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Arm continues to trade with China

DESPITE CLAIMS TO THE CONTRARY, IT APPEARS ARM HAS FOUND A WAY TO CONTINUE TO TRADE WITH CHINA



Despite the on-going trade dispute between the US and China, Arm is continuing to trade with the Chinese electronics industry.

Back in May the media was full of reports that Arm was no longer trading with Chinese companies. The UK chip designer was said to have suspended business with Huawei after the US government placed the company on its 'banned entity' list, forbidding US companies to supply it with technology.

Arm had been working very closely with the Huawei-owned semiconductor company, HiSilicon, which purchases the company's CPU licenses, and the news that it was planning to comply with US demands was seen as a major blow to the Chinese company and the country's wider electronics industry.

It would now seem that, according to reports, Arm, Arm China and HiSilicon have continued with their close cooperation, despite threats from the US authorities.

Arm is said to have told staff, via an internal memo back in April, to stop "all active contracts, support entitlements, and any pending engagements" with Huawei and its subsidiaries, so this news has come as somewhat of a surprise.

It appears that Arm and Arm China believe that they have found a way to supply technologies to Huawei's HiSilicon without breaking any laws or regulations. Both are said to be involved in further discussions about future collaboration on new products.

So, despite the threats from the US authorities, these companies have never stopped co-operating, despite suggestions that their relationship had come to an end.

Arm has made clear that as far as Arm IP and architecture licenses are concerned, all Arm customers in China, including Huawei, can get a full set of source code and related technical support because the patents behind its chip design architectures were based on technologies from the UK circumventing the US trade ban.

There have been reports that the Chinese authorities have been warning companies that those that honour the US ban could face retaliation and could be facing 'permanent consequences' and 'punishment'.

If those threats are real technology firms will find themselves in a very difficult situation and, whatever the situation, it simply highlights the complexity that companies face today as a result of countries using trade as a weapon.

Companies can't afford to ignore these threats because if China does look to retaliate the consequences could be severe for those heavily exposed to the Chinese market.

It does appear, though, that Arm may have found a way through this legal maze.

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

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Xilinx unveils Unified Software Platform

PLATFORM LOOKS TO EMPOWER SOFTWARE DEVELOPERS AND BOOST PRODUCTIVITY FOR HARDWARE DESIGNERS. REPORTS NEIL TYLER

Xilinx has unveiled Vitis, a unified software platform that enables developers – including software engineers and AI scientists – to benefit from improved hardware adaptability.

The Vitis platform, unveiled at the company’s developers’ forum held in San Jose, California, is able to automatically tailor the Xilinx hardware architecture to the software or algorithmic code without the need for hardware expertise and, rather than imposing a proprietary development environment, is able to plug into common software developer tools and use a set of optimised open source libraries, leaving developers to focus on their algorithms.

Separate to the Vivado Design Suite, which will still be supported for those who want to program using hardware code, Vitis can boost the productivity of hardware developers by packaging hardware modules as software-callable functions.

“With exponentially increasing compute needs, engineers and scientists are often limited by the fixed nature of silicon,” said Victor Peng, president and chief executive officer, Xilinx. “Vitis is a singular environment that enables programmers and engineers from all disciplines to co-develop and optimise their hardware and software, using the tools and frameworks they already know and understand. This means that they can adapt their hardware architecture to their application without the need for new silicon.”

The Vitis platform is built on a stack-based architecture that plugs into open-source standard development systems and build environments but, most importantly, it includes a rich set of standard libraries.

The base layer is the Vitis target platform, which includes a board and pre-programmed I/O. The second layer, called the Vitis core development kit, encompasses the open-source Xilinx runtime library to manage the data movement between different domains, including the subsystems, the AI Engine in the forthcoming Versal ACAP, as well as an external host, if required. This layer also includes the core development tools such as compilers, analysers and debuggers. These tools are designed to integrate seamlessly with industry-standard build systems and development environments.

In the third layer are more than 400 optimised and open-source applications across eight Vitis libraries. These include the Basic Linear Algebra Subprograms (BLAS) library, the Solver library, the Security library, the Vision library, the Data Compression library, the Quantitative Finance library, the Database library and the AI library.

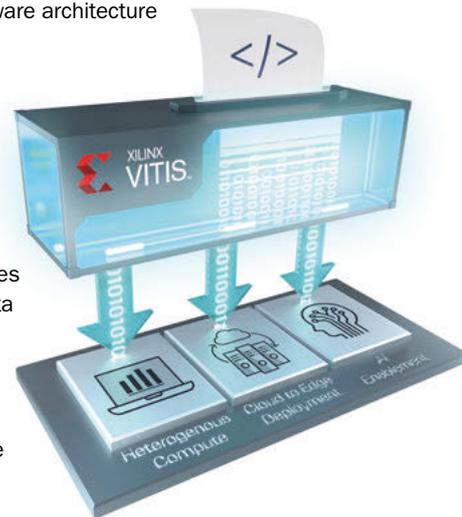
These enable software developers to call pre-accelerated functions using a standard application programming interface (API).

The fourth and most important element of the platform is Vitis AI, which integrates a domain-specific architecture (DSA) that configures Xilinx hardware to be optimised and programmed using frameworks like TensorFlow and Caffe.

Vitis AI provides the tools to optimise, compress and compile trained AI models running on a Xilinx device in about one minute. It also delivers specialised APIs for deployment from edge to cloud, all with best-in-class inference performance and efficiency.

Xilinx has announced that it will soon be releasing another DSA, called Vitis Video, to enable video encoding directly from FFmpeg.

Xilinx also launched a developer site that provides access to examples, tutorials and documentation, as well as a space to connect the Vitis developer community. The Vitis unified software platform is free for Xilinx boards and will be available for download next month.



Arrow drives AI infusion with OpenCL Platform

Arrow Electronics is simplifying the use of AI in high-performance computing with a software platform that is ready to run on the BittWare 385A FPGA accelerator card.

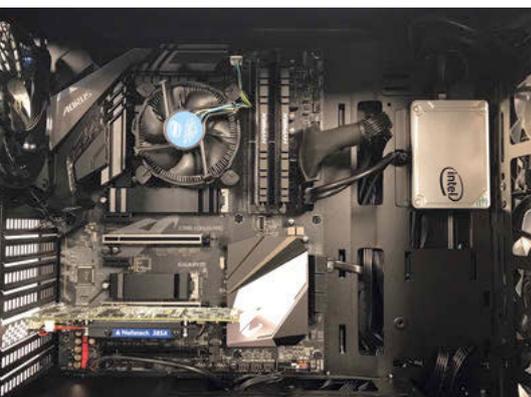
The distributor has created ready-to-use software modules in OpenCL that will help users build custom engines for compute-intensive workloads in applications such as image processing and facial recognition. As a standardised, open environment for parallel programming of heterogeneous computing systems, which specifies standard programming languages and contains APIs, OpenCL ensures users can complete their projects quickly using familiar techniques.

Arrow's AI platform includes a compiler, which lets customers also create their own applications if desired.

"BittWare is excited to be playing an active role in Arrow's Testdrive program which is helping to grow the market for FPGA-based acceleration," said Craig Petrie, vice-president of marketing for BittWare. "Our optimised BSPs for the Intel OpenCL SDK provides a familiar programming experience for software-orientated customers wishing to benefit from the performance improvements and energy-efficiencies achievable using Intel FPGA technology."

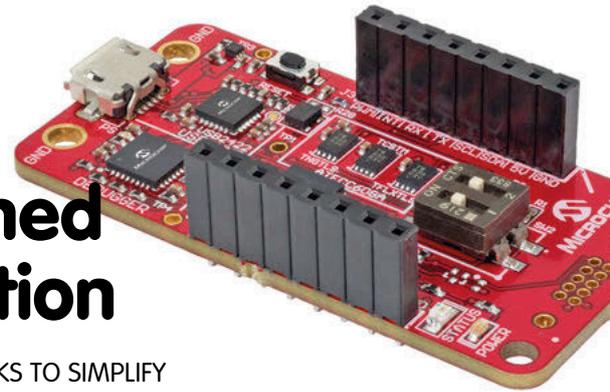
The modules are provided preloaded on the accelerator card and currently include vector addition, FFT and 2-dimensional FFT, edge detection, file transcoding, face detection, and Sobel edge detection.

New functions to extend support and accelerate adoption are planned and Arrow is working to integrate popular AI frameworks including Caffe and TensorFlow, leveraging OpenCL, to support efficient AI infusion.



Pre-provisioned security solution

MICROCHIP'S TRUST PLATFORM LOOKS TO SIMPLIFY HARDWARE-BASED IOT SECURITY. **NEIL TYLER REPORTS**



Microchip Technology has introduced the first pre-provisioned solution that provides secure key storage for low-, mid- and high-volume device deployments using the ATECC608A secure element.

Microchip's Trust Platform for its CryptoAuthentication family looks to help companies of all sizes to implement secure authentication at a time when the vulnerabilities in the Internet of Things (IoT) have created significant challenges for developers.

Hardware-based security is essential when it comes to protecting secret keys from physical attacks and remote extraction, but manufacturers have only been able to support configuring and provisioning for high-volume orders.

Microchip's Trust Platform addresses this problem and consists of a three-tier offering, providing out-of-the-box pre-provisioned, pre-configured or fully customisable secure elements, allowing developers to choose the platform best suited for their design.

Trust&GO is the first tier and provides zero-touch pre-provisioned secure elements with a Minimum Orderable Quantity (MOQ) as low as 10 units. Device credentials are pre-programmed, shipped and locked inside the ATECC608A for automated cloud or LoRaWAN authentication onboarding. In parallel, corresponding certificates and public keys are delivered in a "manifest" file, which is downloadable.

For customers who want more customisation, the second tier in the program is TrustFLEX. It enables customers to use the certificate authority of their choice while still benefiting from pre-configured use cases. These include baseline security measures such as Transport Layer Security (TLS) hardened authentication for connecting to any IP-based network using any certificate chain, LoRaWAN authentication, secure boot, Over-the-Air (OTA) updates, IP protection, user data protection and key rotation.

For customers who want to customise their designs, the third tier in the program – TrustCUSTOM – provides customer-specific configuration capabilities and custom credential provisioning.

"The uptick in attacks on software-based security solutions underscores the need for companies to adopt industry best practices, including isolating private keys in secure elements," said Nuri Dagdeviren, vice president of Microchip's secure products business unit. "Microchip's Trust Platform makes hardware-based security simple and cost-effective for companies of all sizes, removing the barriers associated with configuring and provisioning devices."

XMOS secures \$19m funding

XMOS has announced the completion of a new \$19 million financing round - funding the company's global growth, consolidating its technical leadership in far-field voice interfaces and developing a new product roadmap for the artificial intelligence of things (AIoT).

The funding will support XMOS's continued growth and an expanded global footprint, including new staff, in its Hong Kong office. This investment will enable the company to capitalise on its technical expertise in the far-field voice interface market.

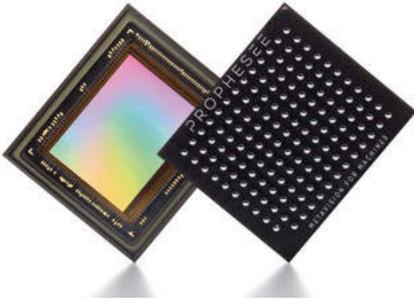
The funding will support the development of XMOS's AIoT solution portfolio. This will build on the company's deep technology solutions for consumer devices, expanding its product set into a potentially transformative market that will fuel new digital and data services in the smart homes, smart cities and smart factories of the future.

The \$19 million investment round comprised equity funding, with participation from existing investors, and a venture debt facility with Harbert European Growth Capital.

Commenting Mark Lippett, president and CEO at XMOS, said: "We're very grateful for the ongoing commitment of our existing investors and welcome Harbert's involvement. This increased investment will be a major part of the growth of the company as we ramp up the rollout of our exceptional XVF3510 2-mic voice interface and accelerate our AIoT roadmap."

Event-Based Vision sensor

PROPHESEE LOOKS TO LEVERAGE EVENT-BASED VISION TECHNOLOGY WITH NEW CHIP. **NEIL TYLER REPORTS**



The Metavision sensor is aimed at developers of cameras to enable next-generation vision in industrial automation and IoT systems such as robots, inspection equipment, monitoring and surveillance devices and leverages the company's use of neuromorphic vision technology to offer highly efficient machine vision capabilities for a variety of use models, including ultra high-speed part counting, vibration measurement and monitoring or kinematic monitoring for predictive maintenance.

"This is a major milestone for Prophesee and underscore the progress in commercialising our pioneering Event-Based Vision sensing technology. We can now offer product developers an off-the-shelf version and move the industry out of the traditional frame-based paradigm for image capture," said Luca Verre, co-founder and CEO of Prophesee.

In the Metavision sensors, each pixel is independent and asynchronous and only activates itself if it senses a change, allowing for major reductions of power, latency and data processing requirements imposed by traditional frame-based systems.

Prophesee, a developer of advanced neuromorphic vision systems, has unveiled the first industry-standard packaged chip that leverages Event-Based Vision technology, described as a significant advancement over traditional frame-based vision approaches.

Developed over a five-year period this third-generation version houses a Prophesee-enabled VGA-resolution sensor and represents the industry's first implementation of Event-Based Vision technology in a commercially-viable, industry standard package.

Aldec reduces ASIC design prototype bring-up time

Aldec, a specialist in mixed HDL language simulation and hardware-assisted verification for ASIC and FPGA designs, has introduced automatic FPGA partitioning to its popular HES-DVM; its automated and scalable hybrid verification environment for SoC and ASIC designs.

Due to design complexity and constraints, the manual partitioning of multiple FPGAs used for prototyping can take days - the automation in HES-DVM, unveiled by Aldec, can perform the task in a matter of minutes.

The latest release of HES-DVM, 2019.09, features Aldec's proprietary HDL compiler. Called SyntHESer, and launched earlier this year, the compiler has performed 10x faster than a leading standalone synthesis tool, when handling identical blocks of HDL for a circa 45-million-gate Deep Learning Accelerator (DLA) design.

"These additions to HES-DVM rise to some of the biggest challenges associated with the FPGA-based prototyping of an ASIC design," said Zibi Zalewski, General Manager of

Aldec's Hardware Division. "With the 2019.09 release of HES-DVM, the most tedious and challenging activities, such as creating and matching partitions with on-board FPGAs or assigning limited FPGA I/O resources, are fully automated."

For the 2019.09 release of HES-DVM, Aldec engineers designed and implemented fast and efficient algorithms capable of finding balanced partitions and minimising required interconnections.

"The user can jump into the process of partitioning any time and modify the partitions and interconnections in harmony with automation algorithms," adds Zalewski.

The HES-DVM also sees the introduction of Board Compiler, used to import files, in the form of Verilog structural descriptions, for third party boards that use Xilinx Virtex UltraScale devices. With this capability the user can easily reconfigure prototyping board by adding or removing inter-FPGA connections or creating hybrid configurations of tail (or daughter) boards and backplanes.

Mesh networking modules

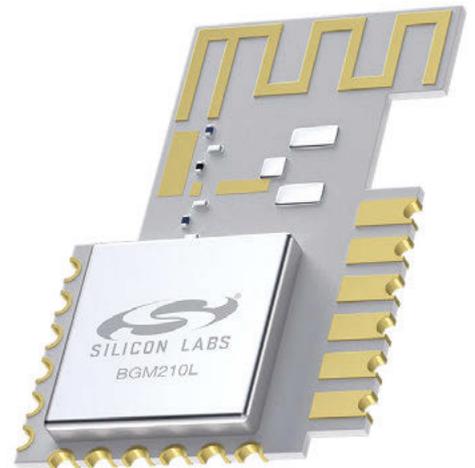
Silicon Labs has launched a portfolio of integrated, secure Wireless Gecko modules that look to reduce development cost and complexity and make it easier to add mesh networking connectivity to a wide range of Internet of Things (IoT) products.

The MGM210x and BGM210x Series 2 modules support Zigbee, Thread and Bluetooth mesh, Bluetooth Low Energy and multiprotocol connectivity and improve mesh network performance for line-powered IoT systems ranging from smart LED lighting to home and industrial automation.

Pre-certified, the xGM210x modules help reduce R&D cycles related to RF design and protocol optimisation, allowing developers to focus on their end applications.

The modules are based on Silicon Labs' Wireless Gecko Series 2 platform featuring RF performance, a powerful Arm Cortex-M33 processor, software stacks, a dedicated security core and a +125C temperature rating suited for harsh environmental conditions.

"This new portfolio of application-optimised modules provides a fast and easy wireless on-ramp to mesh networking, helping IoT developers get their connected products to market quicker while preserving their investments in tools and software," said Matt Saunders, Vice President of Marketing and Applications, IoT Products, Silicon Labs. "Our fully integrated module design, comprehensive wireless stacks, state-of-the-art security and powerful development tools will help customers add wireless connectivity and mesh capabilities to IoT applications with the lowest R&D investment, saving months of engineering effort and testing."



Smart solutions for the test market

FOLLOWING THE INTEGRATION OF THEIR EUROPEAN OPERATIONS ELECTRO RENT AND MICROLEASE ARE NOW PLANNING FOR A FULL RE-BRANDING IN 2020. BY NEIL TYLER

Back in February Microlease and Electro Rent in Europe unified their operations as part of the move to consolidate Microlease and Livingston into Electro Rent, following their acquisition in 2017.

"You're going to see further renaming and rebranding next year," explained George Acris, VP of Marketing, at a press event held in London last month.

"In 2020, we'll be phasing in the Electro Rent name but while it will be used more, both Microlease and Livingston will still be referred to in those markets where we still need to communicate the fact that we are now an integrated global business.

"The plan is to intensify our communications strategy prior to the new business' full launch next year – it's about getting that message out there, that we are now a full-service company in test and measurement."

Blending the two corporate cultures has been a challenge and will remain a work in progress, but the company is planning a number of enhancements and investments to address the changing requirements of customers in the test and measurement space.

"We have invested \$10m in new testing equipment to support technologies, like 5G, at a time when the market is developing rapidly and we're seeing a growing number of deployments worldwide.

"As a business we are investing heavily in digitisation and asset management, it is

an important area for us," said Acris. "We're developing a new website and we'll be looking to provide a range of new features from ecommerce to a personal space for each customer.

"This new feature, MyElectroRent, will enable customers to better control what they buy or rent and will enable us to maximise the service we can provide them with."

"Traditionally, engineers have looked to acquire test equipment and the result is a lot of underused devices."

George Acris

According to Acris, the investments being made are intended to support the brands as they are brought together and to 'future proof' the platform. The company has one of the largest global inventories available and provides engineers with access to a huge range of equipment.

"We can supply test equipment immediately and that level of responsiveness is critical in today's market. We've also been signing a number of distribution agreements around the world, all of which provides better levels of access to test equipment. It's about optimising our customers' spend and how they use that equipment," explained Acris.

Electro Rent/Microlease address a broad range of markets and the test environment is changing.

"Traditionally engineers have looked to acquire test equipment and the result is a lot of underused equipment," said Acris.

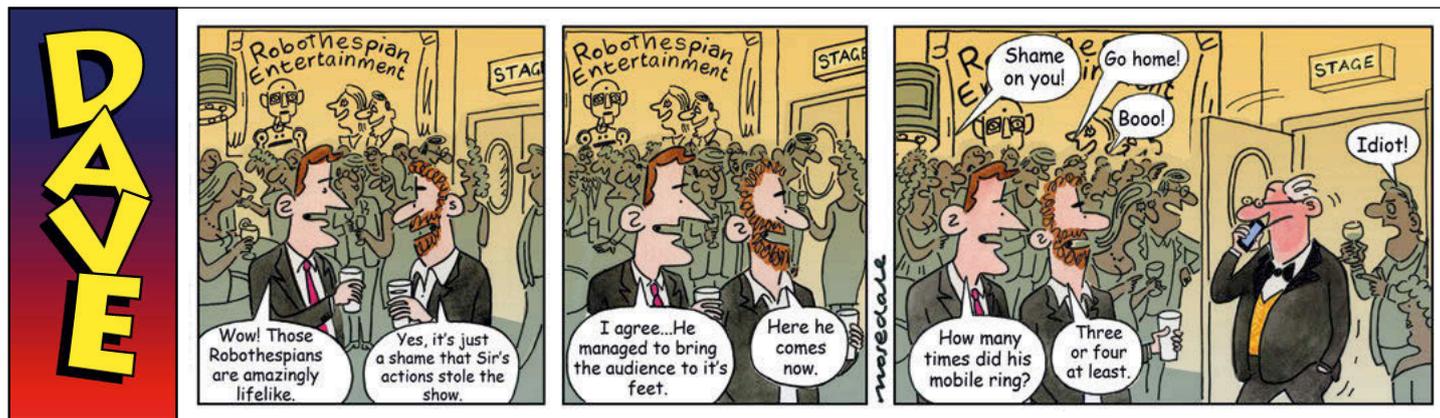
"Today, with the rapid developments in technology, engineers need more test equipment. Many companies have limited budgets, so there is a growing trend towards renting or leasing equipment. More engineers are looking at alternative sources of test equipment and how they can use that equipment more efficiently," said Acris.

"If you are able to move from a capex to an opex model you can afford to use more test equipment and do so more efficiently – the cost savings can be enormous and more companies are moving away from an automatic purchase culture to, at the very least, investigating rental."

New technologies and standards require increased flexibility and companies don't want, or need, to be 'saddled' with investments that can't be changed and they're under the pressure of getting products to market faster.

"Ease of use and access to the latest test equipment are crucial and we are looking to drive growth in the rental space.

"Test equipment is critical for companies and if you are looking to address a specific need, or need greater flexibility, the rental model is becoming more popular. Using rental, it is far easier to justify acquiring equipment in these financially constrained times."



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THE NEW FRONTIER IN CREATIVITY

How technology, from VR and AI to technology tools, is helping to drive new forms of creativity in the world of the arts. By **Neil Tyler**

Technology is pervading all aspects of our lives so it should be no surprise that it is having a growing impact on the world of art.

Whether it is technology as a tool to create digital artwork, technology as the art itself or technology helping to expand access to the arts there is no question that it is changing the way in which we create and consume art.

Museums and galleries are using technology to help people learn about and enjoy exhibits. It is being used to better understand how people interact with art, analysing how they move through exhibits and, with the use of biometric data, creating displays which have more impact.

None of this is new. Technology has influenced the arts for hundreds of years, whether renaissance painters finding cobalt blue and wanting to experiment with it or the development of photography and the use of the colour spectrum.

The availability of oil paints in a tube, developed in London in the 1840s, is often credited with enabling the French Impressionists to use stunning textures and colours and to complete their paintings inspired by the world around them, away from their studios.

Art reflects society and society, in

turn, influences what art is created and today artificial intelligence, technology tools, computers and screen printing are opening up whole new vistas in terms of creativity.

The iPad and Apple Pencil, along with Microsoft's Surface tablets are inspiring a generation of artists and non-artists as well.

As with all aspects of society, art is no longer exclusively the realm of human beings. AI is now able to create complex works of art itself.

Earlier this year the artist, Anna Ridler, used massive datasets to produce a piece of art. Inspired by the high financial value given to tulips in the early 17th century, she used a data set to create an AI-generated video called 'Mosaic' which went on show at the Barbican Arts Centre in central London. Each tulip changed in form and colour depending on bitcoin pricing.

There is no doubt that technology wields great potential for artists – both those who are naturally drawn to being creative, and those who are more into the technology itself.

"Technology and culture have always been inseparable," according to Vanessa Bellaar Spruijt, a network producer for Network for Creative Enterprise, a multi-hub collaborative

project based in Bristol.

“Artists tend to have a different take on the world and how we should be using technology. Art expands and questions our views and creates impact differently to other disciplines.

“Technology designers often have a series of end uses in mind, but won’t have the means to push the boundaries or stress test the technology in ways that interrogate the ethics of its everyday use or its accessibility.”

She believes that the collaboration of arts and culture with technology adds a human element to the development and exploration of it, keeping the work relevant to real people.

“I believe it allows the creation of work where art and technology are inherently linked, as opposed to being art that features technology, or technology being explained by art.”

Sprujit was responsible for a 5G Showcase, ‘Layered Realities’, which was intended to give artists a chance to experiment and create meaningful experiences with 5G, and also test and question how it is or could be applied.

“Through this project we placed arts and culture at the heart of new technologies,” she explains.

Brighton Dome

With the arrival of 5G, a similar project to Layered Realities, devised by Brighton Dome and Festival in partnership with Digital Catapult, has been announced.

Tristan Sharps, Artistic Director of site-specific performance company, dreamthinkspeak, and one of the contributors, is looking to explore the potential of 5G technology.

His company specialises in immersive shows and has used buildings across the UK and around the world to plan and create unique experiences for a live audience.

“As an artist I’ve always used technology in some way to enhance

my projects, implementing media such as film and more recently, Bluetooth and VR in my work,” he explains.

“If you sit in a theatre, for example, you’re looking at a stage with actors, props and scenery. If you were to walk up to the stage you’d clearly enter a 2D world designed to be viewed from the stalls. Our work involves creating a physical and interactive world you can enter.

“You enter via the stage, passing through a door or along a corridor, and you can engage with a performer sat at a table or investigate an architectural model of the room you are in.

“My work currently involves working with models and is a theatrical experience. It’s physically real.

“Now technology is allowing me to create all of this in a virtual space. I no longer have to take over an entire building but rather can use VR headsets to allow users to enjoy those experiences.

“Technology is allowing us to do far more but with a smaller physical footprint,” he says.

Technology is also enabling artists to radically change how they interact with their audience.

“I think there has been a ‘sea-change’ in the way in which technology interacts with art,” suggests Sharps.

“Back in 2003, we created a space installing a series of speakers that were interconnected. We then



“Technology is allowing us to do far more but with a far smaller physical footprint.”

Tristan Sharps

Below: The use of VR is allowing artists to interact very differently with their audiences



created a soundtrack that was played throughout the space and which was routed through a computer. We were able to create sounds in real-time and affect the reactions of the audience. The difference from today was that they didn’t see or engage with the technology. They weren’t aware of the computer or the speaker system. Today the technology is front and centre.

“The audience can now wear a headset or use a tablet or phone to upload an app to experience the work,” he explains.

As an example, dreamthinkspeak created an immersive piece of work for Hull when it was the UK’s City of Culture. Tablets were handed out to the audience and were used to create a visit to a high-tech South Korean corporation.

“The audience were able to then experience the future of retailing, live gaming and virtual reality in parallel with flashbacks to when the country was under military rule.

“The show was spread across several floors. We needed to ensure that all the audience were engaged. You will always get people who are scared of using technology but, in order to explore the art work, they needed to be at ease with it. To engage with the art the audience needed the tablet and we created an interactive maze, using live tracking to achieve that.”

As Sharps explains, the audience is central to his company’s work.

“The audience is the key, they are on the stage themselves.”

Sharps says it’s important for him to keep abreast of new technology, but readily admits he’s “not the one writing the algorithms”.

Instead, dreamthinkspeak works like a production company. “When we’re developing a project we’ll go from our normal team of 2 up to a team of 100, each with a specific focus and skillset, for example artistic, technical or carpentry.



"I concentrate on the creative ideas and pushing technology into areas that I don't believe they've been pushed into before," he says.

However, he notes that it is always a collaborative process. "As an artist my imagination tends to speed ahead. I'm told about a certain piece of tech and I have all sorts of ideas of how to deploy it, but of course, it has its limitations."

Sharps explained that he will leverage the expertise of technicians to understand these limits. This may result in the team devising a way to overcome it, curb his ideas or push them into other avenues.

He gives the example of a recent VR project he developed where he had to make compromises.

"I wanted to create this very detailed 3D world which the audience could inhabit, but I also wanted it so the audience could move around. We connected the headset to a laptop the audience could carry on their backs, but it limited the resolution we could offer. A lot of the detail I wanted couldn't be included."

Another project under development highlights how technology could completely change how we see and engage with live theatre.

"I'm developing a multi-live streaming project; it's a production of a Shakespeare play that will be performed in a space with the

audience looking down on the action.

"Each audience member will have an iPad, and there will be dozens of cameras embedded throughout the set. The audience will be able to select different cameras from the network to view the performance very differently. They will also be able to use social media to interact with characters in the play and by using a 5G enabled network people, in cafes nearby or at home, will also be able to stream those cameras live at the same time; there should be zero latency."

It's a complex project and will involve a large number of cameras.

"The audience will be able to choose camera angles so that there will be a real sense of interaction and you will be able to get away from the passivity of the usual audience experience and get involved."

Engagement

With bandwidth, resolution and latency having restricted his previous work, Sharps is enthusiastic about the prospects of using 5G.

"I could only have a maximum of 6 headsets in my previous VR experience. Now I'm looking at 100 audience members at any one time, all equipped with a device where content will be triggered and received."

But beyond the performing arts the use of digital technology means that

Above: Technology is allowing museums and galleries to present their collections in innovative and novel ways



"Artists tend to have a different take on the world and how we should be using technology."
Vanessa Bellaar Spruijt

museums and art galleries are able to present exhibitions and give people access to collections more easily – that's an overt and obvious gain from the use of technology.

Patrons will be able to look at a painting using an app to see a different perspective of a piece of art or to simply walk through a virtual gallery.

For people like Sharps and Spruijt it's important that technology opens up the arts to more people.

"Whether in the visual arts or the performing arts, technology has always been part of what we do," suggests Sharps. "As a company, I see it as natural to use these new tools when they are available. I think the visual arts and film are keener when it comes to embracing technology."

The big drawback is the expense of using these new forms of technology.

"There is a lot of imagination out there," says Sharps, "but the technology is expensive to use and there's a lack of funding to help artists engage with and understand it."

While technology is helping to bring a new audience to art it is also helping to create a new generation of artists. More people are creating works of art, perhaps that means more poor work will be generated, but a lot of interesting work as well.

Art is also a means to ask questions of technology. In a world where AI is becoming more pervasive art can be used to question its value and allow people to interact with it.

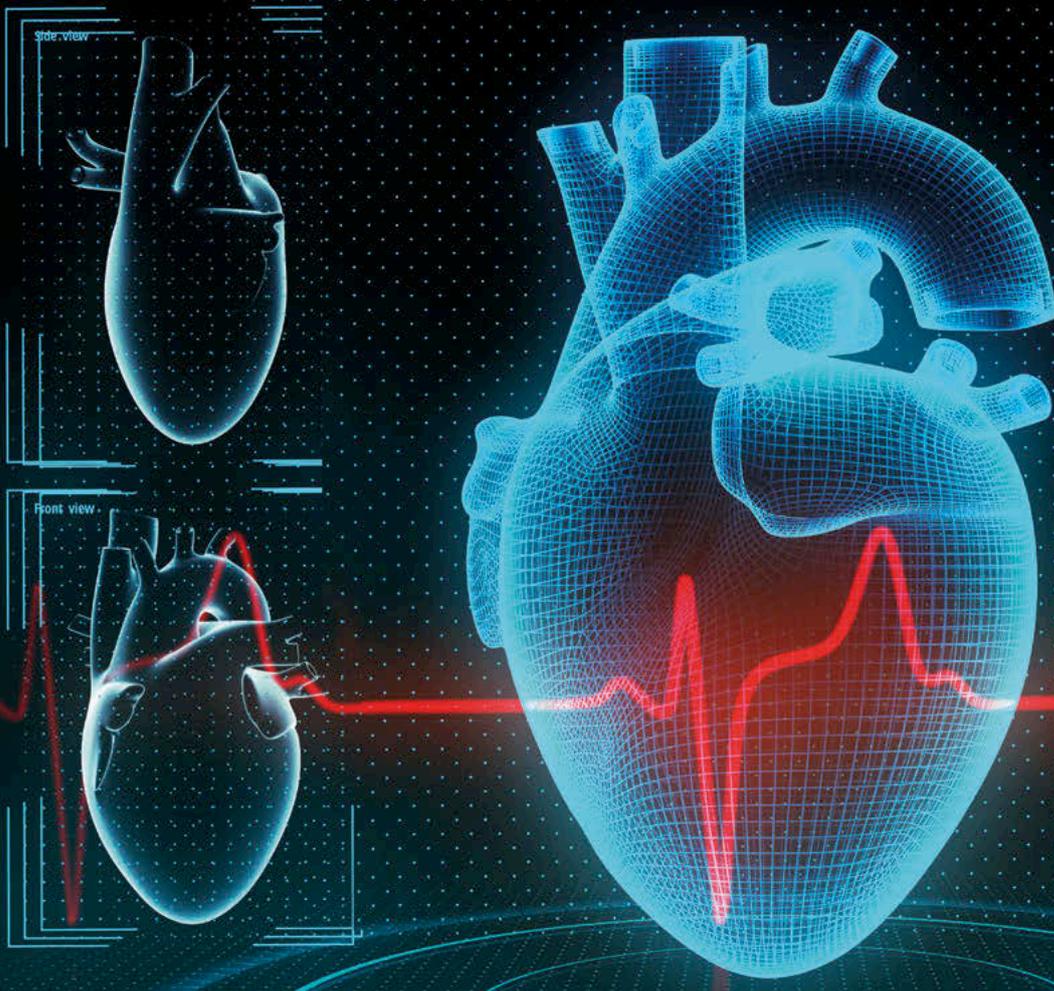
According to Spruijt, "Art can make us feel differently about the world we live in and it will keep doing that with whatever means available, whether it's a paintbrush, 5G, or an AR headset."

"Technology is providing us with some wonderful tools," concludes Sharps. "I would advise artists to get out there, grab and play with it. If you don't like it then simply go back to using traditional forms. Technology gives artists and audiences alike, a thrilling opportunity to engage with our rapidly changing world."

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Carrying the day

Brian Wall has been getting the inside story on the role that the latest electronics systems play in the new Queen Elizabeth Class carriers

The Queen Elizabeth Class carriers are intended to provide the UK's armed forces with a four-acre military operating base capable of being deployed anywhere around the world.

HMS Queen Elizabeth, delivered by the Aircraft Carrier Alliance (ACA), is undergoing MOD lead flying trials, while HMS Prince of Wales is currently undertaking contractor sea trials and should enter service later this year.

Standing 280 metres in length, 70 metres wide (flight deck) and 73 metres keel to masthead, the carriers are impressive feats of engineering but so too are the electronics that lie within them, as Martin Douglass, Engineering Director at the ACA and Chief Engineer of the Queen Elizabeth Class aircraft carrier programme, and Pete Jewson, Combat System Design Authority, reveal.

Breathing life into the vessel

To achieve the mission, and ensure the vessel is always on hand to embark and support the aircraft, the QEC class has a suite of power, propulsion and platform systems utilising a variety of stand-alone networks, some integrated throughout the platform. These systems are the lungs of the vessel – literally in some cases, supplying the air that allows the vessel to breath.

“Key to endurance and efficiency is the ships full electric propulsion system, a derivative from the design utilised on the T45 destroyers benefitting from many of the lessons of the class,” explains Douglass. “The QEC power plant consists of six generators, four Diesel Generators (DGs) and two Gas Turbine Alternators (GTAs), with a total of 110MW capacity – enough to power a town the size of Swindon.

“These supply a HV distribution system, which incorporates four HV switchboards with passive harmonic filtering. Three of the four switchboards supply power independently to the four propulsion motors (total 80MW of propulsive power with two motors per shaft), facilitating the disparity in rating of the DGs and GTAs, but also enabling the separation of propulsion from much of the ship's systems supplies. This design provides flexibility of supply and resilience to failure that meets the demanding needs of flying operations both in peace time and when on a war footing.”

Integrated mission system

While the power system may well be the lungs of the vessel, the heart, veins and nervous system of capability is the integrated mission system. “The primary challenge for the carrier and its crew is information management,” says Jewson.

“Embarked aircraft are some of the most advanced in the world and today's operational environment requires data from a range of sources and sensors to be synthesised for effective utilisation – this to the 1,600 personnel internally (with an embarked air group), and externally to/from the carrier task group and the shore-based national and international HQs. At the core of this construct is the integrated mission system formed of three capabilities real-time systems area (RTSA), communications system, and information systems.”

RTSA has at its core the combat management system (based on the RN T45 Destroyer design), augmented by the RDS 1600 Air Traffic Management System as used at land-based naval air stations, modified to deal with a moving airfield. The use of these critical and pre-existing building blocks has dramatically reduced

the level and extent of integration testing and supported early crew familiarisation. This drive to exploit pull-through, as opposed to newly developed systems, has extended to systems such as the S1850M Long Range Radar, the ARTISAN RT997 Medium Range Radar and the Meteorological System, similar variants of which are all proven on other RN vessels. New to RN service are the Navigation System (developed from a commercial application), the dual-island mounted Identification Friend or Foe system, the visual surveillance system (some 200-plus cameras) and the Instrument Carrier Landing System.

The twin island QEC design has created both opportunities and challenges, in terms of the placement of emitters. There is more real estate to position these and achieve physical isolation between TX & RX antennae. However, two large structures relatively close together impede the ability to achieve uninterrupted 360-degree coverage. This latter issue has resulted in the adoption of multiple sensors/antenna on both islands to 'fill the coverage gaps', which has driven the complexity of the topside design. Consequently, there are upwards of 117,000 electro-magnetic interactions that have had to be considered in determining and arriving at a viable design.

"The 'communication systems' capabilities encompass both on and off-board services, covering everything from internal desk phones through to external radio channels and satellite communications links," adds Jewson. "The overall suite of systems facilitates the sending and reception of data, video and voice, at classified and unclassified levels, throughout the ship and off it at frequencies from HF up to UHF, approximately four times that on the previous RN carrier."

In control

Key to the communications suite is the Communications Configuration Management System, which allows all services throughout the ship to be either dynamically modified under remote control on an 'as demanded' basis or to be holistically pre-planned offline and then activated via named wholeship configurations, as operational scenarios dictate. This flexibility allows services to be

managed coherently by a small communications management team from command positions of their choosing.

In addition to the normal 'hard-wire' internal communications suite, the design includes a wireless communications system (WCS) operating throughout the ship and on the flight deck via the use of 'leaky-feeder' signal distribution paths and repeaters. This scheme provides a trunked carrier to all locations facilitating personnel through hand-held radios, other than within certain EM-protected spaces,

which have their own dedicated provision. Likewise, WCS users can be patched through to use off-board radio services, opening up the ability (for instance) for flight deck personnel to communicate directly with aircraft.

The final major capability area is the information systems. As well as individual systems, this includes the networked infrastructure, integrating all the sensor, communications, and brings together the mission planning and data exploitation applications. The information systems are connected by a fibre-optic network (utilising around 1,800 Km of glass). This includes the Defence Information Infrastructure (DII), which enables the crew to interact on anything from personnel and medical records, through to logistics and stores.

Hosted on this network, the Air Group Management Application supports the management of aircraft movement across the hangar and flight deck spaces, integrating data such as aircraft serviceability, pilot availability

and weapons status. The information systems also include planning and decision aids, imagery exploitation systems and additional specialist applications that enable the embarked aircraft to conduct their mission.

Douglass and Jewson have found it deeply satisfying to see so many innovations built into the vessels, with the majority of the technology employed proven and mature. "That said, the novelty and challenge has been in how to utilise this and integrate it into a vessel of this size to deliver the capability required by the Government of this strategic asset, within the agreed unit cost and projected though-life operating costs," Douglass concludes. Truly, these are two 21st century ships that will literally carry the day.



Above: Martin Douglass, Engineering Director at the ACA and Chief Engineer

Top: Pete Jewson, from the CoSystem Design Authority



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INTERFERENCE ON THE MOVE

Clock rates are going up, so will vehicles need more checks for EMC? By **Chris Edwards**

When Daimler set about creating a test chamber for electromagnetic compatibility (EMC) it wanted an artificial environment that would reflect the conditions its vehicle would meet on the roads of the future. The result, opened over the summer, is a set of metal-lined chambers with floors designed to behave like asphalt and that have the space to build highly realistic tests of high-frequency RF communications.

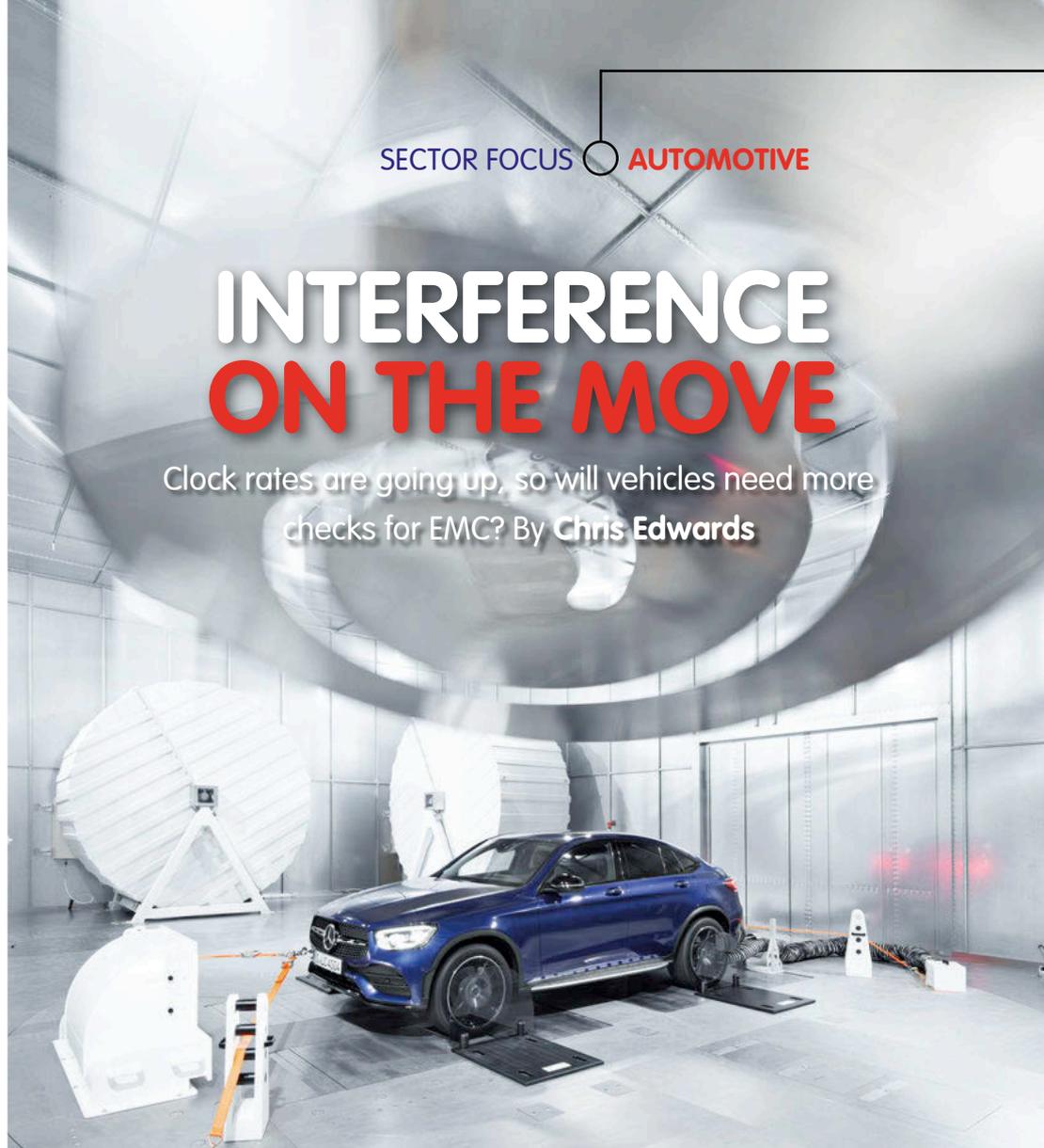
One chamber at the Sindelfingen R&D centre in southern Germany, intended for measuring the performance of RF antennas, is three storeys high.

An unusual element of the Daimler design is its use of a reverberation chamber for conducting interference immunity tests. The chamber has three large rotating metal spirals that can spin at up to 120 revolutions. These stirrers redistribute the electromagnetic waves around the chambers much more efficiently than using traditional techniques using bombardment from an array of antennas spread around the room in sequence.

The Daimler test centre is a response to the way in which electromagnetic environment both around and within the vehicle is becoming more complex and critical to the vehicle's safe operation.

Systems inside the vehicles will have to cope with EMI from the outside world generated by other vehicles and the roadside infrastructure as they begin to exploit the information that can be supplied over wireless vehicle to vehicle (V2V) and vehicle to everything (V2X) networks. The cars will also generate a lot of their own EMI that can have adverse effects on the operation of sensor modules and ECUs.

Although today's vehicles have plenty of interference generators, they tend to operate at the lower end of the spectrum. This is likely to change and possibly change quickly.



The non-isolated DC/DC converter is a mainstay in automotive designers and a common source of EMI within the vehicle. Now, the currents employed by DC/DC converters and their switching rates are set to increase dramatically. Power transistors built using gallium nitride or silicon carbide can switch efficiently more than a hundred times faster than their conventional silicon counterparts. Designers seem likely to exploit those technologies to keep power converter size down and to benefit from the way in which they can run at higher temperatures, which will let them use smaller heatsinks and enclosures. Researchers have shown switching frequencies well into the megahertz range for GaN power circuits that can be exploited for greater efficiency.

As current is a major factor in generating EMI, such power converters are potentially troublesome sources.

Above: A reverberation chamber allows interference immunity measurements to be conducted in a highly efficient manner

Designers will need to keep the high-frequency current loops in their circuit boards as small as possible – though the reduced size of filtering passives and the power transistors themselves may help contain the problem.

Flexible PCBs

Other systems within the vehicle do not have to cope with such high currents but they are potentially more troublesome to debug in an environment where RF protocols such as Wi-Fi and 5G are not just used for infotainment systems but become fundamental components of the drive controls.

Within the bodywork, automakers are now looking beyond basic Ethernet to versions that run at 1Gb/s and even 10Gb/s.

There are also changes in the way that systems are wired together. Rather than stick with a conventional

and often heavy wiring harness made up of many multicore cables, PCB makers such as Trackwise expect vehicle designers to begin to make more use of flexible PCBs – already common in instrument clusters.

A study by Loughborough University argued flexible PCBs are potentially good candidates for replacing much of the wire harness needed for the electronics in door panels.

The study's EMC measurements found performance was largely worse than twisted-pair wiring below 1MHz, the flexible PCB won at higher frequencies. Braiding the traces in a similar fashion to twisting in a wire proved to be effective at reducing EMI.

Adding extra components such as chokes, common in wiring harnesses, remains possible with flex PCBs, says Philip Johnston, CEO of Trackwise: "Some electronic components are of the size that they can be mounted directly and unsupported on a flex PCB. Other larger components can also be mounted directly on a flex PCB but are of the size and mass that the flex PCB will need some support. Either way, an EMC choke can be mounted to either form of flex PCB."

For high-speed automotive networks, one option to limit the EMI produced by network interfaces is to move to fibre-optic cabling, using plastic rather than glass. This is an option favoured by suppliers such as Spain-based KDPOF, which has

been working on large-core fibres that work with 1Gb/s signals. Molex, on the other hand, still favours electrical connectivity and sees 10Gb/s as entirely practical.

Mike Gardner, director of advanced technology development in transportation and industrial applications at Molex, says: "Molex is a strong advocate for the use of copper in automotive for high-speed Ethernet links as the copper technologies are widely accepted and within the reach of advancing toward faster speeds. Differential systems will allow more EMI margin over that of coax in our view at some point.

"Shielding of both cables and connectors are well understood in other industries and can be leveraged in future designs of those products. What is also leveraged is the understanding from other industries of how to manage the PCB designs and enclosures to optimise for EMI that are now becoming a greater part of automotive ECU development practices," Gardner adds, noting that fibre may ultimately start to replace copper but that replacement will depend on greater advantages being identified for the optical rather than electrical approach to in-car communication beyond existing deployments of MOST on plastic fibre.

EDA companies see greater use not just of testing but of pre-manufacturing simulation to assess the performance



Above: Cameras monitor the test set-ups in the test facility during tests. Developers are able to control and observe the measurements on the test rigs from their monitors

of high-speed automotive protocols and ECUs. It has helped lead to a process of acquisition and consolidation in design.

Vic Kulkarni, vice president and chief strategist at Ansys, says his company's decision to buy electromagnetic simulation tools provider Helic was the spread of gigahertz-plus designs across the electronics industry, which make post-silicon and post-PCB tuning much harder to achieve successfully. "The turning point is around 2GHz."

Tom Beckley, general manager of the custom IC and PCB group at Cadence Design Systems, says EM is a major part of the company's move into multiphysics simulation: the same ground as that occupied by players such as Ansys and Siemens.

The complex packaging needed for a camera mounted against a windshield provides an example for him to describe the problems. "We have electronics in a small housing. We have to worry about thermal effects: how it will react as the sun beats down on it year after year. You have to be smart as to how you integrate the design. To get the heat off the vision IC you might put a heatsink on it, but that changes the RF interference profile. If you drill holes in the enclosure, how will that affect RF behaviour?" Beckley asks.

The result, Beckley argues is much greater use of simulation to test different scenarios to work out how susceptibility and propagation changes with different thermal and electrical configurations work, long before they are integrated into a vehicle ready for a testing chamber like Daimler's.



Left: EMC chambers with multi-receiver technology makes it possible to take measurements at all vehicle antennas simultaneously

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AutoSens, which was held at the world-famous AutoWorld museum in Brussels, Belgium, last month brought industry leaders together to look at and assess the most recent developments in the driver assistance market (ADAS).

It's a market that is expected to be worth upwards of \$67 billion by 2025 driven, in no small part, by increasing levels of innovation but also by a growing number of initiatives that are accelerating growth in vehicle automation and self-driving cars.

Sensors are becoming increasingly smart and as a result of becoming more intelligent and capable, design engineers are able to add more perception capabilities and functionality to fewer devices.

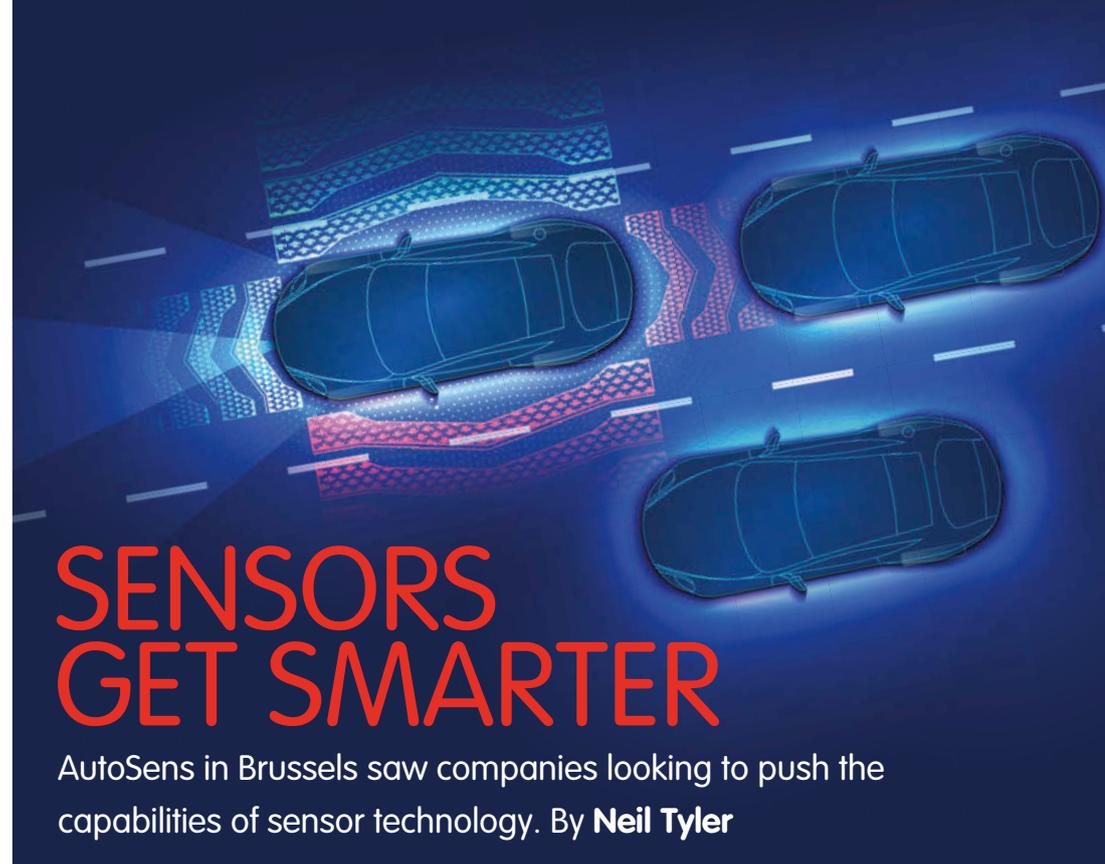
However, because it's likely that we will hold self-driving vehicles to a much higher standard when it comes to driver safety, the incremental innovation that we are seeing in terms of the technology needed to support autonomous driving suggests that it's going to take a long time to reach full autonomy.

The hype around autonomous vehicles is beginning to tail off as engineers and scientists become more realistic about what the development of level 4 and 5 vehicles will actually mean - very significant challenges remain going forward. Claims that we would be seeing fleets of autonomous vehicles, or robotic-taxis, on our roads by 2020 have certainly proved wide of the mark.

But, despite that, progress in this space is being made with on-going research into sensors, computer vision and safety.

One of the most exciting announcements to come out of last month's event was made by CEVA, a licensor of wireless connectivity and smart sensing technologies.

The company unveiled the NeuPro-S, a second-generation AI processor architecture that's been designed for deep neural network inferencing at the edge.



SENSORS GET SMARTER

AutoSens in Brussels saw companies looking to push the capabilities of sensor technology. By Neil Tyler

In conjunction with NeuPro-S, CEVA also introduced the CDNN-Invite API, which is a deep neural network compiler technology that can support heterogeneous co-processing of NeuPro-S cores together with custom neural network engines, in a unified neural network optimising run-time firmware.

"The NeuPro-S, along with CDNN-Invite API, is suitable for vision-based devices with the need for edge AI processing, in particular autonomous cars," explained Yair Siegel, the company's Senior Director Customer Marketing and AI Strategy.

"The NeuPro-S looks to process neural networks for segmentation, detection and the classification of objects. We have been able to include system-aware enhancements that are able to deliver significant performance improvements."

According to Siegel, these improvements include: "Support for multi-level memory systems to reduce costly transfers with external SDRAM, multiple weight compression options and heterogeneous scalability that enables various combinations of CEVA-XM6 vision DSPs, NeuPro-S cores and custom AI engines in a single, unified architecture."

As a result, the NeuPro-S is able to deliver, on average, 50% higher

performance, 40% lower memory bandwidth and 30% lower power consumption than was the case with CEVA's first-generation AI processor, said Siegel.

Addressing the growing diversity of application-specific neural networks and processors that are now available, the CDNN-Invite API will allow users to incorporate their own neural network engines into the CDNN framework so that it can holistically optimise and enhance networks and layers to take advantage of the performance of CEVA's XM6 vision DSP, NeuPro-S and custom neural network processors.

According to Siegel, the CDNN-Invite API is already being adopted by customers who are working closely with CEVA engineers to deploy it in commercial products.

Coccon LiDAR

An interesting use of autonomous vehicle technology is in the development of geo-fenced vehicles, which have a more limited range and set of capabilities.

"With the projected growth in urban populations set to soar by 2055 and with the anticipated doubling of vehicles on our roads, the stress on infrastructure can only get worse," said Vincent Racine, Product Line Manager at LeddarTech.



"The NeuPro-S, along with CDNN-Invite API, has been designed for any vision-based device with the need for edge AI processing, in particular autonomous cars."

Yair Siegel

“We’re facing growing congestion, increased emissions and a real hit to our productivity, if we find ourselves stuck on congested roads.

“In response, we’re seeing demand growing for autonomous shuttles that will operate on geo-fenced routes – in fact some research reports suggest that as many as 2 million of these shuttles could be in use by 2025, moving 4-15 people along predetermined pathways running up to 50km.

“Sensors will be an important component in these vehicles, as they will have to navigate through congested areas and take account of pedestrians, cyclists and animals, all of whose movements can be hard to predict.”

To address this LeddarTech has developed the Leddar Pixell, a Cocoon LiDAR for these types of geo-fenced autonomous vehicles.

“This 3D solid-state LiDAR cocoon solution has been specifically designed for autonomous vehicles such as shuttles and robot-taxis, as well as commercial and delivery vehicles and looks to provide enhanced detection and robustness,” explained Racine.

“It provides highly dependable detection of obstacles in the vehicle’s surroundings and is suitable for perception platforms that are being developed to ensure the safety and protection of passengers and vulnerable road users.”

The solution has already been adopted by over a dozen leading autonomous vehicle providers in both North America and Europe.

“Crucially, the Pixell is able to compensate for the limitations of mechanical scanning LiDAR used for geo-positioning, which has the tendency to generate blind areas that can reach several meters in some cases. There are no dead zones or blind spots with this solution,” Racine pointed out.

The sensor is able to provide a highly efficient detection solution

to cover critical blind spots by using technology embedded in the company’s LCA2 LeddarEngine, which consists of a highly integrated SoC and digital signal processing software.

Situational awareness

While technology can help to provide better situational awareness – whether seeing things, perceiving them and then linking them to a user’s location, there’s still a lot of development required in this space.

One of the company’s looking to address this is Oversight, which has developed a 3D Semantic Camera which it describes as a “revolutionary kind of sensor that brings full situation awareness to smart machines.” According to the company’s President and Co-Founder, Raul Bravo, “It’s a sensor that combines software and hardware which supports remote material identification with comprehensive real-time 3D data processing.

“This technology provides greater accuracy, more efficiently, enabling systems to perceive, understand and ultimately interact with their surroundings in real time,” Bravo



“With the projected growth in urban populations set to soar by 2055 and with the doubling of vehicles on our roads, the stress on infrastructure can only get worse.”
Vincent Racine

Below: CEVA’s NeuPro-s provides edge processing for imaging and computing vision

explained.

“Mobility is evolving rapidly and our 3D Semantic Camera will be able to bring full situation awareness and new levels of safety and reliability to the man-controlled machines that you see in Level 1- 3 ADAS (Advanced Driving Assistance Systems), but it will also help to accelerate the emergence of fully automated smart machines associated with Level 4 - 5 self-driving cars, robots and drones.

“This technology is the first to provide full situational awareness in a single device and this has been made possible through the development of a low powered, long range and eye-safe broadband laser that allows for material composition to be identified through active hyperspectral analysis.

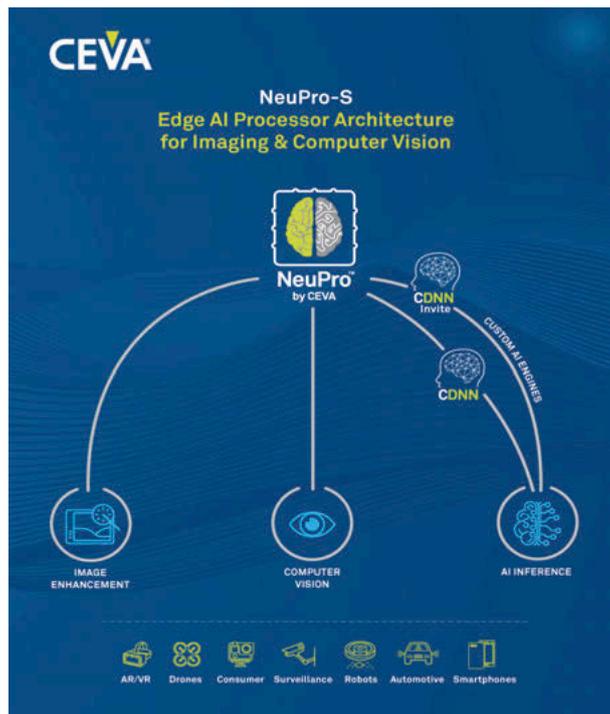
“Combined with its 3D SLAM on Chip capability (Simultaneous Localisation and Mapping), this technology can deliver reality in real-time,” claimed Bravo.

The camera provides actionable information and object classification through its on-board SoC, but does not rely on “machine learning”. As a result power consumption is lower as is the bandwidth required.

“Our approach eliminates the need for massive data sets for training and the guesswork is eliminated by actually ‘measuring’ the objects. Being able to determine the material of an object adds a new level of confidence to determine what the camera is actually seeing,” said Bravo.

The sensor is not only able to see and measure, but comprehend the world, as it provides the position, the size and the full velocity of all moving objects in its surroundings, providing information for path planning and decision making as well as information regarding road conditions.

These examples demonstrate that sensor technology to support autonomous vehicle is undergoing profound change and, crucially, helping to reduce the overall costs of deployment as capabilities are enhanced and improved.



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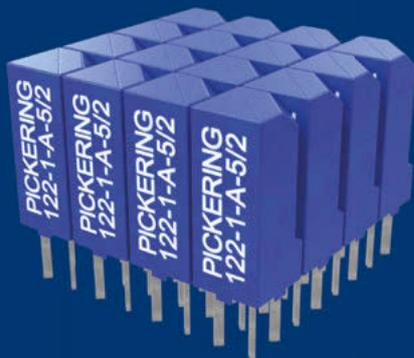
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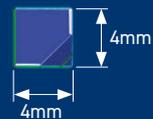
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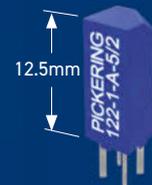
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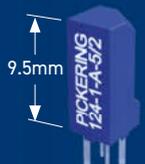
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COULD NAND REPLACE NOR?

With NOR Flash process scaling at a roadblock, could NAND Flash provide a new route to lower cost and higher density for application code storage? By **Anil Gupta**

When it comes to non-volatile Flash Memory there is NOR Flash and NAND Flash and for designers there is a simple, ready-made rule of thumb to guide their selection of memory type for any given application: For code storage, specify NOR Flash to provide reliable performance and long data retention and for data storage, specify NAND Flash for its ability to provide very high capacity at very low cost, just as long as the use case can tolerate a high bit error rate.

While these are widely-held views, they are only partly true. In fact, both NOR and NAND Flash memory are changing at different rates, and this affects their comparative benefits and drawbacks.

While there are certain circumstances in which a certain type of NAND Flash IC may be preferable to a NOR Flash device for storage of mission-critical code there are others where the difference between the two is negligible - the lower the memory density, the more this is the case.

However, a memory capacity of 256Mb is not sufficient, however, for an emerging category of embedded applications that is most clearly seen in today's vehicle systems.

Sophisticated automotive applications from Advanced Driver Assistance Systems (ADAS) up to fully autonomous driving systems will create much larger code bases and automotive systems OEMs are specifying memory systems for code storage with a capacity of as much as 2Gb (or 256MB). Designers,

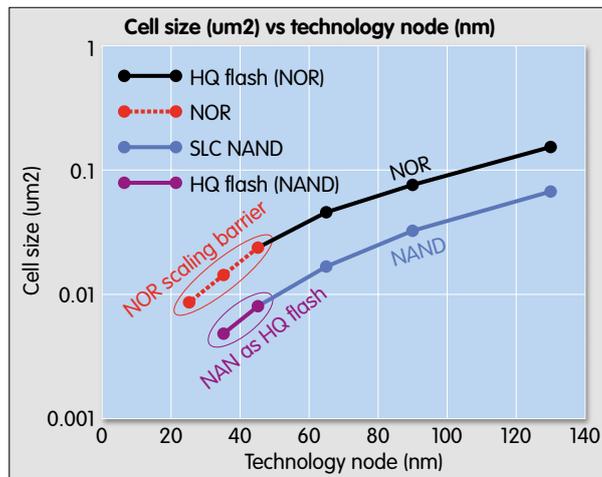


Figure 1: Comparison of NOR and NAND cell sizes with extrapolation of NOR cell size if NOR technology scaled down to 2xnm

who operate in this acutely cost-conscious environment, will want either the cost of NOR Flash at higher densities to drop, or for lower-cost NAND to be made suitable for code storage.

The end of NOR process scaling

Process shrinkage is the semiconductor industry's time-tested method of delivering ever greater functionality at ever lower cost and has been true of NOR Flash ICs.

NAND Flash has shrunk and today the highest density 3D NAND Flash ICs used in smartphones and computing equipment may be fabricated at a 1xnm node.

NOR Flash scaling, however, has ground to a halt. Implementing the 65nm node had already proved to be much more difficult than any previous node and few manufacturers can supply 45nm NOR Flash products.

The industry has discovered that the dimensions of certain elements of a NOR Flash circuit push manufacturing capabilities to their

limits. If 65nm was a speed bump for NOR scaling, 45nm appears to be a complete barrier.

This means that, for automotive systems manufacturers, there will be no Moore's Law-induced drop in NOR Flash cost-per-bit, and process scaling will not blunt the effect on bill-of-materials cost due to the increasing requirement for code storage resulting from the introduction of advanced applications such as autonomous driving.

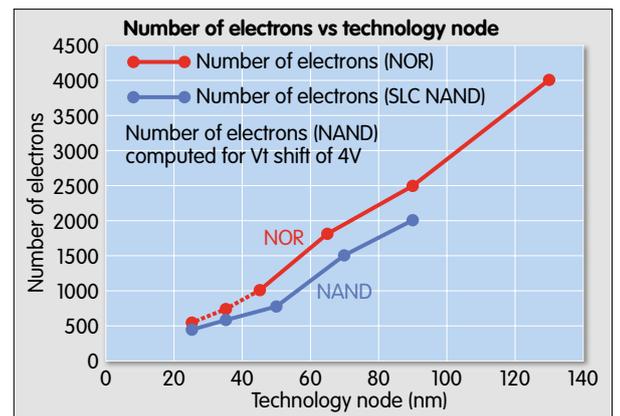
So, if NAND Flash is to step in to replace NOR Flash for code storage, we need to understand the mechanism by which data may be lost from a NAND Flash IC.

Common failure modes

Two common ways for bit error to occur in the normal course of a Flash IC's operation is in writing to the memory array and electron leakage from Flash memory cells can result in loss of data after a period of time, creating potential read errors - high temperature can accelerate electron leakage.

The risk of data loss caused by

Figure 2: Even down to the 3xnm node, a NAND Flash cell will contain above 500 electrons



Read bit error can be eliminated by the implementation of robust Error Correcting Code (ECC).

Electron leakage, on the other hand, cannot be prevented. But what is the risk that it poses? This is simply a matter of calculating the initial number of electrons in a cell after it is programmed, and the rate of leakage but it can take a very long time before the charge in the cell has dropped so far that it cannot be reliably read.

Initial electron count is a function of cell size. As Figure 1 shows, for any given process node, a serial NAND cell is smaller than an SPI NOR cell. This is an inherent feature of the two technologies and explains why NAND offers a lower cost-per-bit. (A smaller die is a cheaper die.)

A comparison of the electron counts of SPI NOR and of Single-Level Cell (SLC) serial NAND Flash devices is shown in Figure 2. This helps explain the emergence of NOR Flash as the 'reliable' memory type. A NOR Flash IC fabricated at the 130nm node would contain 4,000 electrons per cell. Conservatively assuming a leakage rate of 1 electron per month, the effect of leakage on the charge level in the cell is negligible.

Electron leakage, though, becomes a more acute problem the smaller the process geometry becomes: smaller cells hold less charge.

The minuscule circuit features of today's 1xnm MLC or Three-Level Cell (TLC) NAND Flash ICs can result in specified data retention times as short as a few hours or days in some operating conditions. These devices require complex scan-and-refresh mechanisms to periodically recharge the cells.

Mission-critical automotive applications, however, have zero tolerance for data loss over a long product lifespan of at least ten years. And automotive designers do not want to deal with the complication and risk of implementing scan-and-refresh functions.

So what is the minimum electron count required for a device to qualify as a 'High Quality' memory for use in high-reliability applications? The scientific literature suggests 500 electrons per cell can be considered a quality threshold, as such a cell would still retain 75% of stored electrons after 10 years assuming one electron is lost per month.

This threshold for Flash memory quality is borne out by the performance of a new class of High Quality (HQ) SLC serial NAND Flash devices developed by Winbond and fabricated in the company's 46nm process. These parts are subject to special screening and testing procedures.

More relevantly to advanced automotive code-storage applications, data retention in an HQ serial NAND device subject to a maximum of 100 Program/Erase (P/E) cycles and operating at a high temperature of 85°C, is 25 years. In an automotive application, code is highly unlikely to be subject to as many as 100 P/E cycles. Winbond test data also show that the devices support more than 15 years' data retention at 70°C after 10,000 P/E cycles, which is comparable to the performance of NOR Flash products on the market today.

Easy implementation

The Winbond HQ serial NAND Flash devices benefit from the same cost



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advantage over NOR Flash as any other type of NAND, such as ONFI NAND Flash and they are just as easy to integrate in automotive circuits as NOR Flash parts are. When shipped, and for up to 100 P/E cycles, they are guaranteed to contain no bad blocks so, in code storage applications, there is no need to implement bad block management (BBM) in an SoC or microcontroller. BBM would normally be required when using a conventional serial NAND part.

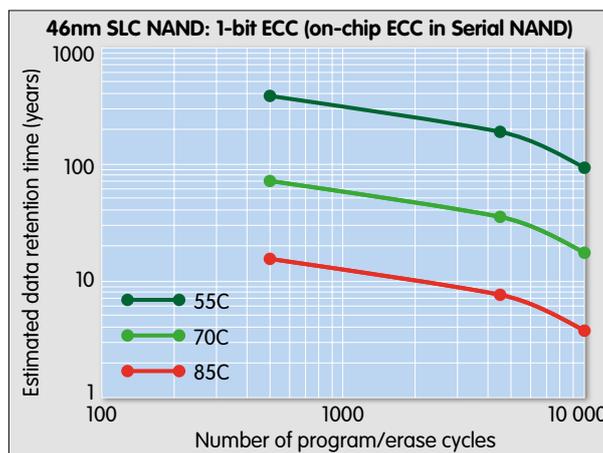
These devices also support boot directly from serial NAND Flash thanks to additional features such as automatic loading of page-0 at power-up, on-chip ECC and NOR Flash-compatible Read commands. Winbond's HQ serial NAND Flash devices are intended for use in code-shadowing applications that include a DRAM supporting the SoC or host processor.

For designs migrating from SPI NOR parts at densities of 256Mb (32MB) and below to the serial NAND parts in 512Mb or 1Gb densities, the pin-out and footprint remain the same, providing for a smooth transition from SPI NOR to serial NAND.

The barrier to NOR Flash scaling beyond the 45nm node means that automotive system manufacturers will face a huge bill-of-materials cost penalty if they decide to meet the requirement for increased code storage capacity in new applications with expensive SPI NOR Flash devices.

At a cost-per-bit typically less than half that of SPI NOR Flash in 512Mb, 1Gb and 2Gb densities, Winbond's HQ serial NAND Flash parts provide automotive manufacturers with a new way to provide sufficient code storage capacity at a much lower cost while meeting the very high standards of reliability and robustness specified in safety-critical automotive systems.

Figure 3: Data retention performance of Winbond HQ serial NAND ICs.





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THE POWER TO CHANGE

Embedded systems need better energy modelling but the standards are still being developed. **Chris Edwards** investigates

During the heatwaves that hit Europe and North America over the summer, users were posting to Twitter and social media sites how their smartphones were suffering from heat exhaustion. Left out in the sun for too long, they went into the thermal shutdown mode intended to protect the SoCs and battery.

At the other end of the scale, the mass deployment of IoT sensors has focused attention on how much energy the processors and memories need to extract from a single battery charge. Both trends are making power and energy management primary concerns in embedded-systems design. But it's far from a simple process to work out how a system will use power before it's built.

Gate-level logic simulation can support highly detailed power modelling. Even then it is not necessarily completely accurate

because traditional simulation and emulation techniques focused on simple algorithms that considered just switching power and not the subtle effects of leakage.

Leakage in digital circuits is a particular problem because of the way it changes not just with process, voltage and temperature (PVT) but gate configuration.

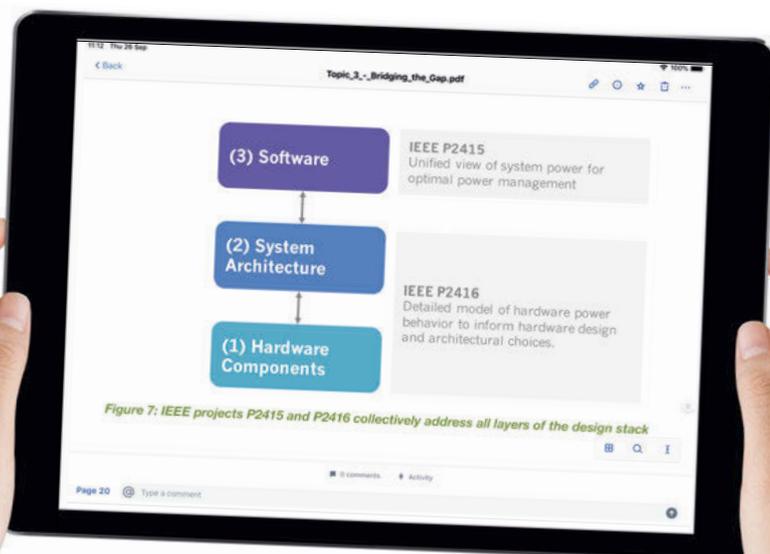
In their work at North Carolina State University, Barkha Gupta and Rhett Davis showed that for a single silicon-on-insulator (SOI) process, which typically exhibit low leakage levels, the ratio of off-currents through an inverter versus a more complex NAND4 transistor stack varies dramatically with changes in process conditions at the fab. A leakier "fast" process corner on circuits running at 1V can exhibit off-current ratios 40 times those of the slow at very low temperatures, dropping to four-fold at 100°C.

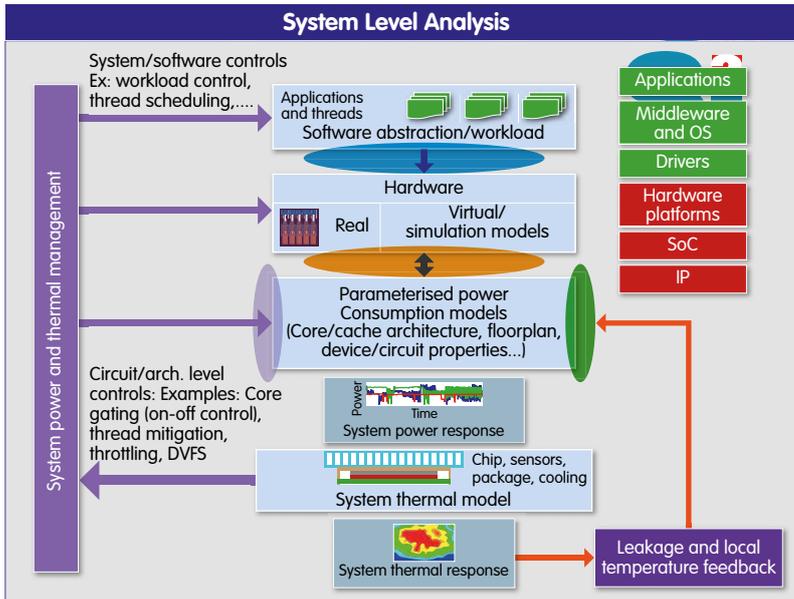
There are two further problems. One is that gate-level simulation is exceedingly slow. A system-level analyser should be able to assess the aggregate power consumption of potentially billions of gates operating at once, which is only possible at reasonable clock rates on expensive emulation hardware. Second, and perhaps even more troublesome, is that the analysis made possible by gate-level simulation comes way too late in the project. By the time the gates are in place, the hardware is more or less fixed with perhaps some wriggle room for clock and power gating. There is little that the software can do to alter the outcome other than juggle with power-down states. With better information earlier architects might have made different architectural decisions. For example a parallelised accelerator may wind up demonstrating excessive power when active that may lead to unanticipated overheating. "In typical designs we see that accelerators are guzzlers. They need to be shut down when not needed or, if they are pipelined, turned off until data is available," says Vojin Zivojnovic, CEO of software-tools company Aggios.

Standards for systems designers

About five years, the Silicon Integration Initiative (SI2) and the IEEE set about creating two standards that could be used by system designers alongside the widely used Unified Power Format (UPF) and which would remove one of the common drawbacks with today's UPF-based flows. The first to make it to completion with a summer 2019 release is IEEE 2416, which uses technology originally developed at IBM to work out how leakage and other aspects contribute to total power. The techniques in the standard, which was released over the summer, makes it easier to build models of leakage that remain accurate across a wide range of temperature and process conditions. However, that

Left: IEEE projects P2415 and P2416 collectively address all layers of the design stack





Left: A somewhat idealised simulation-based design approach

Zivojnovic says the current standard, as well as the Aggios software, takes advantage of a description approach used in the Linux environment. This is a device tree that represents the various dependencies that each software task, such as one used to send data over a network interface, has within the system. If that task is active, all its sub-tasks and the hardware they access have to be active.

Simulation software uses that tree-based description to work out how much power that task will demand based on models of each block. They could be more detailed but often the early power estimate for a block will be a combination of clock speed, voltage and throughput in a simple polynomial function. If the power is excessive, architects and developers can look more closely at what modules need to be active at any one time and rearrange the dependencies if they are not necessary.

In a design flow that involves IEEE 2416 and 2415, UPF remains the core of the hardware design. UPF specifies the way in which logic and circuit simulators apply virtual power to the circuit design.

“As participants on the relevant IEEE teams, we watch those standards closely,” says Allan Gordon, product manager at Mentor for the Questa family of logic-simulation tools. He notes version 3 of the UPF standard has integration extensions to ensure the other IEEE power standards will work together.

It will be vital to ensure that the UPF description and that used in a high-level power model will need to be kept in sync. But by modelling the dependencies early, which may be achievable in a multivendor environment if IEEE 2415 is approved in the near future and EDA vendors support it, tools will be able to show how different configurations work and maintain the connection through to the point the design goes to production.

does not readily address the system-architecture problem.

One thing that did not become readily apparent until widespread adoption of methodologies based on UPF is the frequent mismatch between logical and physical dependencies. Very often logically separate blocks will run at the same voltage and so share the same voltage rails as it is more area efficient for them to do so. In an earlier era when the main technique for saving power was clock gating, where the clock is suspended from blocks with nothing to do, this was not a problem: it is relatively easy to insert the additional logic late in the project.

Now that designers routinely use power gating to suppress leakage in dormant cores, splitting and consolidating supply rails becomes much more important at an architectural stage. If a processor is power gated, it probably makes sense to take down its memory controller. However, there may be DMA-capable peripherals that need to stay awake during sleep and cannot access a power-gated memory. System-level simulations may indicate the cost of dumping the entire contents of memory and reloading them again

after each sleep cycle imposes too much of a delay.

UPF-driven simulations show up these potential mismatches as a design nears completion. But earlier power modelling would help plan the architecture to ensure the design does not break later on when power controls are applied. But it can go further. The memory controller may be too power hungry to keep alive during long sleeps.

It might make more sense for those peripherals to cache data locally and only deliver the data to main memory when the system is in a high-activity state. Accurate power models available at an early stage would make those decisions easier to assess. The currently provisional IEEE 2415 standard seeks to deal with that problem though it may take another year to get there and could end up being abandoned if not. Originally expected to complete this year, Zivojnovic, who is the working IEEE 2415 group chair, says the work has expanded to encompass security considerations. The reason for this is that power controllers have control over an entire platform: low-priority hardware or software cannot be allowed to take an entire system down by programming in the wrong states.

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Quality and reliability

Connector quality and reliability are critical requirements and can significantly impact on the performance of military systems. By **Neil Tyler**

In the military market the use of the correct connectors and cable solutions are critical and engineers are becoming ever more meticulous when it comes to their selection.

Cables and interconnects need to be able to withstand long life cycles, be able to operate in harsh conditions which can involve high levels of vibration, exposure to the elements and temperature extremes as well as cope with every day use in the field.

“Ruggedisation, along with reducing size, weight and power, remains a key differentiator in this space,” explains Phil McDavitt, Managing Director of Nicomatic. “Today, connectors and supporting cables are exposed to a wide variety of environmental conditions and have to operate over extended periods of time.”

There is also a growing need to shield sensitive electrical connections from electromagnetic interference (EMI) and pulse (EMP), as well as electrostatic discharge (ESD).

“We’re seeing more of this as the spectrum becomes more congested and contested,” says McDavitt, “especially at a time when electronic and information warfare are becoming

more prevalent along with the push towards more drones and the growing use of robotic systems.

“We talk to customers and they are now asking about the shielding options that we can provide. Obviously, the specifications will be determined by the system under development but, in response to customer requests, we are now able to offer a scale of shielding to work with.”

Many military platforms under development also need to be able to transmit data such as high-resolution, multispectral imagery. As such connectors need to be able to support a broad range of different mission requirements. The military connector space is seeing growing demand for higher data rates, and companies are being steered by their customers to develop new high-bandwidth, radio-frequency (RF) and data connectors capable of functioning in the multi-gigahertz and multi-gigabit ranges.

Environmental concerns

When it comes to designing in a connector, the environment in which it will operate will always be of

Above: Nicomatic’s range of DCMM connectors are light weight but are still able to deal with extreme conditions

particularly importance.

“Where will the cable assembly be used? Will the conditions be sandy or corrosive? Does the connector need to be able to withstand high-vibration events and will it be mated and unmated frequently? All of these have to be taken into account when designing for military use,” McDavitt explains.

Connectors also have to be able to deliver when it comes to performance.

Are they going to be required to carry power and signal and what are the bandwidth requirements likely to be?

Connectors play a critical role in electrical and electronic systems; yet, interconnect requirements are frequently one of the last design issues to be taken into account and that often occurs at the end of the product design phase.

“If you look at the recent announcements at the Defence and Security Equipment International exhibition (DSEI) then it could be five years before we are engaged in developing and supplying the connectors and cables necessary for a particular project,” says McDavitt. “In terms of the UK, many of the projects under development are not about new innovative designs, much of that work is being out on the back-burner, rather it is about using existing technology at a time when defence budgets are under strain.”

Talking to a number of companies for this article it appears that the importance of good design is only ever really appreciated when the connectors used are either poorly manufactured or incorrectly specified.

“The quality and reliability of the connector is certainly critical and will directly influence the system’s performance and its reliability,” says McDavitt. “If connector selection is not given proper consideration, then the entire application can

be left exposed to poor levels of performance and reliability issues.”

However, McDavitt doesn't think that the approach and attitude towards connector design will change, any time soon.

“With these types of projects there will always be levels of discussion that will ultimately filter down to power supply and connector companies, like ourselves. It's a well-defined process. However, it would help if we could get involved sooner and it would save a lot of time and avoid the risk of redesigns.”

The need to address reliability and quality was on display at the DSEI exhibition last month where a large number of connector companies were in attendance.

Lemo demonstrated its M Series High Power range which comprises of miniature high density ratchet-locking circular connectors that are suitable for use in harsh environments and are intended for applications such as soldier equipment, communications equipment and vehicles electronics.

Smiths Interconnect showed off the relaunched HBB series of single pole high power 300A and 500A circular connectors which have also been designed with extreme conditions in mind.

Nicomatic took the opportunity to introduce its DLMM range of metallised composite 2mm pitch

connectors, which can not only deal with extreme conditions but weigh in at less than 60% of its Micro D counterparts.

These connectors are available with 4-32 signal contacts, 1-8 high power or coax contacts, or a mixed arrangement of signal and high power/coax contacts in the same connector body.

“We have made these devices available in board-to-board, board-to-wire and wire-to-wire configurations for wire gauges of AWG 12-30 and in through-hole or surface-mount styles,” explains McDavitt.

The connectors on display were addressing key trends in the market from miniaturisation to lower weight and EMC protection.

“There's a move towards using composite materials that are lighter, but just as tough as traditional materials – in many cases we can save between 20-40 percent in terms of weight and the modular approach we take means that you don't have to go from one shell size to another. You have the flexibility to add up to 16 pins in one connector and that is a real benefit when it comes to prototyping. Designers appreciate that flexibility.”

Signal integrity

Another issue when it comes to cable and connector selection in the



“Ruggedisation, along with reducing size, weight, and power, remains a key differentiator in the military connector market.”

Phil McDavitt

military space is the issue of signal integrity.

Today, connectors have to ensure that the signal that they receive is passed through it as purely and cleanly as possible and that is an increasing challenge as speeds go up and voltages decrease.

Providers of interconnect technologies are seeing greater demand for smaller connectors but with more complicated cable systems and a need to handle very fast and clean digital signals.

“Signal integrity in terms of the design and its management is now more important,” explains McDavitt.

“In the past there were rarely any specifications associated with this. You would supply a connector with a signal pin but there would be no specifications in terms of data.

“Today, newer connector releases have already been tested and qualified and because we have our own analysers in-house we can now test connectors should a customer ask us for something we haven't got. That ability to provide a proper pass or fail test means that we can test connectors far more quickly.”

According to McDavitt companies, like Nicomatic, are looking to extend their testing capabilities.

“Testing in the past focused on electrical and mechanical testing, now we are having to extend those tests into the digital world and to some other areas such as higher power handling. How much current can a connector handle if it's been specified for 3-5A but expected to handle 10A over a short period of time? We are helping customers to better understand the capabilities of connectors.”

The military market is evolving rapidly and the move to more mobile military systems is certainly a challenge as the demand grows to combine data with video and communications, leading to even more pressure in designing efficient and capable connectors.



Left: Smiths Interconnect unveiled its relaunched HBB series of single pole high power connectors at this year's DSEI, along with its existing portfolio



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Rival networks emerge to capitalise on 5G

The advent of 5G sees two network standards emerge to exploit the connectivity that it offers. **Alex Brinkley** considers the performance and merits of NB-IoT and LoRaWAN



The first release of the new 5G standard made headlines, partly because a completely new standard is a relatively rare event, but also because of what the complex 5G standard means for the industry and users.

The 5G standard, developed by the 3rd Generation Partnership Project (3GPP), which includes the European Telecommunications Standards Institute (ETSI) and China Communication Standards Association (CCSA), introduces New Radio (NR). Erik Ekudden, Group CTO at Ericsson, explained that defining NR is a key focus in the first release. In this case, rather than introducing a new modulation and coding scheme, the 3GPP targeted the IoT and connected environments.

“The main focus this time has been on flexibility to support a large range of devices and services with vastly different characteristics, different types of deployments and

frequency allocations that range from below 1 GHz well up into the mmWave bands,” he wrote.

The inclusion of the NR standard will enable Ultra-Reliable Low Latency Communications (URLLC)

Antenna systems, beam forming and energy efficiency have also been addressed to support the significant growth in data volume, from connectivity and machine intelligence, which 5G is expected to bring.

Smart networks

In this connected future, with smart homes, workplaces and cities, it will not be a case of one-size fits all. Self-driving cars, for example, will be processing a lot of data from multiple sources, whereas smart meters or a network of sensors in a building will not require such heavy data processing.

For these tasks, Low Power Wide Area Networks (LPWANs) will be used – Narrow Band Internet of Things

(NB-IoT) or Long Range (LoRa)-based WANs. Both are low power standards, the first is a radio technology, standardised by the 3GPP, the second is based on Semtech’s LoRa IP and curated by the LoRa Alliance.

Richard Landsdowne, Senior Director of LoRa Cloud Services at Semtech, explains that LoRa-enabled silicon is the physical layer, and LoRaWAN is the protocol standard that defines the product. “[The standard] is simple and lightweight, so that it can be used with the simplest, lowest power device,” he said. The network operates on an unlicensed Industrial Scientific and Medical (ISM) sub-1GHz spectrum which is free for operators and device manufacturers to access.

The principle is based on simple energy technology; the worse the signal on a phone is, the more it drains the battery, so by controlling the range and the data rate, the LPWAN can send data further by

sending it slower. LoRaWAN has a data rate of around 293bit/s to 50kbit/s, depending on the distance of the sensor from the gateway. NB-IoT runs at around 250kbit/s.

Portability

LPWAN has improved mobility between networks, continued Landsdowne.

“Unlike cellular systems which are operated by GSM (Global Systems for Mobile communications) members, and users have to attach to a network when they move from one region to another. LoRaWAN operates one-to-one, to help the portability of devices between network operators,” he explained. “With cellular networks, different operators own the spectrum and different areas will have different frequencies and channels. It is not possible to transmit without permission. LoRaWAN is unlicensed, so you can build your own network.”

LoRaWANs can therefore be installed in public, private or hybrid networks indoors and outdoors. Landsdowne likens installation to adding a Wi-Fi box. LoRaWAN signals can cover up to 30 miles (48km) per gateway in open environments. Transmission current is 18mA at 10dBm and 84mA at 20dBm allowing for use with devices that can be powered by coin cell batteries. NB-IoT sensors consumer 220mA at 23dBm and 100mA at 13dBm.

A city council can use LoRaWAN to create a network for a smart city. Landsdowne cites a project that is in its infancy – waste collection. Sensors in bins can transmit when the bin is full, so the council only collects ones that are full. Another example of long battery life is smart parking. It is estimated that 15% of traffic on the roads is made up of cars looking for somewhere to park. Spaces with sensors, linked to a booking app on a smartphone can reduce congestions and pollution.

LoRaWAN has been built from the ground up for the IoT, explained Landsdowne. Revision 1.01 and

1.02 included the ability to join a server. A LoRa device can join the network by sending a request. “The whole standard is based on things being asleep,” he joked. The device assumes someone/something is listening and sends a join request.

Once it receives the security log, it goes back to sleep. The fact that the device does not have to wake up each hour contributes to the low energy consumption, compared with devices that send a signal each hour to ‘check in’.

Devices may be in the field for 10 to 20 years, and updates will be necessary. Maintenance or service updates can be expensive in terms of capital equipment and labour. Over-the-air software updates are the standardised – and cost-effective way - to update, Landsdowne believes. Later standards will allow people to connect multiple networks or services and update them, he added.

NB-IoT

Like Wi-Fi, the LoRa frequency is open. NB-IoT, however, is based on Intel’s NB-LTE technology and technology from telecoms giants Huawei, Nokia and Ericsson. Users purchase connectivity or bundle services from licensed members to cover a specified area.

Using the LTE cellular infrastructure restricts NB-IoT to outdoor, public networks with which it maintains a synchronous connection.

NB-IoT is designed for machine connectivity and is focused on Industry 4.0 applications, said Phil Evans, UK Head of TUV SUD’s Telecoms Group. The group provides testing services, product certification and qualification across industries which include transport, medical and manufacturing. It is deployed within the LTE spectrum and can use frequency resource blocks within a conventional LTE carrier or it can use unused frequency in the guard band between radio bands. The guard band is designed to prevent interference

between devices when they are transmitting simultaneously.

According to Rohde & Schwarz’s market segment manager, IoT, Feng Xie, the 3GPP standard, from release 13 will dedicate standards address machine communication, developing and defining features. In a tutorial, he revealed that in release 14, there is a defined maximum transmission power and in release 15, there will be wake-up signal and early data transmission to address the power consumption for IoT devices.

The standard requires 200kHz bandwidth and can therefore run next to existing cellular networks, to benefit from that network’s security and privacy features. This also extends to security measures inherited from LTE, for example the SIM card and embedded security garnered from 2G, 3G and 4G networks.

There are examples of LoRaWANs around the world, from keep track of bicycles in Amsterdam to a smart city pack offered by a South Korean telecom operator. The LoRa Alliance reports that there are 83 public networks operating in 49 countries around the world. Adoption in the UK is sluggish, although Landsdowne reported that there are small and private LoRaWANs and that the Scottish National Executive has approved LoRaWAN for all public services and hospitals in Scotland.

According to the GSM Alliance, 40 countries are expected to roll out NB-IoT networks in the near future.

Estimates of how many connected devices will be installed varies wildly, from around 13bn to over 75bn in five years’ time. There is agreement that the IoT will continue to grow and that 5G technology will support that growth. New products and services will be developed which could impact edge, cloud and data centres. While NB-IoT and LoRaWAN jostle for position, a global, scalable approach is likely to see the most success for operators and consumers.

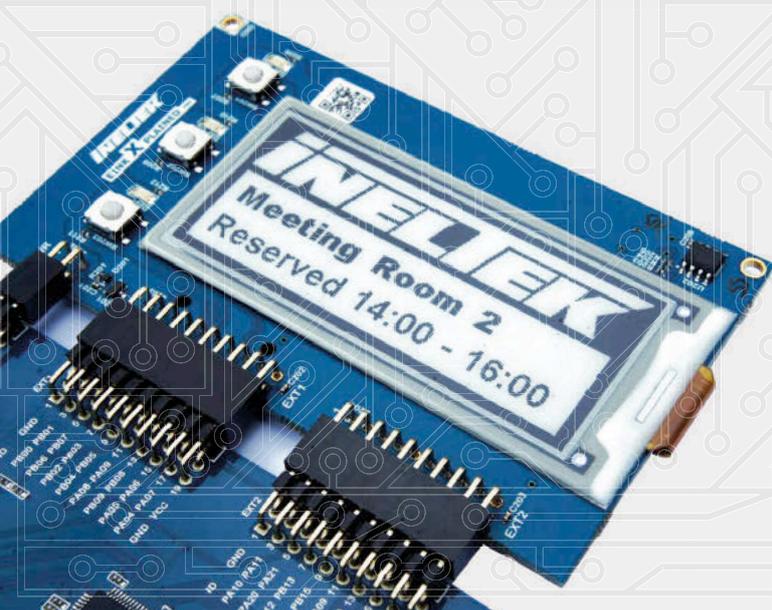


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