to the authorities. These occurred up to an altitude of 12,000ft but some consumer level drones have a service ceiling of as high as 20,000ft.

So, what are the consequences of an aircraft impacting a drone in flight? "The spectrum of adversaries is broad. From the inadvertent actor, who simply doesn’t know the rules and has no malicious intent, and that’s most drone operators, to those with malicious intent, and its those that we not only have to be able to locate and identify but bring down where possible,” said Gill.

Currently, counter-drone systems are under development with over 155 companies involved worldwide. “There are a lot of companies coming into the drone detection space,” said Gill, “but many only have a limited risk management background.”

**Drone regulation**

Commenting on the Gatwick incident Russell Haworth, CEO of Nominet said: “Events at Gatwick have highlighted the urgent need for greater regulation of drones. A UK wide drone registry could go far beyond a mere list of registrations - a database could be created to authorise flights in real time, meaning all flights would need explicit permission before they can take off.

He continued, “The upcoming government’s Drone bill will hopefully start to tackle this, as well as exploring other options such as geo-fenced ‘no-fly’ zones that can communicate with a drone’s in-built GPS. But progress may need to accelerate to prevent highly disruptive events being repeated.”

While Haworth appears to be in favour of greater regulation Gill is concerned that this focus on regulation overlooks the benefits of the technology. A too heavy-handed approach to regulation could seriously impact the industry. “We shouldn’t demonise drone technology, but rather focus on those will malicious intent,” Gill warned.

“At present it is possible to access open source drone projects, download designs, buy components from ebay, source code for a drone and, if I want to, I can delete restrictions and spoof the identity of a drone. All of which means that there’s obviously a lot the industry will need to do to operate securely in this space. “However, I think in time the industry will become self-regulating. We’ll ultimately see the development of standard Unmanned Traffic Management (UTM) systems. These will provide flight planning, conflict avoidance and manage how drones enter and leave specific air corridors,” said Gill.

UTM systems are being developed for low-altitude airspace allowing for safer and more efficient low-altitude operations without requiring human operators.

“Both manufacturers and operators will be happy to develop products that automatically integrate into a national UTM system – hobby drones will be registered and able to talk automatically to those UTM systems.”

When it comes to combating drones i.e actually shooting them down, the law remains opaque. “Current regulations are likely to be relaxed. At present a decision to bring down a drone needs to be authorised by the Home Office, in the UK,” explained Moore.

“I think those regulations are likely to be relaxed and police involvement is likely to be increased, but that will require new legislation and a better understanding of how to use anti-drone technology,” added Gill.

“Airports need guidance from their regulators as to how to counter the growing threat of drones. “When is it legitimate to apply jamming technology? What will be the rules of engagement and how will you mitigate any threat?”
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Is software ever finished? As Leonardo da Vinci observed with art 500 years ago, it is not so much finished as worked on until it is time for it to be abandoned.

In the case of traditional embedded systems that state of abandonment arrived at the point the product was shipped, with only some systems supporting some kind of upgrade or bug-fix through a wholesale ROM replacement or, more recently, a flash-memory update.

But times have changed. Partly due to the rise of connected products and a much greater ability to deliver updates and partly as recognition that it almost impossible to deliver bug-free products embedded systems software is much more fluid than ever.

At a variety of conferences, embedded systems developers have talked about how organisations as diverse as Bosch, Dyson, Ericsson and Google have embraced the concepts of continuous integration for embedded devices, sometimes in a shift to agile development practices or to reduce the time taken in traditional waterfall processes.

Adam Arakelian, director of engineering at Dell’s EMC storage subsidiary told delegates at Vector Software’s 2018 test symposium in Boston, a move to continuous integration was to reduce delays by performing tests as early as possible in a project and to remove the traditional disconnect between development and QA teams. “We were trying to build a shift-left culture. It was about pulling testing back to the left side: when the code is written.”

Continuous integration splits into two main forms. One is continuous delivery. This is where developers commit changes to an evolving product in a process where all the integration tests and actions are performed automatically. But someone makes a conscious decision when to distribute each new binary.

Continuous deployment takes that final step of automating the distribution and installation of the updated software as long as all the tests pass. In web-based deployments, different users might find they are on subtly different versions based on when they last logged into a service.

Eight years ago, John Jenkins, former project director at Amazon, in a speech at O’Reilly’s Velocity conference said he dug into the statistics for at his employer for the month of May 2011 and found “every 11.6 seconds someone is kicking off a deployment” to a production application.

Is such a deployment frequency realistic for embedded? For any device that has to be reflashed with new software each time, it’s not a likely prospect. But applications that rely on an IoT infrastructure, it is entirely plausible that parts of the system will be updated rapidly and they will continue to have to work well with software that may have been in place for years – and work around its flaws because the embedded firmware is not easily changed.

Cloud environment
Regression tests are essential in these environments before pushing out the updates to ensure nothing that already works is broken by the change. Doing those tests manually is an unrealistic prospect. But some help has arrived from the cloud environment, through tools that go under the banner of “development operations”, often compressed to just “devops”. Many of them come in open-source form, ranging from Docker’s software containers to the
Jenkins build-and-test management environment and do not necessarily need to run in the cloud. They can run on developers’ own machines for local unit testing.

Docker provides a lightweight form of virtualisation, largely because the software inside the container shares many resources with the underlying operating system. Docker’s main advantage, and other tools like it, is that it provides the ability to present a consistent environment to the software build and the tools used to test it. This reduces the chances of software not functioning as expected because of subtle differences from machine to machine. In the devops world, Docker has become popular as a way of instantiating many copies of a build in a matter of seconds across a server farm for parallelising tests in large-scale regression frameworks.

Although the tools were conceived for software development, they have picked up supporters in chip design, where continuous integration is used for “shift left” reasons. Developers are now expected to build unit tests to check their modules behave as expected. Those unit tests form part of a suite of regression tests that build up over the lifetime of the project.

In addition to software-test specialists such as Vector Software, EDA tools suppliers such as Siemens subsidiary Mentor have built plugins for Jenkins that trigger a round of verification runs each night based on the code that has been committed by the source-code control system. The output is a new crop of results that go into a database that shows whether a change has triggered a new round of failures or if parts of the code remain stubbornly untested and need attention.

Chip development takes place largely in a virtual realm of simulation backed up sometimes by emulation, where the design is compiled and run on specialised hardware, as well as by static, formal-verification tools. One major difference between the embedded software and chip design projects is that the former rely much more heavily on physical target hardware being available once development of a module moves beyond unit testing and into system-level testing. This is beginning to change as companies such as Jumper work on improving the accuracy of tests on simulated hardware. Jumper has techniques that take into account interrupts and other time-sensitive issues that often lead to a mismatch between testing on simulated and physical hardware. The company claims to have found such a timing bug in one of Nordic Semiconductor’s software development kits using its device emulator.

**Device farms**

For the situations where only the target will do, users of continuous-integration methods turn to hardware-in-the-loop environments that range from one or two prototypes on a bench to large-scale device farms. As the “farm” name suggests, these are collections of target boards that are hooked up to a server somewhere along with some form of emulated I/O.

Google’s Chromecast developers built custom test rigs that push firmware builds onto the smart USB sticks, even to the extent of inserting some into isolation boxes so they could try out different WiFi scenarios without disrupting other nearby tests. With a device farm, the build environment updates the code that sits on the board for each new regression run and pulls off test data once the run completes. Alternatively, individual boards can be run interactively to help developers perform quick unit tests on their own code. For off-the-shelf devices such as smartphones, Amazon Web Services is among those that have deployed readymade device farms for rent. TimeSys has built an environment to try to ease the creation of custom device farms for custom hardware. However, few teams have the resources to create their own farms, with the result that, for the moment, testing for continuous integration with real hardware is performed on a much smaller scale.

Embedded software developers have other issues to contend with, such as licensing. Niall Cooling, head of training firm Feabhas which has run courses and conference on agile methods and continuous integration, points out that the licensing dongles used by a number of popular tools do not play well with Docker containers.

A bigger problem though, Cooling adds, is the design of many of the tools assumes an interactive, graphical interface whereas automated test relies on command-line interfaces and scripting. Many valuable features are not yet available to teams that want to pull debug tools into a continuous-integration environment. The result is that continuous integration using tools such as Docker can be restricted to ensuring that builds complete successfully with regression testing remaining a manually intensive process.

As the demand for faster updates and fixes for connected products continues to grow, the push towards more agile processes supported by continuous integration is likely to see greater support among tools companies over time though few will experience the 11-second updates boasted by Amazon as a result.
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VISIT US
Taking the guesswork out of being human

Artificial intelligence is set to transform the way we live but we will need to add some creativity and wisdom to how it’s used and deployed, argues Rudy Lauwereins

By 2035 artificial intelligence (AI) will be everywhere, but it will be invisible. Behind the scenes, it will help steer the choices we make, offering us the best options to lead a good, healthy life. It will help customise the services and products we buy to best match our preferences and all of this will be achieved by its lightning-fast ability to process huge swaths of data and extract knowledge.

Imagine that at some point in the future you are taken down to the hospital with what appears to be a rare, complex condition. Immediately, the doctors run your personal history and medical parameters through their AI system, searching for identical patterns in a worldwide database of anonymous patient data. They find a dozen matches and see potential treatments and their effects. So there is less guessing and reliance on solely human experience, and luck being in the right hospital. Wherever you live, and who ever you are, you’ll get the best available diagnosis. But wait … chances are that you won’t have to go to hospital. Why? Because with your physical parameters you are constantly monitored, and you’ll be offered intelligent choices at every step in your life. Whether it’s about the food you eat, the exercise you take, your career choices – all of this will keep you healthy for much longer.

One of the most successful branches of AI is machine learning. Machine learning (ML) algorithms allow computers to learn and detect patterns from huge amounts of data and establish the relationship between inputs and outputs, between huge swaths of data and meaningful conclusions.

ML can learn to identify individuals in camera footage, steer cars away from moving objects, detect planets around distant stars, or recognise clusters of health parameters that will help experts predict a disease.

And once they have learned their ‘trick’, they can apply that learning at lightning speed, without pause or getting tired.

Spreading insights instantaneously

Taking another scene 15, or so, years into the future. You’ve just been picked up by a self-driving car that covers part of your journey to a conference on, what else, AI.

It’s raining heavily and while the car picks up speed on the highway, it suddenly has to swerve to avoid a tree branch that has blown into its path. The vehicles next to and behind your car have to break and there is a short moment of chaos. This near-miss, although very rare, could certainly be a possibility. Overnight,
the data of the vehicles involved are analysed and an update is sent to all cars worldwide on how to handle this situation in the future.

Of course, by then you’ve long reached your destination – unaware of how your journey influenced, even improved the driving behaviour of all cars way beyond those involved in the incident.

Humans can change their mind, adapt their behaviour to new circumstances and new learning but so too will intelligent agents, such as cars. And because the world of 2035 is tightly interconnected, the new knowledge can be spread to all intelligent agents almost simultaneously. So there’s no risk of colliding with a car that’s running on last year’s intelligence.

As has to be expected with such a pervasive technology, there are technical and ethical caveats.

One is the issue of explainable AI: if a critical system takes a decision, we humans should be able to track down its reasoning, to understand why the system did what it did.

Another issue is that machine learning is only as good as the data it is fed. Therefore, technologists are continuously on the lookout for biases that may pop up in behaviour of smart systems, or for biases that are added with malicious intent.

Examples are recognition or profiling on the basis of ethnicity or gender, or seeing as global what in effect are only local customs or behaviours, or even just temporary, commercial hype.

And last there’s the concern that people should remain free in their choice to contribute or retract personal data, or to act upon the suggestions of AI systems.

Global but individualised

Of course in 2035 your clothes are made to fit to perfection. When you need a new pair of shoes, your local factory will consult your digital twin, deriving all possible parameters and produce a pair of shoes that are unique, but more importantly, costing no more than you used to pay for your average size 11 shoes.

But there’s more. You just bought and attached a sport’s sensor that’s now breaking in. Give it a few more hours with you, learning the very intimate relation between your blood pressure, heart beat, temperature and many more metrics and it will have become part of you, a sensor that matches up with no other person in the world but you.

The industry is no longer making a small range of average products. Instead, they are able to make separate, individual products for everyone. Like the good, old cobbler changing and learning after you buy them.

It’s machine learning but no longer trained at the manufacturer’s with labelled input, but on your body with unlabelled data.

Budding AI wisdom

You’ve arrived at your holiday destination to find that your luggage has gone missing. You call the airline’s helpdesk and are put through to an operator, whose voice and body language are immediately comforting and reassuring. Within minutes, even while you are speaking, your luggage is located and an appointment is scheduled to have it delivered at your hotel the same evening. You full heartedly thank the operator, who smiles and wishes you a good holiday.

For a split second the thought registers that this was probably a bot, but by now you’ve become so used to being helped by imaginative, empathic bots that you’re rather pleased.

Machine learning is only apparent intelligence. ML systems still have to be trained by humans, who supply it with the training data and determine the questions to be solved. That makes for hugely useful systems, but not really intelligent ones.

But by 2035, we’re also seeing a first budding of really intelligent systems, systems that show some measure of reasoning, creativity, imagination, common sense, and above all empathy.

Leveraging its expertise in hard- and software, imec is setting up an ambitious AI program – together with industrial partners that are active in domains as diverse as personalised healthcare, smart mobility, the new manufacturing industry, smart cities and smart energy.

As for imec’s approach to bringing AI to the sensors at the edge of the Internet of Things (IoT) we are looking to introduce a pipeline of innovative hardware and software that – instead of using hundreds of watts – will consume less than a watt, or even mere milliwatts.

We will also be looking to develop machine learning applications that can be customised for specific uses and for individual people – on the spot, instead of with pre-learned parameters.

To that end the Flanders Government has earmarked a considerable sum to AI research, industrial application, and policy and imec has itself signed a collaboration agreement with the French R&D centre CEA-LETI to advance both AI and quantum computing.
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EMBEDDED WORLD 2019

As the industry gets ready for this year’s show, New Electronics delivers a sneak preview

Last year Embedded World saw more than 1,000 exhibitors present the latest in embedded systems. Once again, the Nuremberg exhibition will open its doors (26-28th February), covering topics such as security for electronic systems, distributed intelligence, the IoT, e-mobility, and energy efficiency.

New for 2019 is the start-up area (Hall 3A), dedicated to showcasing small, young companies.

**Adesto Hall 4A – stand 124**
Live demonstrations include the company’s SmartServer IoT edge server platform. Designed to connect legacy industrial devices to the IoT and the cloud, it enables users to make use of analytics solutions such as the IBM Watson IoT Platform.

**Analog Devices Hall 4A – stand 641**
ADI’s booth will place special emphasis on emerging and rapidly-developing technologies, such as machine learning and artificial intelligence (AI), as they are applied to and deployed in the embedded space. A number of product demonstrations will be on show to present how exactly these technologies have been utilised.

**Arm Hall 4 – stand 140**
Arm’s demonstrations will include machine learning on the edge; Arm Pelion Connectivity Management; simplified algorithm development with high-end signal processing on Cortex-M; and testing for functional safety with qualified FuSa building blocks, to name a few.

Arm will also partake in the conference sessions, discussing the cloud, software development, and security, among other topics across the three days.

**Avnet Integrated Hall 2 – stand 238**
Avnet Integrated will be highlighting its latest embedded Computer-on-Module solutions, including the Intel Pentium processor N4200 platform, plus the recently launched MSC C6B-CFLH COM Express Type 6 module family and MSC SM2S-IMX8 SMARC 2.0 module. There will also be live demonstrations of a range of displays, which will include real customer solutions. A particular highlight will be the SimplePlus solution.

Examples of how the AI-at-the-edge Meta-Sensing product SmartEdge Agile can be used in IoT industrial applications in conjunction with Microsoft Azure to build and create artificial intelligence models will also be demonstrated.

**Cadence Hall 4 – stand 116**
Cadence will showcase its latest Tensilica DSPs and design tools for automotive applications. Demos will focus on ADAS, infotainment, functional safety, ECU/automotive Ethernet design, and FPGA-based prototyping. This will include its safety verification solution for automotive SoCs using fault injection and simulation in accordance with the latest ISO 26262 edition 2 standard.

**Conrad Hall 3 – stand 145**
The omnichannel supplier intends to present its operational and technical expertise in sourcing B2B product ranges. This will include a focus on the areas of 3D printing, single-board computers, high-quality measurement and power supplies, and soldering technology; as well as new and practical service offerings to embedded systems designers.

**Express Logic Hall 4A – stand 122**
Visit Express Logic to view its X-Ware IoT Platform cloud connectivity and IoT network connectivity demos. Developers can leverage the ThreadX RTOS powered platform’s size, performance, safety and security to incorporate best-of-class IoT connectivity into embedded systems. The X-Ware IoT Platform’s Secure Connectivity add-on is designed to offer secure cloud connectivity. It is 100% created in-house, meaning it is professionally supported and includes no open-source code.

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Hyperstone Hall 1 – stand 301

Hyperstone will be unveiling its X1 SATA NAND flash controller designed to provide users with high reliability and the lowest power consumption for industrial solid state drives, M.2, U.2, CFast and embedded flash drives. With its hyMap sub-page-based flash translation layer, the X1 is said to achieve unparalleled random write performance, minimal write amplification and high endurance without external DRAM.

Also featuring on the stand will be Hyperstone’s portfolio of NAND flash controllers and associated technologies, which include the hySMART Heath Monitoring solution. A live-to-view demo will give visitors a visual insight into the behind the scenes behaviour of a 3D NAND storage solution by displaying live bit errors as they occur during read activity of an SSD.

ON Semiconductor Hall 4A – stand 260

ON Semi’s main focus will be battery-less solutions for the IoT. At the core of this is its ultra-low power technology, enabling battery-free wireless solutions that are powered purely by energy harvested from motion, heat, light and even stray RF.

Visitors can also learn about the cloud-connected development environment, Strata Developer Studio that provides an always-up-to-date resource for discovering and working with ON Semi’s evaluation and development boards.

Renesas Electronics Hall 1 – stand 310

Among the technology on the Renesas booth will be the Failure Detection e-AI Solution for motor-equipped home appliances that incorporates the Renesas RX66T 32-bit MCU.

This solution with embedded AI (e-AI) enables failure detection of home appliances due to motor abnormality. Property data showing the motor’s current or rotation rate status can be used directly for abnormality detection, making it possible to implement both motor control and e-AI-based abnormality detection with a single MCU.

Rutronik Hall 3 – stand 159

Rutronik will be presenting a number of connected sensor nodes, gateways, and customer-specific display adjustment solutions on its stand. Visitors can expect to see demos on a sensor-to-cloud concept with Rutronik’s partners Telit and Tianma, an Intel server application example, and antenna technologies from Rutronik’s Wireless division.

Silicon Labs Hall 4A – stand 128

The latest Wireless Gecko connectivity solutions will feature at Silicon Lab’s booth. Hands-on demos will highlight Bluetooth mesh and Bluetooth 5 solutions, device-to-cloud connectivity with low-power Wi-Fi, Zigbee home automation and control, and next-generation Z-Wave 700 smart home solutions.

Silicon Labs’ experts will also host a selection of conference sessions during the three days. Topics range from AI sensors, supercharging Bluetooth Low Energy beacons, and secure IoT.

Tektronix Hall 4 – stand 160

New for this year is Tektronix’s power rail probes, TPR1000 and TPR4000 with 1 mV accuracy. Designed specifically for minimising noise on power rail measurement, these new probes enable clean, ultra-low noise measurement insight, with up to 60V offset. Combined with a 5 Series MSO or the 6 Series MSO oscilloscope (another particular highlight at the stand), a more accurate picture of ripple measurements is possible.

Toshiba Memory Group Hall 3A – stand 424

The industry’s first Universal Flash Storage (UFS) Ver. 3.0 embedded flash memory devices will be unveiled at Toshiba’s stand. While two new solid state drives (SSDs) will be demonstrated to those visiting the booth.

The UFS flash memory is already sampling and will be available in three capacities: 128GB, 256GB and 512GB. With rapid read/write performance and low power consumption, the new devices are intended for applications such as mobile devices, smartphones, tablets, and augmented/virtual reality systems. The devices integrate 96-layer BiCS FLASH 3D flash memory and a controller in a JEDEC-standard 11.5 x 13mm package. The controller performs error correction, wear levelling, logical-to-physical address translation, and bad-block management for simplified system development.

Xilinx 3A – stand 235

Xilinx will show how its silicon, IP and tools are enabling adaptable, intelligent, industry-leading systems. It will also demonstrate how its latest solutions are addressing key and complex design challenges in the next generation of machine learning/artificial intelligent (AI) autonomous systems, the Industrial Internet of Things (IIoT), ADAS, and cloud technologies.

Moreover, making its debut appearance at Xilinx’s booth is the Alveo product family, designed to meet the constantly changing needs of the modern Data Centre.
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Artificial intelligence (AI) is now seen as a vital technology for the development of the Internet of Things (IoT) and cyber-physical systems such as robots and autonomous vehicles.

The smart speaker provides an example of advanced AI in action in everyday life through its ability to recognise natural language and synthesis high-quality speech. To do so, the speaker needs to pass data on to multiple high-speed computers in remote server farms. The embedded hardware is seen as being too limited to be able to run the kinds of deep neural network (DNN) algorithms on which they rely.

AI need not be limited to deployment in high-powered computing engines located in server farms. AI techniques are now also being proposed as a way of managing the immensely complex 5G New Radio protocol. The number of channel parameters that need to be analysed by handsets to deliver optimum data rates have outpaced the ability of engineers to develop efficient algorithms. Algorithms trained on data obtained during field trials provides a way to balance the trade-offs between different settings more efficiently.

When it comes to maintaining the health of industrial equipment operating in remote locations, machine-learning algorithms running on embedded hardware are becoming an effective option. Traditional algorithms such as Kalman filters readily deal with linear relationships between different types of input data such as pressure, temperature and vibration. But the early warnings of problems ahead of problems are often identified by changes in relationships that can be highly non-linear.

**AI implementations**

Systems can be trained on data from healthy and failing machinery to spot potential problems when fed with real-time data. However, a neural network, though a popular choice today, is not the only AI solution available. There are many algorithms that can be applied and an alternative solution may be the most appropriate for the task at hand.

One possible solution can be found in rule-based AI. This leverages the expertise of domain experts rather than direct machine learning by encoding the experts’ knowledge within a rule base. An inference engine analyses the data against the rules and attempts to find the best match for the conditions it encounters. A rule-based system has low computational overhead but developers will encounter difficulties if the conditions are difficult to express using simple statements or the relationships between input data and actions are not well understood.

The latter situation, which applies to speech and image recognition, is where machine learning has been shown to excel.

Machine learning is closely related to optimisation processes. Given input database elements, a machine-learning algorithm will attempt to find the most appropriate way of classifying or ordering them. A curve-fitting algorithm based on a technique such as linear regression can be considered as being the simplest possible machine-learning algorithm: one that uses the data points to formulate the best-fitting polynomial that can then be used to determine the most likely output for a given input datum. Curve fitting is only appropriate for systems with very few dimensions. True machine-learning applications can deal with complex high-dimension data.

Clustering goes further by classifying data into groups. A typical algorithm is one based on centroids but many other types of cluster analysis are used in machine learning. A centroid-based system uses geometric distance between...
data points to determine whether they fall within one group or another. Cluster analysis is often an iterative process in which different criteria are applied to determine where boundaries form between clusters and how closely related data points within a single cluster need to be. However, the technique is effective for demonstrating patterns in data that might elude domain experts. Another option for separating data into classes is the support vector machine (SVM), which divides multi-dimensional data into classes along hyperplanes that are created using optimisation techniques.

The decision tree provides ways to use clustered data in a rule base. A decision tree provides a way for the AI algorithm to work through data inputs to develop an answer. Each branch in the tree may be determined by cluster analysis of input data. For example, a system may behave differently above a certain temperature such that a pressure reading that is acceptable in other conditions may help indicate a problem. A decision tree can use these combinations of conditions to find the most appropriate set of rules for the situation.

Although DNNs generally require high-performance hardware to run in real time, there are simpler structures such as adversarial neural networks that have been successfully implemented on mobile robots based around 32bit or 64bit processors such as those found in the Raspberry Pi platforms. The DNN’s key advantage lies in the large number of layers it employs. The layered structure makes it possible for neurons to encode connections between multi-dimensional data elements that may be highly separated in space and time but which have important relationships that are revealed during the training process.

As well as its computational overhead, a drawback with the DNN is the huge amount of data that is needed to train it. This is where other algorithms such as those based on Gaussian processes are now being investigated by AI researchers. These use probabilistic analysis of data to build models that function in a similar manner to neural networks but which use far less training data. However, in the short term, the success of the DNN makes it a key candidate for dealing with complex multi-dimensional inputs such as images, video and streaming samples of audio or process data.

One option in applications with complex requirements may be to use a simple AI algorithm in the embedded device to look for outliers in the input data and then request services from the cloud to look at the data in more detail to provide a more accurate answer. Such a split would help maintain real-time performance, limit the amount of data that needs to be transmitted over long distances and ensure continuous operation even in the face of temporary network outages. If a connection is lost, the embedded system can cache the suspicious data until an opportunity arises to have it checked by a cloud service.

**AI providers**

Amazon Web Services (AWS) and IBM are among the companies that now offer cloud-based AI services to their customers. AWS provides access to a wide range of hardware platforms suitable for machine learning, including general-purpose server blades, GPU accelerators and FPGAs. The DNNs run in the cloud can be built using open-source frameworks such as Caffe and Tensorflow that are now widely used by AI practitioners.

IBM has built direct interfaces to its Watson AI platform to boards such as the Raspberry Pi, making it easy to prototype machine-learning applications before committing to a final architecture. ARM provides a similar link to Watson through its mbed IoT device platform.

Although AI may seem like a new frontier in computing, the availability of high-performance boards at low cost such as the Raspberry Pi and access to cloud-based machine-learning services mean embedded developers have straightforward access to the full gamut of machine-learning algorithms that have been discovered over the past few decades. As more sophisticated techniques are developed, the combination of onboard processing and cloud computing will ensure embedded developers can stay abreast of them and deliver the smartest solutions possible.
New Electronics met with Cypress CEO Hassane El-Khoury at this year’s Consumer Electronics Show (CES) in Las Vegas, where the company was heavily focused on the key themes of connectivity and IoT computing power.

“Compute and connect capabilities are what we are pushing in response to the needs of the market and we’re looking to push the boundaries as to what is possible with the technology that we have today,” El-Khoury explained.

“Look around this show and car manufacturers, for example, are focused on autonomous vehicles and given time, and plenty of it, most vehicles will become self-driving. That will have a major impact on the way companies like Cypress address the market and create viable use cases.

“What I mean by that is that we’ll need to focus on where we, as a company, will be able to bring added-value and differentiation.

“A few years ago car manufacturers looked to differentiate on engine size and efficiency, today it’s infotainment.

“When we talk of self-driving cars they will all have to be 100 percent accurate, so where’s the competitive angle? Where will OEMs look to compete? That will determine where we play in this space.”

At CES Cypress announced the expansion of its wireless connectivity portfolio for automotive infotainment by unveiling a trio of new products.

“The Wi-Fi and Bluetooth combo chipsets we have unveiled, will enable multiple users to connect and stream content to as many as 10 mobile devices simultaneously,” said El-Khoury.

The new infotainment platforms include a Wi-Fi 6 (802.11ax) and Bluetooth combo solution that features the company’s Real Simultaneous Dual Band (RSDB) architecture, which has become the de facto standard for premium connected infotainment and integrates two complete Wi-Fi subsystems into a single chip.

“We are using Wi-Fi 6 which will enable gigabit-level throughput and will improve the reliability of content streaming,” El-Khoury explained and pointed to the fact that while Wi-Fi 6 was not widely deployed the company was determined to, “shoot where the market will be.”

The company also added two Wi-Fi 5 (802.11ac) and Bluetooth combo solutions to its portfolio, providing a scalable platform solution that will be able to address a wide range of vehicles.

“We’ve had real success in the automotive segment and have outgrown it by a significant margin. Our focus is inside the vehicle so we are looking to support gesture, touch and voice – all of which, I believe, will co-exist in the vehicle as there are use cases for both touch and voice recognition.”

Touch or voice is a redundant question, according to El-Khoury, as both will be needed.

He sees the accelerating pace at which automakers are looking to differentiate as helping Cypress.

At CES Qualcomm, NXP and Nvidia were all displaying “digital cockpit” solutions in which a digital cluster and a high-end infotainment system were powered by the same processor.

According to El-Khoury, while it’s the case that it’s necessary to power critical instrument cluster functions separately from infotainment systems, those legal and regulatory compliance issues will help Cypress see significant design wins for its digital cockpits.

Beyond automotive

Beyond the automotive space Cypress is also looking to profit from the growing demand for smart home hardware.

“We are a major supplier of MCUs and Wi-Fi/Bluetooth connectivity chips for both consumer and industrial IoT devices, and sell other types of chips into these markets,” El-Khoury explained. In fact, the company’s chips can be found inside a variety of products from Amazon’s Echo speakers, to Nest’s thermostats and the Oculus’ VR headset.

According to El-Khoury, “Cypress is seeing strong growth in the smart home market and that’s due in no small part to the fact that we are willing to support both high-volume and low-volume customers, which is crucial in a segment where there are so many niche companies – just look around CES at the variety of companies in this market and the prototypes and products on display.”

El-Khoury said that the company was always keen to take existing technology and push the boundaries – “I like to see us as a $2billion start-up.”

In the consumer space security is an evolving issue and the growing use of voice recognition and the fact that voice commands are analysed in the cloud, does raise issues of privacy, which El-Khoury believes can be solved by doing more processing at the edge or locally.

“If we can localise commands and move more intelligence to the edge, then we can help to ensure that these devices are secure and safe.”

Cypress manufacturers a broad range of devices from microcontrollers (MCU) and connectivity chips to memory and power...
management chips and supplies a wide range of industry segments.

“In 2017 we saw revenues of $2.3 billion and we’re on course to beat that figure in 2018,” El-Khoury said.

The market, however, is not without its challenges with the Chinese economy showing signs of weakness and that has not been helped by the US and China still being at loggerheads over trade.

“It’s certainly a drag on momentum,” according to El-Khoury, “and we’re now seeing a softening in the European market.”

Companies are trimming their orders and El-Khoury pointed to inventory replenishment issues among hardware makers and distributors as causing sales pressures.

More and more customers are in what he described as a “wait-and-see mode”.

Cypress, however, is well placed to deal with any situation, according to El-Khoury.

“We’ve taken the business broad and we can supply both MCUs and connectivity chips for devices, which I believe is a competitive strength and certainly puts us at an advantage over some of our competitors.”

Cypress has offloaded its NAND business to a joint venture in which SK Hynix is a majority partner, while retaining its NOR flash and SRAM memory chip businesses.

“These are far more focused on higher-margin products sold via long-term supply deals,” he explained.

“Whatever happens over the coming years we are in the best financial situation we have been in for some time, we can weather whatever the global economy throws at us; debt is falling, we are certainly profitable and building cash on the balance sheet.

“We’ve managed to de-risk the business,” he concluded.

Hassane El-Khoury

Hassane El-Khoury is president and chief executive officer of Cypress Semiconductor and a member of the company’s board of directors. He was previously executive vice president of Cypress’ Programmable Systems Division, managing its standard and programmable MCU portfolio, including PSoC devices, and its automotive business.

Prior to that, El-Khoury ran Cypress’ automotive business unit and targeting the infotainment, instrumentation cluster and Advanced Driver Assistance Systems (ADAS) segments.

Prior to joining Cypress, El-Khoury served in various engineering roles with Continental Automotive Systems in the US, Germany and Japan.
Improving reliability with cryogenics

Cryogenics plays an increasingly important part in the development of electronics, but the components sold into this market need to be both incredibly reliable and well designed. By Neil Tyler

Cryogenics is the study of the production of extremely cold temperatures and is a field of science that looks at what happens when materials, whether metals or gases, are exposed to very low temperatures.

There are a wide number of potential and actual applications that use cryogenics. For example, as well as mission-critical cooling systems for space and science projects, such as the Large Hadron Collider or the Planck Space Observatory, cryogenics is being used for cold storage and transportation in the food industry; in the prevention of overheating in underground cables and wind turbine technology as well as in aerospace, telecommunications and electronics.

When it comes to electronics and the operation of electronic devices, circuits, and systems cryogenic techniques were actually being used as far back as the 1950s.

While often referred to as low-temperature electronics, or cold electronics, and despite being first used in the 1950s, it wasn’t until the 1980s that a conference looking at the application of low-temperature electronics was actually held.

If you look at cryogenic semiconductor electronics, it can involve a circuit using a single transistor or a system that covers hundreds of large integrated circuits. It can include both analogue and digital systems and span the frequency spectrum from DC to 100s of GHz.

As transistor types have expanded to include Si, Ge, GaAs, SiGe and III-V semiconductor materials so the scope and use of cryogenics has actually increased.

So, why is cryogenic processing used when it comes to the development of electronics?

Well, it can improve the performance of the electronics in the form of lower noise, higher speed and increased efficiency. With cryogenic treatment of electronics, gaps within the structure of their metallic components can be reduced, so lowering the artifacts in the electrical current and producing a truer signal and providing better performance and endurance.

Among other attributes associated with cryogenics are that it has been found to extend the life of circuit boards in extreme conditions and that it reduces the residual stress found between the layers of thin film magnetic memory.

It has also been found to increase the contact life of relays, circuit breakers and switches.

Other benefits include: improved thermal and electrical conductivity, lower operating power, reduction of parasitic losses, diminished chemical and metallurgical degradation, and improved overall reliability.

So what kind of temperatures are we looking at? The range of temperature associated with cryogenics does tend to vary but is usually associated with temperatures that are below -190 degrees Fahrenheit or 123 degrees Celsius.

There are a number of ways to generate these kinds of temperatures, including the use of specialised deep freezers or by employing liquefied gases like nitrogen, and at those kinds of temperatures, the impact on materials can be profound.

British Cryogenics Council

The British Cryogenics Council (BCC) was established in 1967 to promote and extend interest in the science of cryogenics and now has over 100 members.

It looks to offer a broad spectrum of expertise from companies providing cryogenic products and services to universities undertaking low temperature research and end-users of cryogens and cryogenic systems.

Interconnect supplier and manufacturer Intelliconnect recently became a member.

“Joining gives us the opportunity to extend the market reach of our cryogenic cables and components and to participate in the rapid development of what is a fast-growing field,” explained the company’s Managing Director, Roy Phillips.

“The cryogenics market has quickly becoming a significant part of our business, accounting for around 35% of our sales.”

Above: The CryoCoax brand specialises in connectors and cable assemblies for cryogenic systems.

www.newelectronics.co.uk 12 February 2019
percent or our turnover,” according to Phillips. “A lot of our product is used in research applications, probably the biggest of which is quantum computing.”

Despite the use of cryogenics going back more than 60 years, it is a relatively ‘young’ industry and, according to Phillips, remains one in which the supply chain is still relatively under-developed.

Intelliconnect entered the market around 4 years ago when approached to source components and help manage a UK company’s supply chain. “The opportunities within the space are enormous and not only do we manufacture connectors, adapters and cables but we are also sub-contracted to supply complete assembled units,” Phillips said. “We’ve invested heavily in new manufacturing and test equipment because the materials we have to handle are of a much higher standard – in fact we are looking at installing our own cryogenic chamber.

“As a result of this engagement and investment we are now a leading supplier of UK designed and manufactured cryogenic interconnect products and as a member of the BCC, are able to ensure that our products keep up to date with leading-edge research and market opportunities as they happen.”

Intelliconnect is also a member of the Cryogenic Society of America allowing it to extend the market reach of its cables and components beyond the UK and Europe.

The company’s growing range of cryogenic cables and components work to 2 K (-271.15°C) and can be used in a wide range of applications including: test and measurement, instrumentation, medical and material research and cryogenic systems including dilution refrigerators, superconducting magnet systems, low temperature detector systems, infrared array systems.

As Phillips explains, “Cryogenic systems need well-designed, reliable and repeatable cable assemblies and we are able to provide customers with high volume standard products or unique custom designs. The key is to be able to work with them and supply the cryogenic components they need.”

He continues, “We combine decades of experience in the interconnect industry with a modern, streamlined approach and have long experience in providing defect-free, high-quality cryogenic products.”

In a market where the technical difficulties can be significant it’s crucial that the company has a close working relationship with its customers.

“Our designers and engineers spend a lot of time with customers and will work alongside them from start to finish of a project, to ensure the best possible solution is delivered.”

Companies and organisations working in this space also have to contend with a limited supply chain and because it’s not possible to use standard components, it can be difficult to source the right products when needed.

“We’ve had to be very innovative to meet the specific needs of customers. For example, we developed a solderless connector as in this space the type of materials that are used means that you can’t use soldering as a technique. The solution – a clamp-type connector – has proven its worth and is actually now being used in other sectors we supply as assembly.

“A lot of our product is used in research applications, probably the biggest of which is quantum computing.”

Roy Phillips

“...times are quicker, it’s field replaceable and has a much improved electrical performance.”

As the market for these products has grown Intelliconnect has taken the decision to launch CryoCoax, a new brand that specialises in connectors and cable assemblies for cryogenic systems.

“The CryoCoax range of connectors has been developed to include sturdy constructed stainless steel interconnects including SMA, SMP, custom designed products and all common connector interfaces,” explained Phillips.

Cables and cable assemblies for the cryogenic market use advanced materials and manufacturing techniques with test capabilities to 40Ghz.

CryoCoax designs and manufactures standard, IP68 and glass sealed hermetic adapters and a range of attenuators, from 0dB – 30dB which are specially configured to withstand the low temperatures that are associated with cryogenics.

“Core capabilities include the ability to withstand temperature to 2K and below.

“We’ve also developed stainless steel cable assemblies to 40GHz, niobium titanium cable assemblies to 40GHz, cupro nickel cables, raw St/St and NbTi cable, non-magnetic cables, SMP connectors, crimp solderless and 2.9mm connectors and adapters, sealed adapters, hermetic connectors and adapters, attenuators and low temperature hardware,” Phillips explained.

The cryogenics space is an area of rapid growth and Intelliconnect is fast becoming a market leader in this space, suggested Phillips.

“We see strong growth for the industry because cryogenics is starting to be applied across so many different sectors.

“It’s a technology that is being used more, in more industries, and I think, as a business, we are in a good position to take advantage of this.”
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With the rollout of 5G expected to ramp up in the coming year, a complete spectrum of test & measurement solutions will be required, according to Meik Kottkamp

As the rollout of 5G starts to ramp up in 2019, we will move a step closer to enjoying the much-anticipated benefits this new technology will bring. Higher data rates will radically improve the experience of using mobile networks for both business and leisure activities and reduced latency will enable new applications, which require a deterministic real-time response, such as autonomous driving, remote surgery for eHealth, virtual reality and cloud robotics for Industry 4.0.

Finally, increased capacity will also significantly reduce or eliminate congestion issues and facilitate M2M communications at a scale which will take system interconnectivity to a new level.

The three main focuses of 5G enhancements, namely enhanced mobile broadband (eMBB), massive machine type communications (mMTC) and ultra-reliable low latency communication (URLLC) all come with their own technology challenges, however, including the spectrum shift to higher frequencies and the need for advanced antenna arrays to enable beamforming and Massive MIMO.

The advent of 5G will result in a far more complex technology that will require the techniques that have previously been developed and used to test preceding generations to be optimised and rethought.

Leading engineering companies will have to develop new test methods that ensure that the commercialisation of 5G products and solutions are viable across different industries and applications.

Network and end-user equipment developers have already been making steady progress in addressing these challenges over the last few years but critical to the successful rollout is the development of test and measurement equipment that enables developers to evaluate the performance and standards compliance of this new equipment in the lab, in production and in the field.

To get 5G equipment to market quickly, efficiently and economically requires T&M vendors to work closely with both the top tier equipment makers and the standards authorities to resolve their own set of technical challenges and provide a complete spectrum of T&M solutions that are both fit for purpose and have a low cost of ownership.

The solutions to these challenges are both evolutionary and revolutionary. Since both 4G and 5G are based on OFDM, existing equipment designed for 4G can often be upgraded, in some cases just with software, to make it suitable for 5G.

This will certainly be the case with signal generators and spectrum and signal analyzers from leading,

Above: OTA testing is difficult but one solution involves making near field measurements under far field conditions.
established T&M equipment vendors, like Rohde & Schwarz, that look to design in this future-proofing in order to reduce not only development costs for themselves, but notably also the total cost of ownership of their products for their customers.

In other cases, hardware evolution will be required. This is the case for example with vector network Analysers, which are now required to have true multiprot test capabilities to support Massive MIMO. A top of the range 5G analyser can now boast support for up to 24 ports in real time, which can be increased to 288 ports using a switch matrix. This is important as Massive MIMO antenna arrays typically have 128 antenna elements or more.

Simultaneous testing of LTE and 5G terminal devices, necessary for the network architecture favoured by the majority of network operators, also requires hardware enhancements, in part because OTA measurement solutions need additional shielded chambers.

Where evolution of existing T&M equipment or designs is not feasible however, technological revolution is required. A clear example in this category is a consequence of the introduction of new frequency bands. The implementation of components, chipsets, modules, wireless devices and base stations in the 28 GHz or 39 GHz band requires much higher integration density and the use of active antenna systems in order to enable efficient beamforming.

The need for low path loss and small size lead to highly integrated PCBs that include antennas, amplifiers and analogue phase shifters.

As a result, RF connectors are no longer available and the cabled methods currently used to validate the performance of 5G technology will no longer be able to be used. All of which means that over-the-air (OTA) test solutions will have to be rolled out to replace existing conducted measurement methods.

However, OTA testing at sub-6 GHz frequencies is very difficult as far-field analysis would require very large chambers measuring 3m or more. One innovative solution to this problem is to make near-field measurements under far-field conditions.

At cm/mmWave frequencies compact antenna test range (CATR) solutions apply, which create far-field conditions in close vicinity to the DUT (See opposite).

CATR realises the NF-FF transformation with a well-designed and highly accurate produced mirror. The reflector weight significantly increases below 6 GHz operation, since massive MIMO antennas easily reach radiating dimensions greater than 70 cm or 80 cm. The cost, fabrication time and handling of large heavy mirrors becomes prohibitive.

Using an antenna array, it is possible to create a planar field that allows for a quiet zone of 1 metre in diameter within a measurement distance of 1.5 metres, thus enabling much more convenient and cost-effective equipment to be used (See below).

All of this means that for test engineers, increased frequencies, new package technologies, great antenna counts and the like, will make it extremely difficult to keep capital and operating costs down.

While new OTA testing techniques can certainly help they bring other challenges with their successful implementation, whether that is measurement accuracy or taking into account business considerations such as minimising the impact on time to market to the development of new, innovative test and measurement solutions.

As mentioned, with the introduction of mMTC and URLLC in particular, 5G facilitates a whole new range of applications from automated driving to IoT and cloud robotics. This broadens the field of test and measurement to encompass additional requirements such as safety and security, where reliability, deterministic low latency, authentication and encryption are critical.

A T&M equipment supplier with products already in these markets and an experience in topics such as cybersecurity and radio monitoring will have much to contribute to 5G testing in these areas.

Clearly 5G test and measurement is a complex and rapidly evolving topic. Successful T&M equipment suppliers will need to build on their success and experience in 4G, evolving the software and hardware where feasible to minimise costs both for themselves and for their customers. They will need to leverage their close relationships with those customers and work together to develop solutions for 5G that will enable those customers to access the new markets first.

Taking an active role in driving the new standards from within the standards bodies, particularly the 3GPP, is providing the advanced insight that will also facilitate early market access.

Finally, as new 5G-enabled applications evolve, many industry watchers suggest that single-source, broad-range T&M suppliers will have most to offer to companies which are keen to make early gains in those developing markets.
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