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23 March 2021

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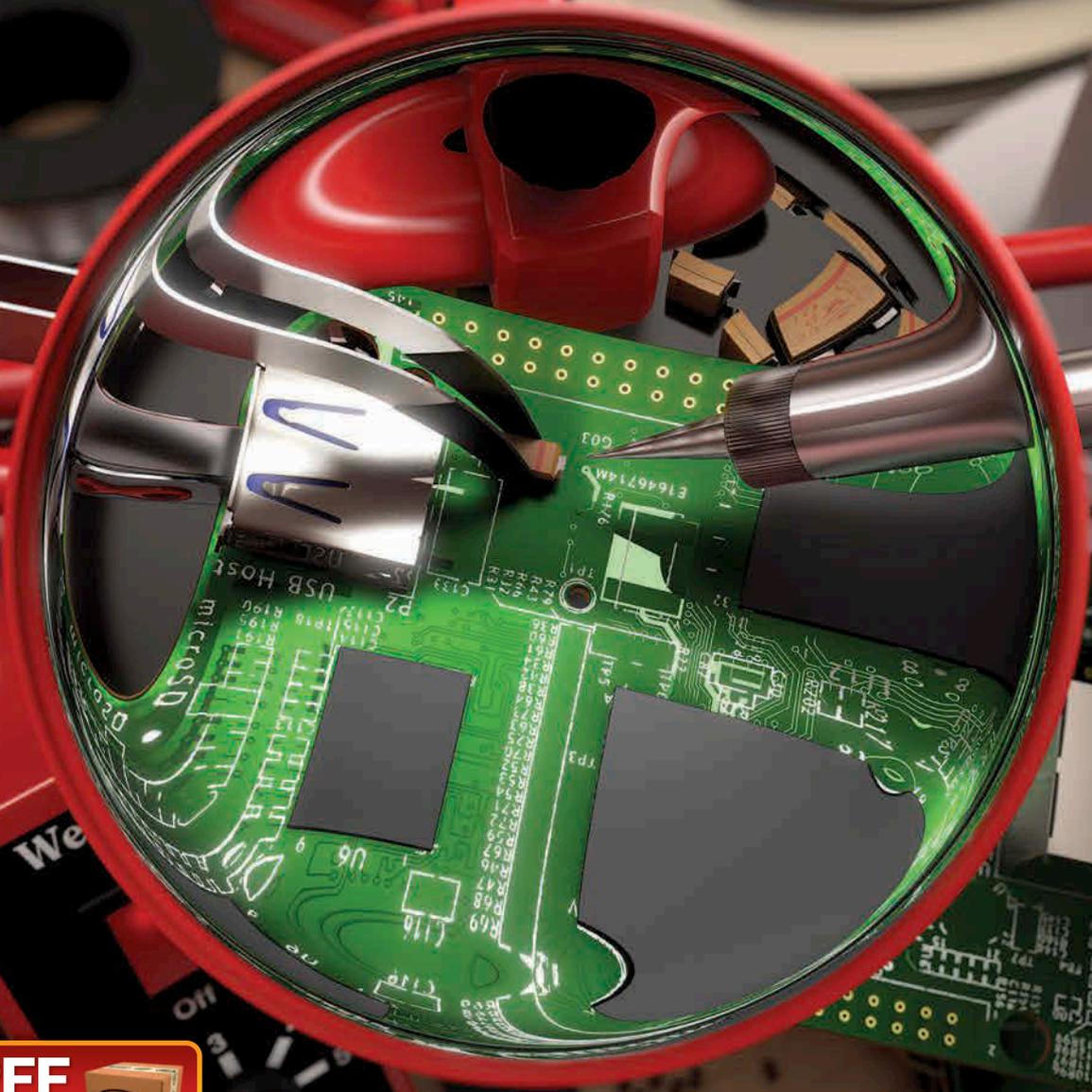


RETAIL REALIGNMENT

Trading conditions for retailers have been brutal forcing many to move online and invest in new technology

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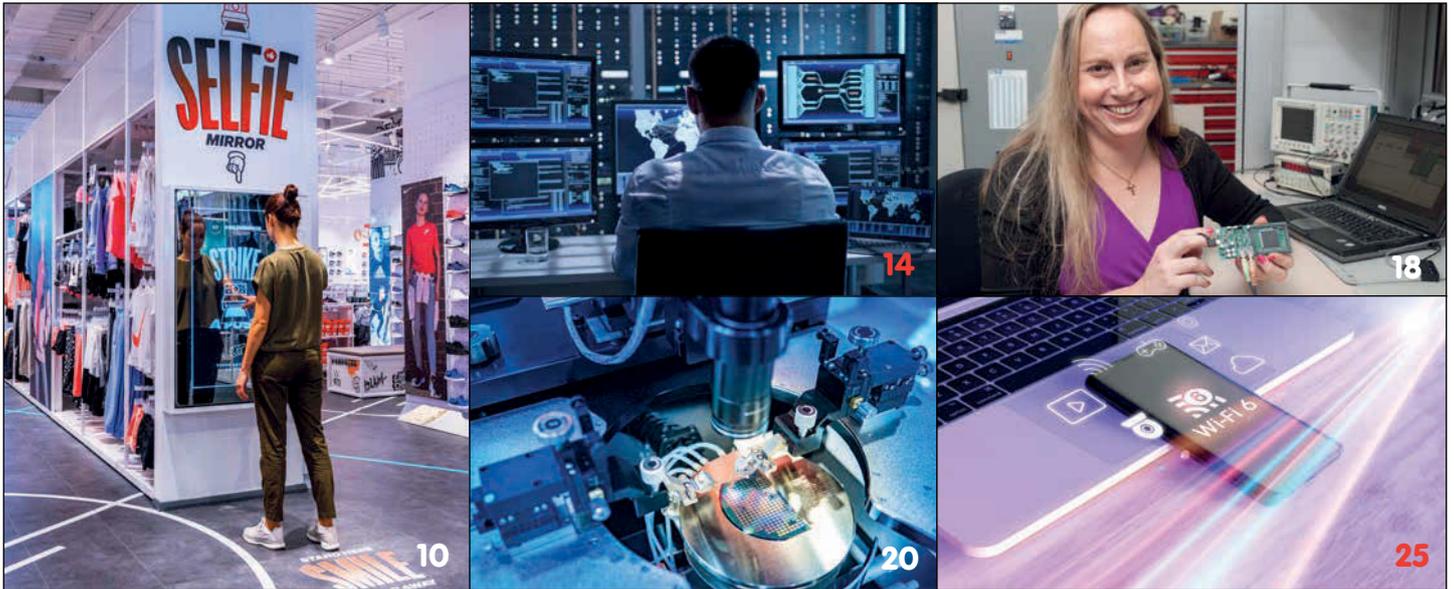
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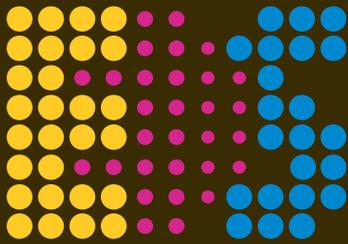
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Wi-Fi urgently needs more spectrum

To meet demand from new applications Wi-Fi urgently needs more spectrum, according to research from the Dynamic Spectrum Alliance and Policy Impact Partners

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Unintended consequences

COULD THE 'RIGHT TO REPAIR' ON THE GOODS CONSUMERS BUY PROVIDE A BOOST TO ADDITIVE MANUFACTURING?



UK ministers recently confirmed that, from this summer, consumers will have a right to repair on goods they buy in what is being described as a major step in cutting down on the estimated 1.5 million tonnes of electronic waste that the UK generates each year.

It comes at a time of pushback amongst consumers against unrepairable devices and the idea that many manufacturers deliberately sell products knowing that they will only last a few years i.e. planned obsolescence.

Our consumer society has succeeded in creating a mountain of e-waste and it's only recently that governments have started to announce plans to ensure that products can be more easily recycled, repaired or simply designed to last longer. Too many manufacturers fail to offer replacement parts or servicing, so this new law is looking to extend the lifespan of household appliances by up to 10 years – from a current average of around 2-3 years.

While this 'Right to Repair' law chimes with changing consumer attitudes and the demand for more sustainable technology Lesley Rudd, Chief Executive of Electrical Safety First, has warned that while this is a well-intentioned green policy, consumers should not attempt to repair their electrical appliances without the knowledge to do so safely and the Government should be giving serious thought as to who can carry out repairs – which is a fair point.

It's a sensible law but it only applies to domestic appliances and not to mobile phones or other electronic devices. Surley a missed opportunity when you consider that the likes of Apple and Samsung continue to make it impossible to fix their devices – consumers should be able to get their devices repaired without having to go to the manufacturer.

This legislation also comes with some possible unintended consequences, one of which is that 3D printing could provide manufacturers who are affected by this law with a solution for supplying spare parts, which they are legally obliged to make available to consumers for up to a decade.

For many companies this could involve stocking hundreds of thousands of spare parts. So, could 3D printing reduce the need for physical inventory and vast warehouses and make it possible to hold less frequently required parts as digital files only reproducing them as required?

The 'Right to Repair' law will undoubtedly mean that goods last longer, to the benefit of both consumers and the environment, but it could also provide as real boost for additive manufacturers.

Neil Tyler, Editor (neil.tyler@markallengroup.com)

“We’ve created a mountain of e-waste and it’s only recently that governments have started to announce plans to ensure that products can be more easily recycled, repaired or simply designed to last longer.”

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SiGe BiCMOS technology collaboration

X-FAB AND IHP HAVE ANNOUNCED A MAJOR INDUSTRY-ACADEMIC PARTNERSHIP.

NEIL TYLER REPORTS

X-FAB Silicon Foundries and IHP, the Leibniz Institute for High Performance Microelectronics, have announced a major industry-academic partnership bringing together X-FAB's semiconductor manufacturing capabilities with IHP's wireless communication expertise.

The partnership will see IHP's active devices directly integrated into the backend of line (BEOL) of X-FAB's 130nm XR013 RF-SOI process featuring Cu and thick-Cu based metallization, alongside high-performance passive elements, such as inductors and transformers. This integration will mean that a wide array of next generation wireless systems concepts can be experimented with and developed.

Another focus of the collaboration will be on the development of advanced SiGe BiCMOS technologies - the foundation of which will be IHP's SiGe heterojunction bipolar transistors. These offer strong performance parameters, with fT/f_{max} figures of up to 250/340 GHz for SG13S-Cu and up to 300/500 GHz for SG13G2-Cu. The use of 3 μ m thick low-loss copper interconnects are seen as helping to boost RF performance levels.



Both companies said that there will be opportunities for the technologies developed by IHP and X-FAB in terms of both optoelectronics and 5G wireless communication systems, as well as for innovative radar implementations.

"SiGe BiCMOS remains an attractive prospect for a number of wireless applications, including 5G, because it enables the integration of high-performance RF on a silicon-based platform," said Dr. Greg U'Ren Director of RF Technology at X-FAB.

"This partnership enables us to transfer first class research into commercial applications laying ground for next generation high performance RF systems, such as 400G data communication, 60-300 GHz radars and sub-THz imaging," Prof. Gerhard Kahmen, Scientific Director at IHP, added.

Fundamental physics collaboration

A leading academic team from Heriot-Watt University is partnering with ASML, a major supplier to the semiconductor industry, in a move designed to drive advances in new light source technologies.

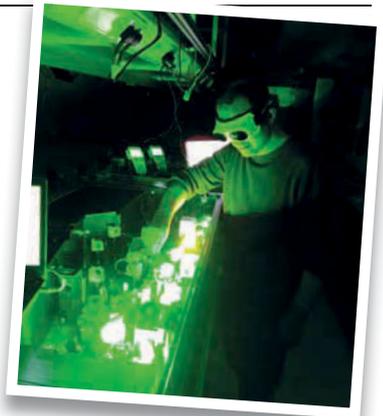
Professor John Travers' research into fundamental physics will be accelerated, creating a direct route from lab to market for new laser technologies.

ASML uses light to print tiny patterns onto silicon, resulting in the mass production of semiconductor chips and optical metrology uses light to establish the exact measurements required. Developments in this field

will allow chipmakers to create better performing, cheaper chips.

The partnership will see a new laboratory at Heriot-Watt University which will accelerate the industrialisation of its fundamental physics research.

Commenting Professor Travers said, "The type of optical components used in our recent research previously sat in the domain of fundamental physics research. Working in close cooperation with ASML we will be able to rapidly move our work in the direction of the industrialisation of



this technology, where we are addressing specific engineering challenges that will have a real-world impact."

Applications in light source technologies are not limited to semiconductor chip manufacture, as there are also valuable uses for the technique in healthcare technology and precision manufacturing.

'State-of-the-art' galvanic capacitor

TOWER SEMICONDUCTOR INTRODUCES STATE-OF-THE-ART GALVANIC ISOLATION TECHNOLOGY. NEIL TYLER REPORTS

Tower Semiconductor, a foundry of high value analogue semiconductor solutions, has announced a newly developed, 'state-of-the-art' galvanic capacitor technology integrated with its 0.18um power management and mixed signal platforms, enabling up to 12kV isolated gate driver and digital isolator ICs, enhancing the safety and power efficiency for applications in the automotive, green power and industrial markets worth up to \$1bn.

The technology offers a cost and size advantage thanks to the integration of the galvanic isolator, saving the need for an additional device. Lead customers are prototyping initial products addressing applications such as battery chargers, power supplies and motor drivers for electric and hybrid vehicles, green power and industrial markets.

"We are very excited to announce this innovative technology as we partner with lead customers to bring new products to market, supporting the anticipated high-growth in electrical vehicles and other applications for isolated power," said Mr. Shimon Greenberg, Tower's Vice President and General Manager of Mixed-Signal and Power Management Division, AIC BU. "The new technology augments our widely deployed 0.18um power technology, supporting applications from 5V to 200V".

Xilinx expands UltraScale+ portfolio



Xilinx has expanded its UltraScale+ portfolio to markets with new applications that require ultra-compact and intelligent edge solutions.

With form factors significantly smaller than traditional chip-scale packaging, the Artix and Zynq UltraScale+ devices will be able to address a wider range of applications within the industrial, vision, healthcare, broadcast, consumer, automotive, and networking markets.

Based on 16nm technology, these devices are available in TSMC's state-of-the-art InFO (Integrated Fan-Out) packaging technology. Using InFO, both devices meet the need for intelligent edge applications by delivering high-compute density, performance-per-watt, and scalability in compact packaging options.

"Demand for compact, intelligent edge applications is driving the requirement for processing and bandwidth engines to not only provide higher performance, but also new levels of compute density to enable the smallest form factor systems," said Sumit Shah, senior director, Product Line Management and Marketing at Xilinx. "These new additions to our UltraScale+ portfolio are powerful enhancements that leverage the architecture and production-proven technology of Xilinx's UltraScale+ FPGAs and MPSoCs, which collectively have been deployed in millions of systems worldwide."

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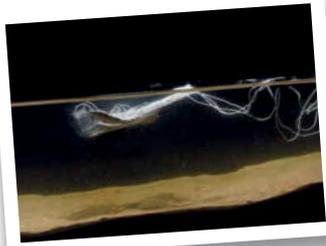


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Ag-hydrogel composite for soft bioelectronics

Researchers in Carnegie Mellon University's Soft Machines Lab have developed a silver-hydrogel composite that has high electrical conductivity and is capable of delivering direct current while maintaining soft compliance and deformability.

Hydrogels are lightweight, stretchable, and biocompatible but poor at conducting electricity, which is needed for digital circuits and bioelectronics applications.

Soft Machine Labs' team was able to suspend micrometer-sized silver flakes in a polyacrylamide-alginate hydrogel matrix and after going through a partial dehydration process, the flakes formed percolating networks that were electrically conductive and robust to mechanical deformations. By manipulating this dehydration and hydration process, the flakes were made to stick together or break apart, forming reversible electrical connections.

"With its high electrical conductivity and high compliance or 'squishiness,' this new composite can have many applications in bioelectronics and beyond," explained Carmel Majidi, professor of mechanical engineering. "Examples include a sticker for the brain that has sensors for signal processing, a wearable energy generation device to power electronics, and stretchable displays."

Superconducting coils for contactless power transmission

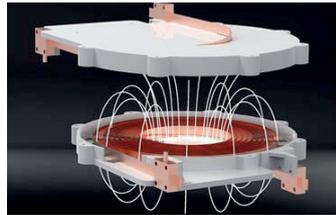
SCIENTISTS DEVELOP A COIL WITH SUPERCONDUCTING WIRES THAT CAN TRANSMIT CONTACTLESS POWER WITH ONLY LIMITED LOSSES. NEIL TYLER REPORTS

Technical University of Munich (TUM) physicists Christoph Utschick and Prof. Rudolf Gross, have made a coil with superconducting wires capable of contactless transmitting power.

Although widely used in charging small devices, there is now a growing interest in contactless charging for larger electric machines. These types of devices could be placed on a charging station whenever they are not in use. Current transmission systems for high performance recharging in the kilowatt range and above, however, are based on copper coils which are large and heavy.

Working with Würth Elektronik and superconductor coating specialist Theva Dünnschichttechnik, the TUM team have created a coil with superconducting wires capable of contactless power transmission in the order of more than five kW and without significant loss.

Minor alternating current losses can occur in superconducting



transmission coils and these losses grow as transmission performance increases - the surface temperature of the superconducting wires rises and the superconduction then collapses.

To address this, the researchers developed a special coil design in which the individual windings of the coil are separated from one another by spacers.

"This trick significantly reduces alternating current loss in the coil," said Utschick. "As a result, power transmission as high as the kilowatt range is possible."

The team chose a coil diameter for their prototype that resulted in a higher power density than is possible in commercially available systems.

Making the distance between the windings of the superconducting coil too small can result in superconduction collapse during operation, while larger separations will result in lower power density.

"We optimised the distance between the individual windings using analytical and numerical simulations," said Utschick. "The separation is approximately equal to half the width of the tape conductor."

The researchers now want to work on further increasing the amount of transmittable power, but will have to overcome the problem that the coils used require constant cooling with liquid nitrogen, and the cooling vessels cannot be made of metal.

"This will mean an extensive amount of further development effort," conceded Rudolf Gross, Professor for Technical Physics at the Technical University of Munich and Director of the Walther-Meissner-Institute of the Bavarian Academy of Sciences and Humanities.

Hall Effect sensor designed for battery applications

Paragraf has developed a graphene Hall Effect sensor designed for battery applications, such as the electric vehicle (EV) sector.

The GHS01AT Hall Effect sensor can be used in relatively low field environments and normal ambient temperatures and is able to address a broader range of monitoring tasks.

The sensors are suited to the battery market where they can be used in battery cell analysis when investigating the validity of different battery cell chemistry derivatives and form factors under development. By using them, it will be possible to get a more detailed



and localised understanding of battery cell behaviour.

The GHS01AT is able to deliver detailed real-time current density mapping - with any variations at different locations in the cell being detected during repeated charge/discharge cycles - providing insights into the physical processes occurring in the battery.

The sensors can also be used to measure the current flow into and out of cells. The method is an indirect means for measuring real-time magnetic field (current) data, so that the battery cell itself and the tabs/busbars feeding into the cells are not disrupted during testing.

By utilising a graphene monolayer (just 0.34nm thick), the GHS01AT is not affected by the presence of in-plane stray electromagnetic fields that would severely impact the accuracy of alternative sensing mechanisms. Paragraf is also making available a GHS Array Starter Kit.

Self-testing in Embedded Systems

Unless available memory is totally exhausted, in an embedded design it is worthwhile considering the implementation of some self-testing capabilities.

Modern electronics tends to be amazingly reliable, but failures are still possible. In an embedded system there are broadly four categories of failure:

- CPU
- Peripheral
- Memory
- Software errors

If a CPU fails, it tends to be a hard failure. This does not offer any possibility for self-testing. Partial failure of a CPU is very unlikely. In a multicore system, it is good practice to assign one of the cores as “master” so that it can monitor system integrity.

Peripherals can fail in various ways, but many modes of failure are very device/application specific. If a device fails to respond to its address, the trap occurs; it is essential to include a trap handler to process this fault. Otherwise, communications devices commonly include a “loopback” mode that enables testing of transmission and reception and associated interrupts.

Memory failure is always a possibility. This failure may be transient – i.e., a single bit being flipped by a passing cosmic ray. It is generally not possible to detect such a fault and it may cause a software crash. It is, therefore, essential

```

set every bit of memory to 0
for each bit of memory
{
    verify that all bits are 0
    set the bit under test to 1
    verify that it is 1
    verify all other bits are 0
    set the bit under test to 0
}
    
```

Moving Ones Test

to accommodate crash recovery. A hard failure maybe a lack of address response or bits stuck at 0 or 1. A trap handler deals with the former, but the latter requires some specific testing. Comprehensive memory testing can only be done on device

start-up. A *Moving Ones* test is effective.

While the device is operating, pattern testing can be performed on individual bytes/words, which may highlight certain types of failure.

The most complex part of modern devices is software. Although software does not exactly wear out, its complexity can result in faults that are difficult to detect during development. Good, defensive coding techniques can help anticipate some problems. Broadly, there are two types of software error: data corruption and code looping.

Data corruption can be caused by pointer misuse, which is hard to detect or prevent,

but it can also be as a result overflow of a data structure, like an array or the stack. The insertion of “guard words” can assist with the detection of overflow before any damage is caused.

Code looping can be addressed by careful design – precautions like timeouts on waiting for devices – or some kind of watchdog facility (in hardware or software) that traps unresponsive code.



Stack Guard Words

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Colin Walls,
Siemens Embedded

With some of the toughest trading conditions in living memory retailers are moving online and investing in new technology, as **Neil Tyler** discovers

A 'brutal' realignment in retail

The past year has seen the retail sector undergo enormous changes and there's been a marked shift towards e-commerce and trading online. The high street has witnessed the collapse of some big names, such as Arcadia and Debenhams, and profitable retailers, including the department store John Lewis, have reported record losses and are being forced to close stores.

New data has found that more than 17,500 chain stores and other venues have closed over the past year in the UK, and while there were 7,665 store openings the net loss of stores was the worst on record.

The pandemic has triggered a massive sectorial transformation in a matter of a few months, at a time when retailers have also had to contend with closures for extended periods of time.

Traditional bricks and mortar retailers have struggled - a trend that started well before the arrival of the pandemic - but those with successful online platforms have prospered.

As high street names have collapsed and thousands of jobs have been lost the likes of Amazon, ASOS and Boohoo have reported significantly better results, and have been among those buying up failed brands. However, while online groups are expanding, Boohoo is set to open a new warehouse creating 1,000 new

jobs, for example, these online models require far fewer employees.

The shift to online has never been more obvious, neither has the importance of having a strong digital presence enabling retailers to better meet changing consumer behaviours, as well as to remain both relevant and competitive.

Retailers are developing their online offering at a time when consumers have become more reliant on online channels and platforms and are also having to engage with, and use, different forms of marketing.

Many retailers have turned to 'influencer' marketing, for example, using these platforms to reach new audiences with more creative content as they look to drive awareness of product ranges and services.

These are trends that are likely to accelerate, even as we enter a post-pandemic world.

The 'bricks and mortar' experience

"Prior to the crisis, as a business, inurface was about creating in-store experiences using technology, and that usually involved putting a display screen behind a till or in a window but as our business has grown, and new technology has improved, so things have moved to a new level," said Josh Bunce, CEO, inurface. "All Covid-19 has done has been to expediate the need



Above: The retail digital experience can employ touchscreens, projectors and screens

for change and we're seeing more stores being turned into destinations."

Inurface works with some of the world's leading brands and designs and deploys bespoke, end-to-end digital signage solutions.

Pointing to stores like Nike Town in New York and London, Bunce said that their focus is entirely on creating an 'experience'.

"These stores have limited product on display and for the consumer the experience they create is all about 'falling in love' with the brand. "Engagement with the brand builds a much stronger relationship than the act of simply buying a product," Bunce added. "I think that what the pandemic has done is simply highlight that trend. Brands like Debenhams or Arcadia were likely to fail in time as they were not investing in, or creating, an attractive shopping experience."



According to Bunce successful retailers will be those that combine an experience with product.

“The face of retail is changing and brands that fail to innovate will have real difficulty in attracting customers to their physical spaces. Customers have discovered the pleasure of being able to buy products from the comfort of their own homes, so retailers are going to have to offer far more. If you look at centres like Westfields or the Trafford Centre in Manchester, they are incorporating leisure as much as retail – the retail experience has to be more than simply buying a product.”

For many retailers, however, building an experience won't be enough or suitable for their customers. For many it will be about personalisation using digital technologies.

“When we apply digital technologies, we have to first

understand the retailer's aspirations and what its brand is trying to say. That will determine the digital experience and could involve touchscreens, projectors and screens – will those screens use gesture, touch or simply be dumb?” explained Bunce.

Inurface is currently working with retailers in the development of digital showrooms. For example, Reformation, a US retailer has recently opened an immersive shop in London's upmarket Bond Street.

“Reformation displays clothes as samples and shoppers use a digital touch screen to select their clothes and then use a personalised changing room where they can select their own music and lighting,” explained Bunce. “It creates and adds to the personalised nature of the experience.”

Alternatively, H&M are using displays combined with artificial intelligence to create a shopper's avatar. In their digital changing rooms AI is used to scan the body of the shopper and by using a simple app the shopper is able to create an avatar to try on clothes to see if they would suit them.

Another store, Men's Warehouse, is using a contactless measurement tool to deliver a personalised shopping experience and can, via a 3D tool, size up the customer delivering the correctly sized clothing.

“These are responses to Covid-19 but I think that what we are seeing is that the future of retail will depend on the blending of digital solutions,



“Using our combination of AI and machine learning with nutritional expertise enables retailers to deliver highly personalised experiences tailored to the unique dietary, health and wellness requirements of each customer.”
Markus Stripf

like these, within traditional stores – where personalisation, interactivity and convenience are all going to be critical,” said Bunce.

Last year the company acquired ‘We are Interact’ and its Events Tag technology platform in a move designed to further enhance the shopping experience.

“Everything today is about reinventing the retail experience and through this acquisition we are looking to transform traditional retailers and create experiential hotspots,” explained Bunce. “We want to help retailers encourage consumers back on to the high street by creating exciting and innovative immersive experiences.”

Grocery retailing

While retailing has struggled over the past 12 months one part of retailing that has boomed has been food retailing, with grocery chains coming under pressure for making ‘excess profits’. Even here, though, there has been a shift to online shopping and retailers are using technology in order to keep up with changing consumer eating habits.

According to Markus Stripf, CEO and Co-Founder of Spoon Guru, “Well before Covid-19 lifestyle and changes in attitude had been reshaping shopper behaviour, so Covid simply accelerated those changes further.”

Shoppers were becoming more health conscious but during the pandemic that trend has accelerated with research pointing to almost a third of people in the UK changing their diet.

“People want to know what they are putting in their bodies, they want to be proactive and take control. We've also seen growing concerns about the environment and people are demanding more eco-friendly products,” said Stripf. “People have been embracing technology and using e-commerce and digital tools to help them.”

Spoon Guru uses AI to help consumers to better manage their



food shop and helps them to exclude certain foods, manage diets, or ensure their health by guiding them towards healthier food options.

“Finding healthy food isn’t easy and there needs to be better support for consumers when it comes to managing their dietary needs,” explained Stripf.

A food search and discovery technology start-up, the company was founded in 2015 and recently received funding from the venture capital arm of Australia’s largest retailer, Woolworths Group.

The company first appeared in the UK partnering with Tesco’s to help shoppers who were trying to manage individual dietary preferences.

“Spoon Guru works with retailers to provide an end-to-end solution that combines AI with nutritional expertise to determine the suitability of products when people conduct a search online and then delivers a personalised shopping experience,” said Stripf. “It’s all about building trust and reinforcing a shop’s relationship with its customers.”

According to Stripf, too many of the online search engines used by retailers bring back inaccurate results, so the company’s TAG platform was developed to analyse ingredients and ensure that data was kept up-to-date and accurate, so that consumers are able to make better and healthier choices.

“Retailers need to accurately classify all of their products and keep their consumers informed when it comes to making wise food choices,” said Stripf. “Using our combination of AI and machine learning with nutritional expertise enables retailers to deliver highly personalised experiences tailored to the unique dietary, health

and wellness requirements of each customer.”

With governments around the world launching campaigns to tackle obesity and other lifestyle diseases, grocery retailers can also use the company’s technology to drive and scale healthier shopping too.

“The role of digital technologies, like ours, together with supporting technologies like apps, wearable technology and data management, will be crucial in helping the sector deliver a healthier, more sustainable and more personalised experience.”

Supply chains

Efficient supply chains are critical for the retail sector and here technology is being used to ensure that it’s safe, transparent and efficient.

Research suggests that 50 per cent of large global companies are set to use a combination of AI, advanced analytics and the internet of things (IoT) to better manage their supply chain operations by 2023. AI is transforming the way that retail supply chains function with companies able to process massive amounts of data to find out faster than ever which products are seeing the most interest or the highest purchase rate at any given time.

This is helping to speed up the supply chain process and allows manufacturers to know where to focus their resources.

Cloud technology is being used to revolutionise the way that different elements of the supply chains function and communicate while the automation of the supply chain has made it easier to track and report on products.

With more companies moving online



“All Covid-19 has done has been to expediate the need for change and we’re seeing more stores being turned into destinations.”

Josh Bunce

an automated supply chain is now essential for big brands if they are to keep up with consumer demand and for many retailers wearable tech is utilised in warehouses and distribution centres, allowing for increased communication and efficiency - from in-house communication to real-time data sharing.

Technology also has a role in making it easier for brands to be more transparent about their practices. This is particularly important when appealing to younger shoppers. Generation Z and millennial customers prioritise ethical practices more than any previous generation so technology can be used to produce clear and transparent reports on supply chains.

Turning to the future

According to Bunce the future of the high street is not necessarily a bleak one.

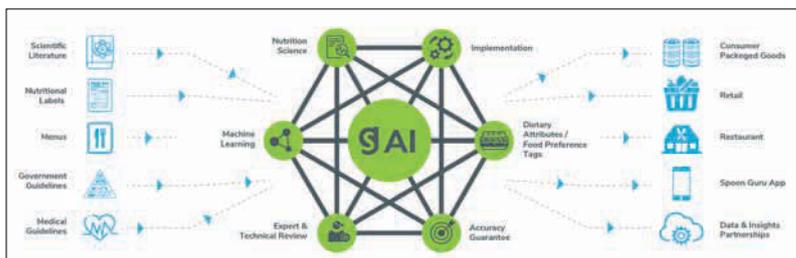
“I don’t think it is the end of the high street, but in the future we will see a mix of hospitality, residential, retail and experiences. When big brands disappear, new opportunities will appear in the market. New retailers will come forward and we are already seeing online retailers developing flagship experiences.”

Bunce points to the opening of Amazon’s new Amazon Fresh shops in Ealing and Wembley in London, which are using tracking technology to allow customers to enter and leave the shop without paying – their Amazon accounts are simply charged later.

“I think you’ll see more online retailers like Amazon starting to go into bricks and mortar - there will be different drivers for each retailer. We’ll also see more flexible retail models such as pop-ups appearing.”

Despite the loss of so many retailers in recent months the future for retailing remains an exciting, if challenging one.

But as Bunce warns, “those retailers that want to survive and go forward will need to invest and technology will have a crucial role to play.”



Left: How Spoon Guru works



MANHATTAN SKYLINE

Size	Res.	P/N	Status	Kick Off	CAS	1 st Sample	Final Sample	MP
8.4"	1024 x 768	ET084030DVA	Developing	Sep. 18	Oct. 12th	End Dec.	Jan. 2021	2021
10.4"	1024 x 768	ET104030DSA	Developing	Oct. 8th	Oct. 23th	End Dec.	Jan. 2021	2021
12.1"	1024 x 768	ET121030DVA	Developing	Sep. 7th	End Sep.	End Nov.	Jan. 2021	2021

EDT releases replacement TFTs for Mitsubishi's discontinued display modules

Following Mitsubishi Electric's official press release in June 2020, where the company announced:

The company's LCD business, currently focusing on small and medium-sized TFT-LCD modules for industrial and automotive use, has been expanding its business by developing and launching high value products with advanced technologies in the specific market segments based on the market needs. However, the company has decided to end the TFT-LCD modules production and terminate the business based on the consideration that the company is no longer able to maintain the products' competitiveness under the situation that the global competition involving the company's focusing segment of high display performance and high reliability expands and intensifies with significant falling in price.

EDT is developing a new series of display modules aimed as compatible replacements and offering the same features such as size and resolution and same mechanical outline structure. Until further notice they have planned for 3 sizes in XGA resolution (refer the table below), and more sizes can be added to this road map. If you are looking for other product sizes to replace Mitsubishi module, please do not hesitate to send us your inquiry and notify us what are the most important criteria for your application. Together we can develop the most suitable alternative.

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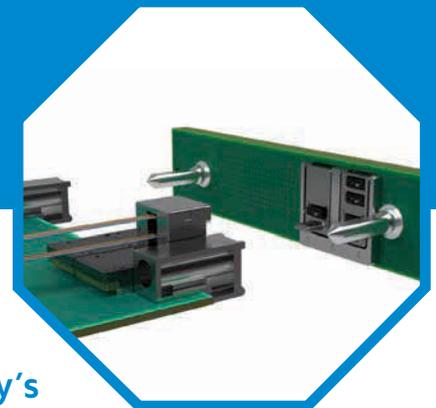


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Creating a cyber-aware culture

Earlier this month the US saw a hack on Microsoft's Exchange email software with the possibility that tens of thousands of organisations, both in the US and beyond, may have been impacted.

In fact, shortly after the news broke, the European Banking Authority said that its email servers had been compromised by the attack and that personal data may have been accessed from its servers. As a consequence it was obliged to pull its entire email system offline while it assessed the damage.

Despite the Microsoft Exchange servers being widely used for email by major businesses and governments, to date, few organisations have actually admitted to having been hit by the attack.

According to Microsoft the cyber-attack appears to have exploited a vulnerability in its Exchange email system making it possible to look like someone who should have access to the system. As a result the hacker(s) were able to take control of the email server remotely - and steal data from the network.

Another week, yet another series of attacks.

Singapore Airlines also recently reported a data breach that affected 580,000 frequent flyer customers which seems to have stemmed from a cyber-attack launched against air transport communications and IT vendor, SITA, which serves roughly 90% of the world's airlines.

"Many organisations don't see the full picture of what their third-party vendors do with their critical data and systems. For example, if a vendor uses a shared account to access your corporate network, your organisation won't be able to determine which of their employees has made a given change in the system," said Florian Thurmman,



How can AI play an effective part in cyber-defence strategies and what are the challenges when it comes to deployment? NE investigates

Technical Director, EMEA, Synopsys Software Integrity Group. "This lack of visibility, control, and security insight leaves a critical blind spot. Every organisation has the responsibility to ensure their software supply chain vendors meet your cybersecurity policy requirements."

As these examples demonstrate, the cybersecurity landscape continues to evolve at pace, as criminals become ever more sophisticated.

As a consequence, digital security tools need to continuously be improved in order to mitigate the risks as much as possible.

"Over the past twelve months we've seen more opportunities for hackers to strike, for example, using email phishing scams such as purporting to be authentic PPE providers, or from HMRC to dupe unsuspecting victims. More recently we have seen how phishers are now

using the vaccine rollout to trick people into paying for fake vaccines," said Oliver Paterson, Product Expert VIPRE Security Awareness Training and SafeSend.

At the same time Artificial Intelligence (AI) and Machine Learning have been heralded as innovative technologies that could help thwart evolving exploits and are seen as a key part of any cyber security arsenal.

"However, AI is not necessarily the right tool for every job," warns Paterson. "Humans are still able to perform intricate decision making far better than machines, especially when it comes to determining what data is safe to send outside of the organisation. As such, relying on AI for this decision making can cause issues, or worse, lead to leaked data if the AI is not mature enough to fully grasp what is sensitive and what is not."

So where can AI play an effective part in a cyber-defence strategies and where can it present challenges to the user?

Spotting similarities

One of the primary challenges for AI is to mitigate risk from accidental insider breaches by being able to spot similarities between documents or knowing if it is ok to send a particular document to a specific person. “Company templates such as invoices appear to be very similar each time they are sent, with minor differences but typically, Machine Learning and AI fail to pick up on this,” said Paterson. “The technology will register the document as it usually would, despite there being very few differences in the numbers or words used, and would typically allow the user to send the attachment. Whereas in this example, a human would know which invoice or sales quote should be sent to which customer or prospect.”

Deploying AI for this purpose in a large corporation would likely only stop a small proportion of emails from being sent. But even when the AI detects an issue to flag, it will alert the administration team rather than the user.

“This is because if the AI believes that the email shouldn’t be sent, it doesn’t want the user to override it and send the email anyway. This can therefore become an additional burden for the admin team and cause frustration for the user at the same time,” Paterson suggests.

Data storage

AI can also be very data-intensive when used for this defence strategy. According to Paterson, “This is due to the fact that in this setup, every email must be sent to an external system, off-site, to be analysed. Especially for industries that deal with highly sensitive information, the fact that their data is going somewhere else to be scanned will

be an obvious concern.

“Moreover, with Machine Learning, the technology has to keep a part of this sensitive information in order to learn rules from it and use it again and again, to make an accurate decision the next time. Given the Machine Learning nature of these types of solutions, they cannot work straight off the shelf, but have a learning phase that lasts a few months, and therefore cannot provide instant security controls.”

Understandably, a lot of companies, especially at enterprise-level, are not comfortable with their sensitive data being sent elsewhere. The last thing they want is it being stored off-site, even if it is just for analysis. AI, therefore, can add an unnecessary and unwanted element of risk to sensitive material.

The role of AI in cybersecurity

Whatever the concerns or drawbacks AI does have a critical role to play in many elements of a business’ cyber defence strategy. Antivirus technology, for example, operates a strict ‘yes or no’ policy as to whether a file is potentially malicious or not. It’s not subjective, through a strict level of parameters, something is either considered a threat, or not.

“In those cases, the AI can quickly determine whether it’s going to crash the device, lock the machine, take down the network and as such, it is either removed or allowed,” says Paterson. “It is important to note that VIPRE uses AI



“Relying on AI can cause issues, or worse, lead to leaked data if the AI is not mature enough to fully grasp what is sensitive and what is not.”

Oliver Paterson

and ML as key components in their email and endpoint security services for example as part of their email security attachment sandboxing solution where an email attachment is opened and tested by AI in an isolated environment away from a customer’s network.”

So while AI might not be an ideal method for preventing accidental data leakage through email, Paterson does suggest that it has an important part to play in specific areas such as virus detection, sandboxing and threat analysis.

Conclusion

Cyber-attacks have wide ranging implications whether that’s having a reputational impact, causing a compliance breach or associated financial damage – all of which can be devastating. A cyber-aware culture with continuous training is essential, and so is the right technology to combat it.

“Providing a technology that alerts users when they are potentially about to make a mistake – for example, by sending an email to the wrong person or sharing sensitive data about the company, its customers or staff – not only minimises errors, it helps to create a better culture,” says Paterson. “Mistakes are easily made in a fast-paced, pressured working environment – especially with the increase in home working not providing the immediate peer review that many are used to.

“But rather than leaving this responsibility solely to AI, this type of technology, needs to be combined with trained human insight, so that users are able to make more informed decisions about the nature and legitimacy of their email before acting on it.

“Ultimately,” according to Paterson, “it’s about supporting organisations to mitigate against this high-risk element of business, and reinforcing compliance credentials through a cyber-aware culture.”



While it may seem that AI is already endemic, there is still a long way to go before it fulfils its promise. This raises many questions but one of the most pertinent is 'will AI be secure?' In the embedded sector the topic of security in the IoT has been fiercely debated for over a decade and we can now say with some certainty that the IoT is well on the way to being made more secure. Manufacturers have access to guidance and best-practice, not least because of the efforts of ETSI and free access to its work, such as the Technical Report ETSI TR 103 533, which gives an overview of the standards landscape for security in the IoT.

Following several surveys carried out between 2018 and 2019, the European Commission discovered that while it could identify over 200 organisations working on AI, only one of them was specifically addressing security as it applies to AI. This was identified as a major potential threat, looming on the horizon. Anyone familiar with the IoT will appreciate how consuming the subject of security can become. As more things become connected, the legal liability associated with introducing a node with poor security is, alone, enough to make manufacturers stop and think.

Considering that we can expect AI to soon be embedded in everything, from IoT nodes to cloud servers, the scale of the potential threat is apparent. Depending on which analyst report you consult, the AI market is expected to demonstrate a compound annual growth rate (CAGR) of as much as 50% over the next five years, some say it could be even higher. This means we are at an inflexion point in the evolution of AI. The time to address security is now.

With most ICT systems the security threat is identifiable and, often, direct. With AI, this is not necessarily the case. The nature of AI means that the threat could be introduced at various points. We can expect most IoT-like

WHY DOES AI NEED A SECURITY STANDARD?

The effort going into making AI a viable technology is enormous but, until now, there has been no consolidated effort to make AI secure. **Alex Leadbeater** explains

systems to employ a form of AI known as Machine Learning (ML), a subset of AI that is formed through acquiring, curating and presenting data to an algorithm to build a model. It is the model that is subsequently deployed in embedded software, but it then still needs to be trained for a specific application.

Threat assessment

In order to assess the scope of the potential threat, ETSI formed the world's first standardisation initiative dedicated to securing AI. The ETSI Securing Artificial Intelligence Industry Specification Group (SAI ISG) was formed in September 2019. In January 2021 it released its first group report,

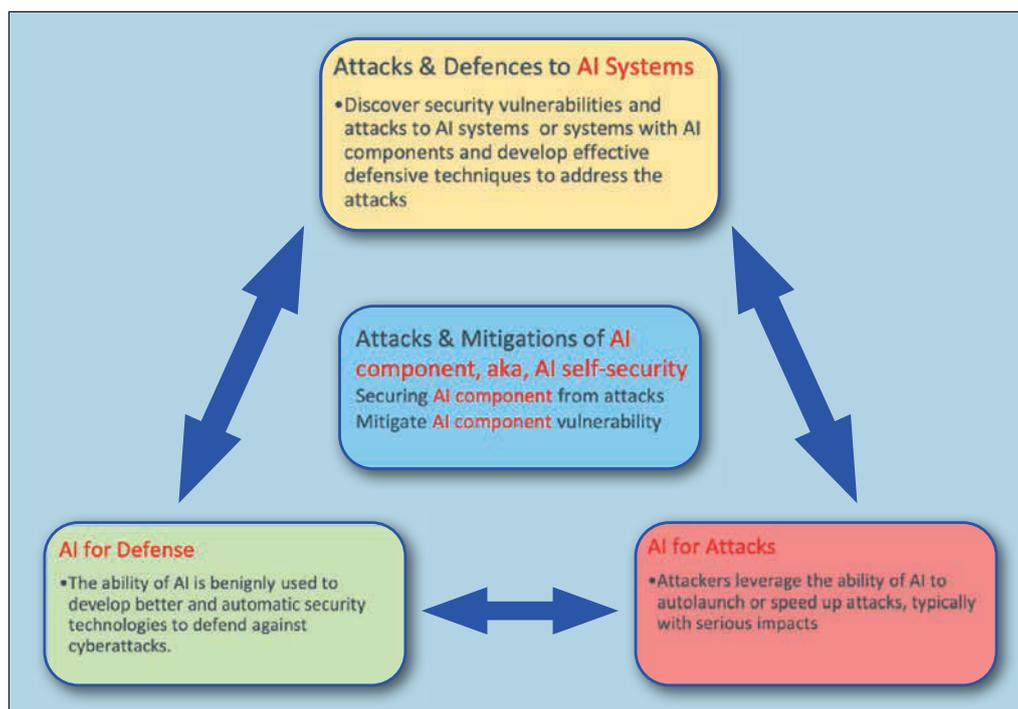
giving an overview of the problem.

While the ultimate intention is to see standards produced that provide solid solutions to the threat, the initial objective must be to identify how AI might be used and how those use-cases may be susceptible to attacks.

As an example, which is indicative of the unique challenge AI systems present, it is currently uncommon for an AI system to be backed up or rolled back in the event of an attack causing total lockout. It may not even be possible to 'switch off' an AI system, in the traditional sense.

The SAI ISG has identified three scenarios that it feels put manageable parameters on this challenge; defending a system from an attack

Figure 1: The three threat scenarios facing AI



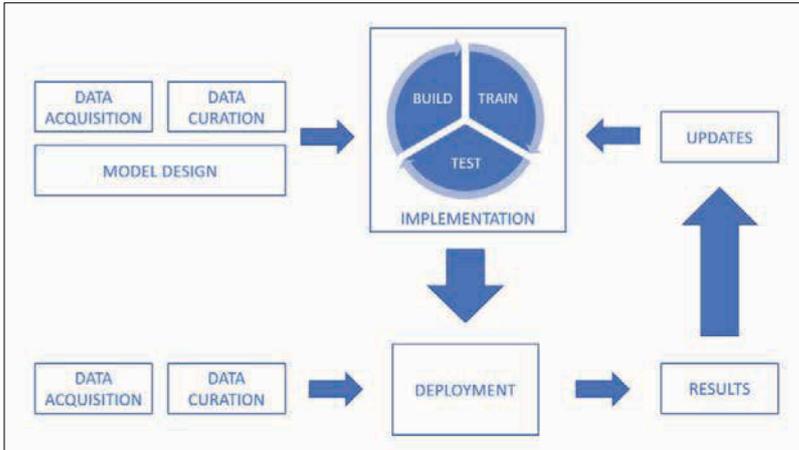


Figure 2: The Machine Learning lifecycle

launched by another system that is using AI; using AI to make systems more defensible from all attacks, and making AI systems less susceptible to all forms of attack.

The concept of using a trained model to probe another system, looking for weaknesses, is compelling. This could include using AI to break the type of encryption being used (if any) by analytical methods, or it could simply involve using AI to create a more intelligent type of brute force attack.

Similarly, AI could be employed to defend a system, by being trained to identify attacks faster and respond quicker. This is, perhaps, the most familiar type of threat, as it extends the way antivirus software is used today. Arguably, antivirus software is much less common in edge devices and the IoT, but this is exactly where ML will be deployed.

It is inevitable that cybercriminals will enlist AI to help them in their attempts to break into secure systems. This will pit AI against AI, forcing the respective systems to go head-to-head in an unseen battle. Standards that help in the development of AI systems that understand this threat and can defend against it will be crucial in the future.

The unique threats

It would be understandable to view AI through the same lens as other ICT systems, but the real picture is

very different. Networks operate in an inherently serial, linear way; protective mechanisms have been developed to operate in the same way. AI systems are not serial, they are much more parallel in nature, which means the threats present differently. Directly porting existing security measures across from other ICT systems would not provide adequate protection.

The SAI ISG is going back to the start, to look at AI from the bottom up, to identify where the weaknesses exist. This is a technology-centric, rather than application-centric, approach. The result is the security solutions developed will not be specific to any given application of AI. In short, it will not matter what AI is being used for as it will still be protected.

By understanding how to build a trusted AI solution, any application layer that sits on top of that will be inherently secure, thanks to the building blocks put in place. Simple firewall filtering or monitoring approaches, as we understand them today, would not provide that.

The ML lifecycle

Unlike a traditionally developed system, which generally needs to protect itself from attacks only after it has been put into service, AI systems have many stages in their lifecycle that are susceptible to potential attack. These are outlined in Figure 2.

During the data acquisition and data curation stages, the data comes

from many real-world sources. Any of these sources, or their data, could be influenced, or ‘poisoned’ to introduce a security weakness. This represents an integrity issue, which can extend to the training phase of the ML lifecycle. The deployment and inferencing stages are also susceptible to integrity issues, by attackers introducing data that forces the system to react or behave in an unplanned or unexpected way.

What makes these issues more specific to AI systems is that they can be associated with and optimised for the method of learning employed. For example, AI and ML systems will typically use supervised, semi-supervised or unsupervised learning, where the data sets are labelled, partly labelled or unlabelled, respectively. In addition, reinforcement learning is a method that ‘rewards’ the system for a correct answer and ‘punishes’ it for an incorrect answer, but the concept of reward is entirely subjective and therefore prone to abuse.

The SAI ISG has six active work items, securing the AI problem statement is the first. This will be followed by the AI Threat Ontology (which will define what might be considered an AI threat); the Data Supply Chain report (which would address the issues associated with maintaining and protecting the integrity of training data); and the Mitigation Strategy report (which will summarise and analyse the existing mitigation against threats to AI-based systems). The final two are the Security Testing of AI work item and the group report looking at the role of hardware in SAI.

The efforts of the SAI ISG will likely result in standards being developed that can help all users and beneficiaries of AI-based systems maintain a high level of security.

At the very least, it will promote greater conversation around the issues threatening that security. As with all standards produced by ETSI, it and the findings of the SAI ISG will be freely accessible online.



Author details:
Alex Leadbeater
is Chair of ETSI SAI ISG

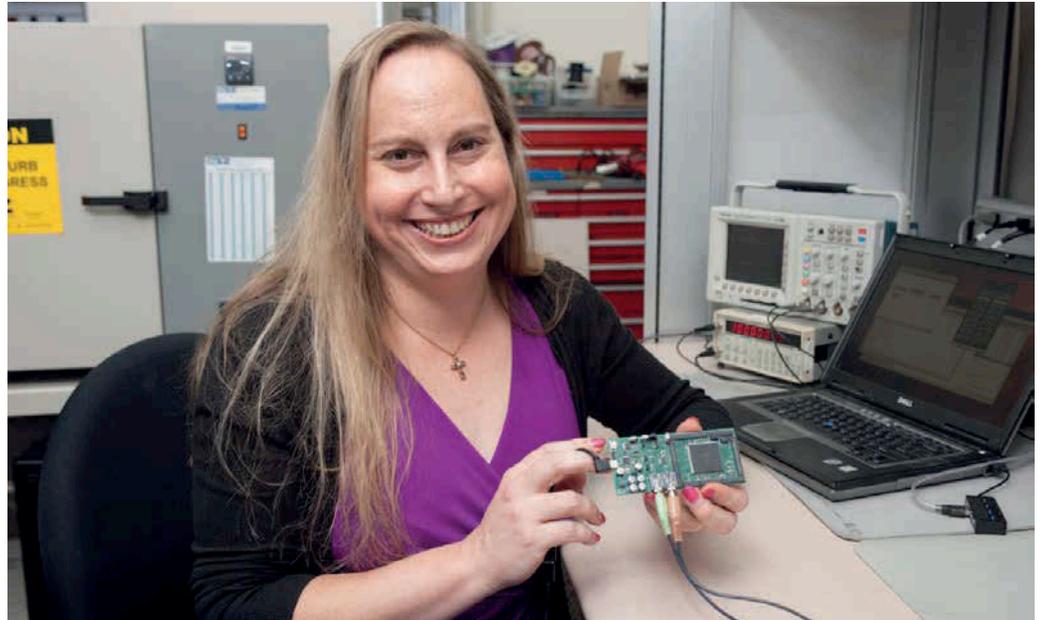
ANALOGUE PROGRAMMABILITY

When you look at the success of the field-programmable gate array (FPGA) in capturing a wide range of designs where flexibility counts more than volume price, the attraction to do the same for analogue makes a lot of sense. But the analogue cousin of the FPGA has faced more of a struggle.

Conceptually, the field-programmable analogue array (FPAA) is only a little younger than its logic-oriented big brother: the first proposals from researchers appeared in the late 1980s, with work at two independent groups, one at Caltech and the other at the University of Southern California. Since then the concept has been tried commercially though with mixed results. The most famous proponent has been Anadigm, which started as a spinout from glassmaker Pilkington mid-1990s before being acquired by Motorola and again being spun out as a company based near the semiconductor company's Arizona fabs.

For its parts Anadigm chose a switched-capacitor implementation, which was already a technique used in the design of ASICs to add analogue functions cost effectively to a predominantly digital process. Switching capacitor-based circuits on and off rapidly provides the ability to build resistor networks that are more accurate than physical CMOS resistors and useable as long as the signal bandwidth is below the switching rate. The somewhat younger start-up Okika Technologies has similarly chosen a switched-capacitor approach for tuning the parameters of on-chip amplifier modules and I/O cells that are provided alongside digital lookup tables for control.

A key issue for companies selling FPAA is the tension between the need for small size and flexibility versus cost and performance in an environment



Some three decades on from the first FPAA being proposed programmability is steadily making its way into analogue, as **Chris Edwards** discovers

where discrete analogue circuitry, even with highly specific functions, is plentiful and often inexpensive.

Andrea Rivero, head of product management for semiconductors at distributor Farnell, says users with a need for fast prototyping or working on research applications are likely to benefit more from programmable-analogue parts. Once a requirement becomes specific, it can be more cost-effective to develop a hardwired implementation and still be able to add some level of programmability, possibly by switching some elements in and out of the circuit.

A key question is how much in-field flexibility is needed. An FPAA can make sense if there is need to cater for different sensor inputs and to tune how their signals are conditioned. For example, the interface might need to implement a variety of filters to cope with different input types. But this is

Above: Professor Jennifer Hasler of the Georgia Institute of Technology argues that there are functions that analogue circuitry can potentially do efficiently such as optimisation and differentiation

a situation where full programmability may not be the most cost-effective option. Some vendors have developed with specific applications in mind that have more limited configurability.

FPAA examples

An example is Analog Devices' SWIO product line, which uses on-chip, sometimes with the help of external passives, to let a variety of sensor interfaces and instruments that signal using 4-20mA current loops to feed data to its digital processor. According to Analog, the driving force for their SWIO product line is a transition to Ethernet that the industrial automation industry is going through. On one side, companies that need to support legacy analogue instrumentation are trying to reduce the number of platforms they need to support. Having a single board design that is able to cater for the wide variety of sensor

interfaces could save millions of dollars in development in situations where vendors have to support tens of different I/O combinations. A second driver is the Ethernet transition itself, by allowing factory owners to keep 4-20mA instruments in place but have them talk to systems using the digital network. Equipment makers can, in principle, provide a single configurable module to support the changeover.

Maxim Integrated's PIXI family was developed originally to provide a way to bias the power amplifiers in wireless transceiver designs to help overcome the inventory problem that sector has with the sheer range of radio bands in use around the world. In addition to dedicated temperature sensors, parts such as the MAX11300 employ on-chip ADCs and DACs multiplexed across a number of channels to measure and generate different voltages.

Dialog Semiconductor's GreenPak offers a combination of digital sequencing and real-time analogue programmability with the provision of on-chip op-amps and rheostats combined with digital lookup tables. The parts are designed to be able to enable and disable analogue macrocells so that the analogue interfaces are only active and drawing power when needed. The PSoC developed by Cypress Semiconductor, which is now part of Infineon Technologies, couples its programmable-analogue macrocells to a microcontroller to support more complex control scenarios.

Changing systems design

One argument for programmable analogue finally beginning to break out is not so much a desire to cut inventory for designs like industrial sensors but a change in systems design, led by the currently fashionable technology of machine learning. Most machine learning algorithms use some kind of linear algebra for numerical analysis, whether it's for gradient descent in neuron networks or some other kind of iterative optimisation.

Professor Jennifer Hasler of the Georgia Institute of Technology argues that though some numerical analysis methods, such as matrix factorisation are far easier on digital hardware, there are functions that analogue circuitry can potentially do far more efficiently. They include optimisation and differentiation. Early analogue computers were called upon to do those jobs to handle control loops in the absence of fast digital computers.

Though digital logic still has an advantage in terms of speed and density for most jobs, analogue computing has the potential to leap ahead in terms of energy efficiency, at least for the right jobs. In one experiment by Hasler's group, an FPAA was able to recognise command words in speech, taking just 1µJ per inference, or about a thousand times less than similar digital implementations. The FPAA implemented a bank of bandpass filters that were used for feature extraction, feeding into a simple machine-learning algorithm based on an analogue matrix multiplier and a winner-take-all classifier that converted spectral inputs into a few selected symbols.

Now in its third generation, the Georgia Tech RASP work started as blocks of sub-circuits that could be combined in different ways using capacitance in a different way to the switched-capacitor implementations. Here the capacitance being exploited is in the floating gates of transistors

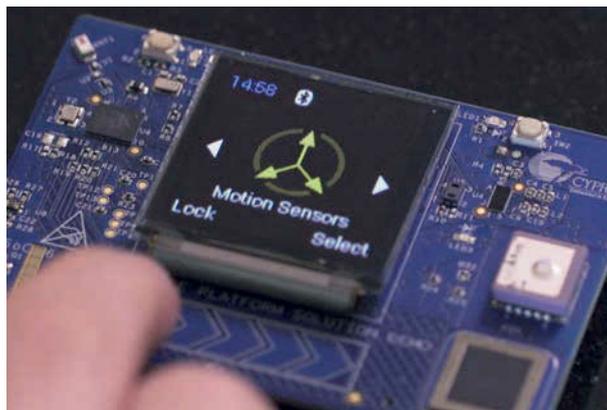
developed for non-volatile memory. These are not new to FPGAs. Microsemi's devices have exploited this technology for some though most other FPGAs use SRAM cells to program the connections between configurable elements as well as the entries in their core lookup tables but can only reliably hold digital values. Floating-gate switches on the other hand are capable of holding analogue values, though with limited resolution and accuracy.

The most recent form of the Georgia Tech work implements 600,000 programmable parameters using a relatively old 350nm CMOS process. The floating gates can perform double duties in that many of them are used in the routing fabric but can be programmed to be partially on and so adjust the signal levels that reach destination blocks. Similar to the approach used in analogue AI devices such as those made by Mythic, the analogue nature of the interconnect matrix lets it perform tasks such as matrix multiplication simply by mixing input signals at crosspoints.

Start-up Aspinity has taken a more explicit approach to applying analogue circuitry to machine learning. Its RAMP device uses analogue circuitry operating in the subthreshold regime to save power with the aim of implementing neuromorphic functions. Whereas the Mythic architecture focuses squarely on analogue matrix arithmetic, the Aspinity AnalogML cores include interface functions to connect to sensors and other input devices and blocks that can be configured to perform feature extraction before passing the results to an inferencing core.

Some three decades on from the first FPAAs being proposed, programmability is steadily making its way into analogue. A combination of industrial renovation and the adoption of machine learning in low-power devices may push it into the mainstream as dynamic flexibility becomes more of a requirement.

Below: Cypress Semiconductor developed a PSoC that couples its programmable-analogue macrocells to a microcontroller to support more complex control scenarios



Semiconductor design is set to look very different

What are the current challenges confronting semiconductor design, and how is the industry looking to address them? By **Michael Munsey**

If 2020 propelled the semiconductor market to new levels of demand, just wait for what 2021 and beyond have in store. Fabs are already at capacity and semiconductors can be found in more products and systems, powering everything from personal devices to self-driving vehicles.

Despite the impact of the pandemic on the global economy, International Data Corporation (IDC) says that demand for semiconductors remained strong, fuelled by the growth in cloud computing and devices to support remote work and learning.

Its own research bears this out. According to IDC's Semiconductor Applications Forecaster (SAF), in 2020 worldwide semiconductor revenue grew to \$442 billion, an increase of 5.4% compared to 2019. IDC has now forecast that the semiconductor market will reach \$476 billion in 2021, which would mean a 7.7% year-over-year growth rate.

There are some clear trends within the industry too. For instance, PWC has predicted that the market for AI-related semiconductors will reach \$30 billion by 2022, representing an AGR of almost 50%. At the same time, there is very much still a place for traditional system on chips (SoCs). Memory chips are expected to carry on holding the biggest market share through 2022, and silicon chips will dominate for the next couple of decades.

New technologies and players

Other factors shaping the future of semiconductors stem from technology directions, such as a burgeoning

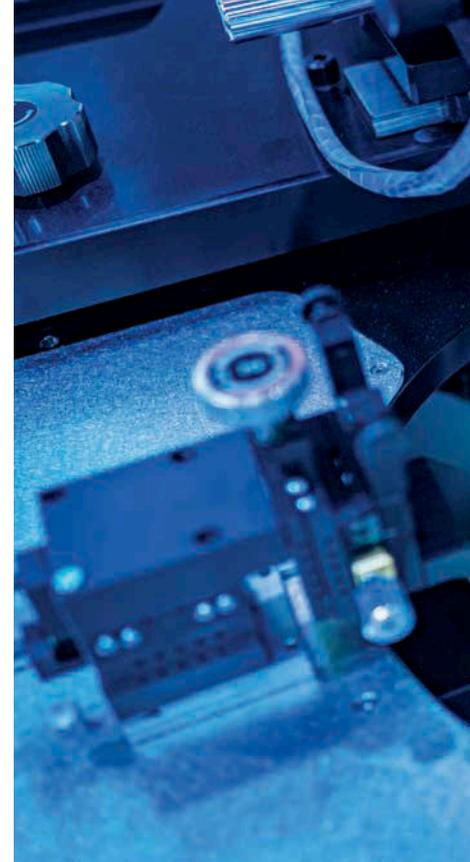
focus on open source hardware. As that gains momentum, it is going to change how organisations think about design, and will encourage a more collaborative and partnership approach to development.

The IoT is driving demand for more cost-effective semiconductors and on a larger scale. Similarly, 5G enables the bandwidth to finally support vast, interconnected infrastructure, for example for transportation, combining inputs from multiple API-connected sources. To achieve the scale required, standards-based reusable and sharable IP is going to be key to meet design requirements, but in a way that supports distribution and collaboration, while also meeting safety and security requirements. Open source could be a key to achieving that scale.

The nature of the players involved in the industry is shifting too, such as the introduction of vertically-integrated systems and non-traditional semiconductor firms, who may prefer to create their own devices and platforms for greater control. A good example of this being Apple's M1, a processor designed for Mac, which furthers their commitment to building key functionality internally. This adds another interesting dimension to the industry, increasing competition and sources of innovation.

Remote collaboration

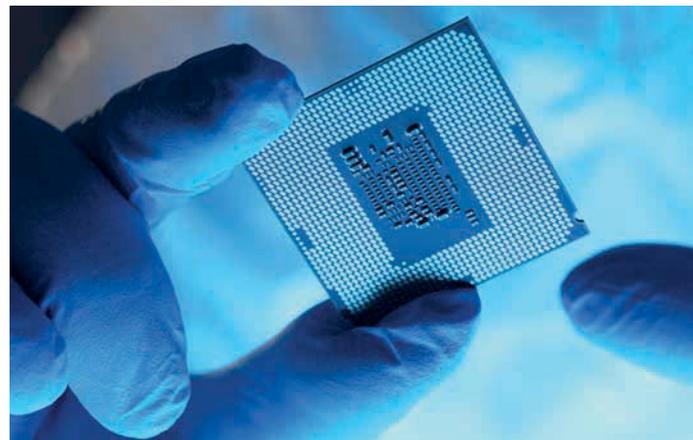
As much a necessity as a trend, semiconductor design teams have had to embrace remote collaboration on an unprecedented scale. Of course, to some extent that was



already happening, but the pandemic made it a necessity for survival in many cases.

In these virtual environments, problems with workflow processes became impossible to ignore, with sharing of IP happening on a much wider scale. Addressing issues around collaboration and security has become a priority, and once organisations have achieved that, they will be equipped with experience that can be used to improve processes irrespective of location, whether in the design office or working remotely.

Regardless, the shifting nature of the semiconductor market reinforces some age-old challenges for designers: keeping pace with change and complexity, controlling



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a project. Even small files become simpler to locate and reuse, and there may be millions of those within an enterprise, not just the big complex designs. A single source of truth is typically based on using a version control system, which provides real-time and historic visibility into all the assets involved, while allowing users to carry on working with their preferred tools and systems.

A single source of truth is also critical to identifying configuration issues across systems, in hardware and software, that are masked by the complexity of the systems. In turn, that makes it easier to bring together collaboration across remotely located teams, both internally and externally.

costs, making sure a project stays on track and in line with requirements, and then meeting delivery deadlines. Many semiconductor product launches do not meet the original launch date. Contributing factors can include: the difficulty of collaboration across remote and dispersed teams, company acquisitions leading to design silos, not addressing management of exploding design data sizes, or keeping up with increasing complex design environments.

IP reuse versus over-sharing

IP reuse has long been talked about as the solution to keeping up with the sheer scale of developments required, avoiding unnecessary reinventing of the wheel, speeding up time-to-market and drastically reducing costs. A variety of assets can be reused including source code and binaries for software, plus hardware IP like arm processor cores.

The theory is sound, but successful management of IP reuse is another matter. Many organisations have multiple systems, including shared drives and source code management, to store and track all these files, but that makes it difficult to manage – let alone reuse – these files. Fortunately, there are a variety of tools and techniques that

can help designers overcome those barriers, but those have to include a strong structure and control around reuse. While sharing of IP is the route to faster development, it can also bring risks around management and security. Traceability of IP and meta-data – who has access to what, where, and how they are using those assets – becomes critically important to the success of projects.

There is a balance required between sharing and over-sharing, which is why a combination of traceability, visibility, and access control are essential for modern semiconductor design. Of course, manual traceability is widely adopted, but to address large and complex projects, more organisations are using tools that automate much of the process, from requirements through to design and verification. This makes it easier to track which IPs have been used, where, and when, and in turn avoid costly respins in design. Changes in requirements can be surfaced and communicated earlier and more clearly. Traceability also supports better remote collaboration.

In addition, creating a 'single source of truth', or data management platform, can unite all the software and hardware components within

Overcoming IP leakage

With comprehensive traceability and visibility in place, then it becomes more feasible to identify and prevent IP leakage, a perennial and costly concern in the semiconductor industry. Some of the root causes include dispersed collaborators, inadequate control over who can view and download IP, and users inadvertently exporting IP to an unauthorised source. With semiconductor markets becoming ever more global, mitigating IP leakage is of paramount importance.

Semiconductor design is going through a period of unprecedented change. The events of the last year, however, have given us a blueprint of how to handle the needed changes to collaboration and culture. The good news is that there are tools available to provide the needed traceability to facilitate IP reuse at scale while also providing the security and communication layers for effective collaboration.

Semiconductor design will look different going forward, but the changes facilitated by a global pandemic will help drive major technological innovations moving forward.

Safe, secure and first to market

What do you need to develop a successful IoT system? One element that haunts developers is security, however a new platform may provide a solution. **Janus Piwek** explains

The development of IoT systems demands interdisciplinary areas of competence, from embedded design via communication protocols and IT/OT to cloud services. Security constitutes a fundamental component of what a platform concept will require and this starts with the chip and will, via secure supply chain considerations and device operations, end in the cloud.

The complexity and scarcity of expertise in planning and implementation, however, are a concern. Both the requirements for selection of a secure processor platform and the regulatory security guidelines have changed. OEMs need to consider processes to ensure that sensitive data and intellectual property will be handled safely.

Issues concerning scaling of security concepts and management of a fleet of IoT systems over their life cycles are equally challenging. Arrow's Shield96 Trusted Platform, is a reference design that combines a secure Micro Processing Unit (MPU) with a matching security software framework by Sequitur Labs in which secure booting of IoT systems, secure storage of sensitive data and secure operation over entire life cycles are supported.

Protecting IoT products

The "C.I.A.A. concept" represents the four measures towards protection of information security: **Confidentiality** - Protection of privacy and security of

data during transmission and final storage; **Integrity** - Stored and transmitted data were verifiably neither manipulated nor changed; **Availability** - IoT system availability has top priority. The disruption of processes and/ or even complete failure may have serious consequences and, **Authenticity** - The hardware manufacturer and author of the data are above suspicion. All hardware must be securely identified on manufacture (comparable to digital ID cards).

IoT system developers should ensure that their hardware satisfies each of these four criteria. Product or project managers, technical directors and managing directors must, regardless of standards and technical guidelines, ask themselves the following questions:

1. How will I protect my company's intellectual property and brand image in order to secure my revenue streams?
2. How will I protect my product from overproduction and plagiarism?
3. How will I protect my device identities, keys, critical data, firmware and root certificates whilst in production and throughout their life cycles?
4. How will I use security as a



Figure 1:
Shield96 in
an enclosure

differentiating characteristic of my products to thereby establish new business models?

5. How will I launch my product onto the market, fast and without the need to build a team of security experts?

6. How will I control secure Over The Air (OTA) firmware updates and manage device identities in a Public Key Infrastructure (PKI)?

7. How will I use cloud services to find security risks based on device behaviour?

IoT product protection should be based on a secure-by-design approach. The platform developed by Arrow will allow companies to anticipate many potential problems and speed up the market launch of IoT products.

Platform architecture

A basic premise should be, "Zero trust: Unless you trust the system, do not trust the data either. Trust no-one, verify all".

Arrow's Shield96 Trust Platform single board computer (SBC) concept combines a holistic secure-by-design approach based on a Linux operating system and a 500 MHz Cortex A5 SAMA5D2 family processor by Microchip – manufacturers are able to implement a wide range of security peripherals and IPs – and the SAMA5D2 processor family includes pre-qualified models for PCI 5.x (PCI, Payment Card Industry) payment applications.

The concept is supplemented by the EmSPARK Security Suite software security framework by Sequitur Labs, selected to match the processor. Critically, this platform may be implemented across a range of IoT products.

The board design uses the 96Boards Community IoT Extended

form factor of 54 x 85mm and includes additional semiconductor components/ICs by Microchip for power management, clocking, 100Base T-Ethernet, Wi-Fi, USB interfaces and passive electromechanical connectors by selected manufacturers.

The board can be expanded via the 2x20 pin I/O connector, using mezzanine cards.

The concept is rounded off with a 1 Gbit QSPI flash memory by Micron together with the SAMA5D27 MPU and the complete Root of Trust (RoT). This also includes encrypted and signed EmSPARK security payloads such as Secure Bootloader, Linux Kernel, Device Tree Blobs and Trusted Execution Environment.

Arrow will also, in this process step, diversify the payloads. This means that each Shield96 board will be unique and that the Secure Bootloader will boot only the payloads provided by the OEM from the external QSPI flash. Developers will thus ensure that their IP cannot be copied from external flash memory to other hardware.

The SAMA5D27 is supplied with 1 Gbit DDR2 memory (System-in-Package, SIP) and various safety-related peripherals are also available for the SAMA5D2 processor family ranging from crypto engines and algorithms, via a Trust Zone trusted execution environment and down to secure SRAM and physical anti-tamper functions. To integrate the board into proof-of-concept applications, Phoenix Contact has adapted the UCS housing, including printing and mechanical processing of the side panels.

Fail-safe – at all times

The platform methodology addresses four issues:

- **Protect:** The mechanism protects the existing integrity of the firmware and critical data from manipulation. It also includes a process that will ensure the authenticity and integrity of firmware updates.
- **Detect:** The mechanism will detect physical attacks or manipulation of the firmware or critical data.
- **Recover:** Restoration of the firmware and critical data to their state of integrity.
- **Notify:** Logging authenticated events for audit purposes and to report critical device health metrics to cloud services such as AWS IoT Device Defender.

The Shield96 Trusted Platform is able to manage this without external security elements, Trusted Platform Modules (TPMs) or smartcards. The EmSPARK Security Suite implements various Trusted Applications (TAs) in the isolated domain “CoreTEE” and will offer software developers a structured C library.

Secure Boot

The procedure provides boot process authentication and protection for all applications and functions ex-factory. Security-critical resources will be isolated and payloads decrypted.

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Secure OTA firmware update

Updating is associated with a high risk of data corruption. Authentication of updates must therefore be binding. The following critical functions are provided:

- Payload authentication
- Payload decryption
- Memory location for identification of new updates when booting
- Rollback prevention (on request)
- Tool for the generation of secure firmware images
- Device failover protection

Detection of inconsistencies or even physical attacks when booting or during runtime is essential. The Secure Bootloader fail-safe concept will address these threats by allowing fall-back to secondary images and ensures that the complete process will be coordinated and adaptable to customer requirements.

Shorter time-to-market

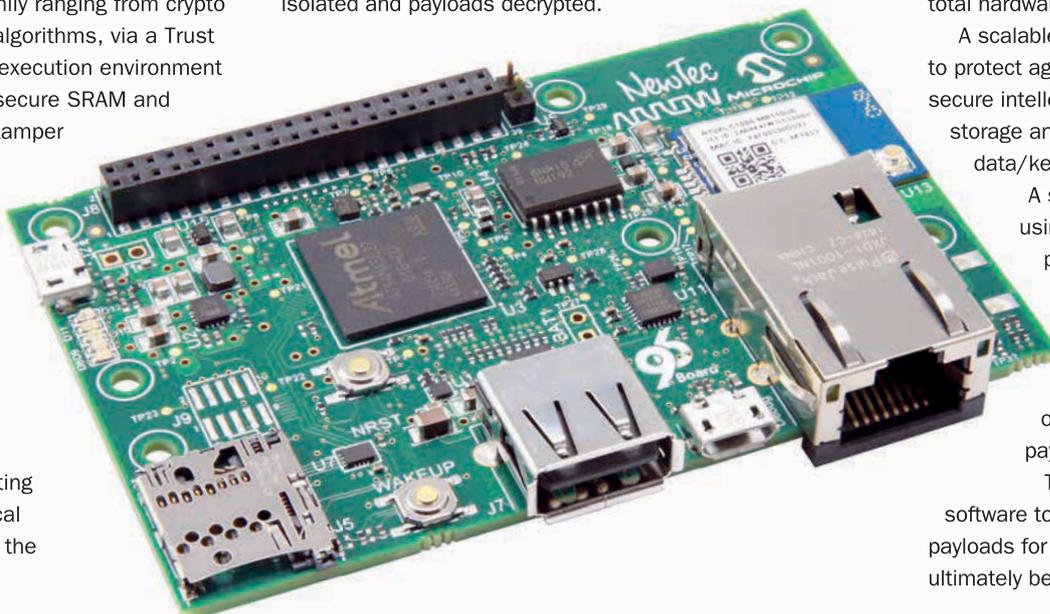
Overall, this approach will allow companies to minimise their total cost of ownership and various risks to thereby speed up the introduction of IoT products onto the market. This is achieved by using the processor’s SIP technology and a security software framework tailored to suit the SAMA5D27 processor security peripherals to simplify and reduce the total hardware design costs.

A scalable provisioning concept to protect against product piracy and secure intellectual property as well as storage and distribution of critical data/keys is equally important.

A secure boot process using a trust anchor to provide partitioning of the more secure (CoreTEE) and the less secure (Linux) domains will also boot only authenticated OEM payloads.

The provisioning of software tools to create trusted payloads for software updates will ultimately be essential.

Figure 2: Elements and components making up Shield96



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Wi-Fi urgently needs more spectrum

To meet demand from new applications Wi-Fi urgently needs more spectrum, according to recent research by the Dynamic Spectrum Alliance and Policy Impact Partners

If we have learned anything in the past year, it is the importance of the internet to keep us connected – Internet access is no longer the luxury commodity it was in years gone by, but a necessary component of everyday life.

But as we continue to integrate the internet into more aspects of our lives: working from home, shopping, education and even socializing with friends, demand for broadband is continuously increasing. Thanks to the effects of the COVID-19 pandemic, connectivity became vital to retain a sense of normality in a world of uncertainty; with 300 million participants in June 2020 alone, Zoom calls at home became the new going out, and dining rooms and bedrooms were transformed into offices and classrooms – and that's without taking into consideration other platforms like Teams, Bluejeans, GoToMeeting and many more.

Adding to this demand is the delivery of internet to rural areas of the world; enhancing digital

technology and global proliferation of Wi-Fi access is important for both established and developing economies in order to bridge the digital divide. Access to high quality broadband is essential, and without it – people and communities are at risk of becoming isolated from our increasingly connected world.

What's more, consumer expectations for the internet connection we are receiving are getting more and more stringent. We expect a fast connection, low latency, and usage on many devices at once – all on a broadband plan that is affordable for us. All-in-all, the global demand for broadband is seemingly insatiable.

Supporting the 5G promise

With the buzz of 5G promising higher speeds, lower latency, and greater possibilities than ever before, you would be forgiven for thinking broadband connectivity has had its day – but that couldn't be further from the truth. According to CISCO, half



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DSA

of global internet connections still start or end with a Wi-Fi connection, and research shows that the global Wi-Fi network is continuing to grow exponentially.

In future, 4G and 5G must be supported by high quality Wi-Fi – the cost-effective distribution mechanism of choice for broadband connectivity indoors and at numerous hotspots. 5G networks will work together with Wi-Fi 6, for innovative use cases like virtual and augmented reality.

A 5G smartphone will be able to connect to an AR or VR headset using Wi-Fi 6, allowing them to access a breadth of immersive entertainment, educational, e-Health and industrial applications.

But while the demand for Wi-Fi grows, congestion at the access point level is becoming an issue. Wi-Fi bottlenecks mean that consumers experience reduced speeds, curbing the value of the broadband connection. As such we are at what many see as a pivotal moment for the future of Wi-Fi.

More access is needed for Wi-Fi

While spectrum is a finite source, restrictions on license-exempt use of the mid-band spectrum creates an artificial spectrum shortage. The amount that is currently available does not offer sufficiently wide channels for the new use cases and industrial IoT applications that Wi-Fi 6 is expected to enable, and that is why Wi-Fi urgently needs more spectrum, according to recent research by the Dynamic Spectrum Alliance and Policy Impact Partners.

Policy makers need to ensure that both licenced and licence-exempt wireless technologies have access to the spectrum they need.

In regions across Europe, the Middle East and Africa (EMEA), where Wi-Fi demand is rising inexorably, there will be a licence-exempt mid-band spectrum shortfall that will directly impact citizens and businesses. Around the world, the average number of people living in one home is currently 4.9 people, but in areas such as sub-Saharan Africa, this number can be considerably higher, with an average of 6.9 people.

Assuming that within a household, most members share the same Wi-Fi access point, the network can become congested.

The reason for this congestion is because access to licence-exempt mid-band spectrum is scarce: as things stand, there is only 455 MHz (5150-5350 MHz and 5470-5725 MHz) of mid-band spectrum available for licence-exempt use in Europe, the Middle East, and Africa. In fact, since the World Radiocommunication Conference in 2003 no new mid-band spectrum has been made available for Wi-Fi despite the exponential growth in the data traffic. By 2025, there is expected to be a shortfall of up to 1.6 GHz in Europe alone, according to a study by Quotient.

In other nations such as the US and Canada, there is an additional 125 MHz available in the 5 GHz band. However, since the licence-exempt spectrum in the 5 GHz band is



fragmented, it doesn't offer sufficiently wide channels for newer applications and services, such as high-resolution AR and VR.

Leading telecoms operators have acknowledged the need for more spectrum. JR Wilson, VP of Tower Strategy & Roaming at AT&T said: "Many believe that if Wi-Fi 6 is to reach its full potential, there is need for additional unlicensed spectrum. Wi-Fi 6 will enable new use cases for industrial IoT, smart homes and support for high-density deployments, to name a few, but access to wider channels is needed to support these new use cases."

The 6 GHz band's potential

The 6 GHz band (5925-7125 MHz) is well suited to bridging the gap, and greatly enhancing the impact of next generation Wi-Fi. As well as supporting existing indoor connectivity, it will enable the emergence of a new generation of advanced applications and services based on the Wi-Fi 6 standard, supporting demanding personal area network applications and data transfer.

It will also open the door to a number of industrial opportunities, as manufacturing plants continue to automate their activities, using Wi-Fi to monitor and remotely control machinery.

The 6 GHz band already has a co-primary mobile allocation in the ITU Radio Regulations, meaning it can be used by IMT and other wireless connectivity services so international action is not required. That means

administrations can immediately open up the band. In EMEA, technical studies have shown that WAS/RLANs can operate in the lower 6 GHz band without adversely affecting incumbent users' operations, therefore immediate opening should be feasible.

The US and Brazil have recently adopted a decision to open up 1,200 MHz of spectrum in the 6 GHz band, in order to meet the growing demand for licence-exempt spectrum. The UK has also made the decision to make the lower 6 GHz band available for Wi-Fi and other RLAN technologies. More jurisdictions in Europe and in countries such as Canada, Colombia, Costa Rica, Honduras, Peru, Argentina, Saudi Arabia, Jordan and Mexico are also working towards making all or part of the 6 GHz band available for Wi-Fi use and have ran or are running public consultations on opening up the 6 GHz band to licence exempt technologies.

The FCC noted that its decision in the US would promote more efficient and productive use of the spectrum, by enabling wide usage including several 160 MHz and 320 MHz channels. Looking forwards, it says that eventually 320 MHz is absolutely necessary to be made available under Wi-Fi 7 in order to obtain unlicensed 5G-like capabilities. It also added that in sum, the move to open up spectrum in the 6 GHz band will allow 5G to happen faster and more widely.

JR Wilson, Vice President Tower Strategy & Roaming at AT&T and Chairman of the Wireless Broadband Alliance added: "Recent economic research shows how allowing Wi-Fi devices in the full 6 GHz band will generate significant economic value by improving connectivity, extending the Internet of Things, boosting productivity and the development of richer applications and services."

The Dynamic Spectrum Alliance is a global organisation advocating for laws and regulations that will lead to more efficient and effective spectrum utilisation.



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Lattice Semiconductor Corporation (NASDAQ: LSCC), the low power programmable leader, launched the latest version of its award-winning solutions stack for low power embedded vision systems, Lattice mVision™ 2.0. The new version features multiple updates that further accelerate the design of embedded vision applications for industrial, automotive, medical, and smart consumer systems. It includes support for popular new image sensors used in industrial and automotive systems and a new image signal processing IP core and reference design to help developers design smart vision applications at the Edge. The stack also includes support for the Lattice Propel™ design environment to simplify development of vision systems with an embedded RISC-V processor.

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As the next step in its ongoing mission to deliver secure, cyber-resilient system control solutions, Lattice Semiconductor Corporation (NASDAQ: LSCC), the low power programmable leader, today announced the latest version of its solutions stack for secure system control, Lattice Sentry™ 2.0. The solutions stack enables next-generation hardware Root-of-Trust (HrOT) solutions compliant with NIST Platform Firmware Resiliency (PFR) Guidelines (NIST SP-800-193) and supporting 384-bit encryption. This new version of Lattice Sentry addresses the rapidly evolving security requirements of current and emerging server platforms by providing developers an efficient and secure way to quickly implement enhanced system and cryptographic applications. The stack supports firmware security for the communications, computing, industrial, automotive, and smart consumer markets.

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More capacitance, less dissipation

Panasonic Industry introduces new ZU and ZSU series of Electrolytic Polymer Hybrid Capacitors type – each one being a remarkable evolution of the recent ZS series in specific aspects

Reliability, efficiency, performance – this triad of automotive engineering applies in particular to the crucial components a modern car consists of. And there is an increasing number of them, as the level of comfort, functionality and safety is increasing with every new car generation.

Acknowledging those prevalent industry trends, Panasonic Industry has developed its popular ZS series of Hybrid Capacitors with outstanding successors: When developing the ZU types (25–63V.DC at 8–12mΩ), the focus has been set to particularly reducing power dissipation - while the ZSU series (25–63V.DC, Capacitance 120–1000µF) comes with an almost unrivalled capacitance.

Yusuke Nagata from Panasonic Industry Europe summarizes: "ZU series is able to withstand ripple currents up to 53% better than its predecessor. For a diameter of 10 x 12.5mm with 25V.DC we achieve 5 Arms, for the 10 x 16.5mm equivalent 5.8 Arms. The ZSU series," continues Nagata, "takes our capacitance specs for Hybrid Caps to an entirely new level: For a diameter of 10 x 12.5 mm with 25V.DC we achieve 680µF for the 10 x 16.5mm equivalent 1000µF."

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New Switch'Air™ Domes with Hole from Nicomatic enable integration of LEDs into electrical membrane

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Nicomatic, the leading manufacturer of high performance interconnect systems, has added new Switch'Air™ Domes with Hole to its successful Switch'Air 4-legged Domes range. Switch'Air™ Domes feature patented technology with a cushion of air that prevents domes sticking to each other during automated pick & place manufacturing, resulting in faster, easier, more accurate assembly. With a life expectancy of up to five million actuations and guaranteed for one million actuation cycles, Switch'Air domes provide reliable, extended-life performance for demanding applications in the medical and industrial markets among others.

Electrical specifications for Switch'Air domes include switching current of 5µA to 100mA DC, switching voltage of 0.1VDC to 100VDC, switching capacity 1W. Contact resistance is < 100 mΩ.

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Pickering delivers clear, comprehensive new information resource

Interactive datasheets revealed - packed with more information – clear and easy to read

Pickering Electronics, the reed relay company which has pioneered miniaturization and high performance for over 50 years, has completely revamped the datasheets of its entire range of reed relays, providing more information in a clearer format with interactive links to further useful content.

New information includes additional environmental specs, mechanical characteristics and relay weights, plus RF plots for coaxial relays, showing VSWR, isolation and insertion loss. Instead of being 'squashed' onto two pages – a legacy of printed datasheets - the specifications and relay details are more clearly laid out, especially the mechanical drawings.

The new designed-for-digital datasheets include interactive links to relevant technical applications information and content, including a summary document entitled '10 key benefits of Pickering Reed Relays' and a comparison table to similar products from Pickering.

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www.pickeringrelay.com/data-sheets

Pickering Interfaces launches industry's highest bandwidth general purpose PXI matrix

Offering bandwidths up to 70MHz and high switching capacity

Pickering Interfaces, the leading supplier of modular signal switching and simulation solutions for use in electronic test and verification, today launched the industry's highest bandwidth general purpose PXI matrix. Available in 16x8, 2-pole, or high-density 32x8, 2-pole switching configurations, the matrix modules offer bandwidths ranging from 35MHz to 70MHz depending upon path selected and a VSWR <1.5:1 to 85MHz.

The modules are in two-slot PXI (model 40-588) or PXIe (model 42-588) formats and are constructed using telecommunication grade electromechanical relays capable of hot or cold switching up to 2A at 220VDC/250VAC. Every signal has an accompanying analog ground connection on the front panel connectors for interfacing with cabling accessories. Simple matrix expansion is facilitated by two groups of front panel Y-axis connections on the 32x8 variant.

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Powell Electronics adds specialist RF connector franchise, COAX Connectors to European franchise portfolio

Robustly designed RF connectors for reliability and high performance

Powell Electronics, the supplier of connectors and more for high-rel applications including defence, aerospace and industrial, has added COAX Connectors to its burgeoning portfolio of connector franchises in Europe following the signing of a full stocking franchise distribution agreement between the two companies.

COAX Connectors is a leading UK designer, manufacturer and supplier of high-performance standard and custom RF connectors. The company provides a complete end-to-end service from initial problem-solving, through design concepts and prototyping, to the supply of a fully-qualified production part. That is one reason why the agreement with Powell is so synergistic, since Powell is also highly experienced and able to support customers both commercially and technically.

Commented Powell Electronics' European MD, Gary Evans: "When you buy a COAX Connector you do so in the knowledge that it has gone through a rigorous development process, and that the robust design will give you the reliable and enduring performance you require."

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Thank you to all that entered this year's British Engineering Excellence Awards. Paul Fanning, publishing director at MA Business, said: "The British Engineering Excellence Awards have been the benchmark for great British engineering design for more than a decade now. I'm delighted to say that – despite all the disruption we've seen - this year is no exception, with an exceptionally diverse and fascinating set of entries".

To see who made the 2020 shortlist, visit: www.beeas.co.uk/finalists

The winners of this year's awards will be revealed during British Engineering Excellence Week, a special week-long programme of virtual festivities that will be hosted on the New Electronics and Eureka! websites from **22-26 March 2021**.

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