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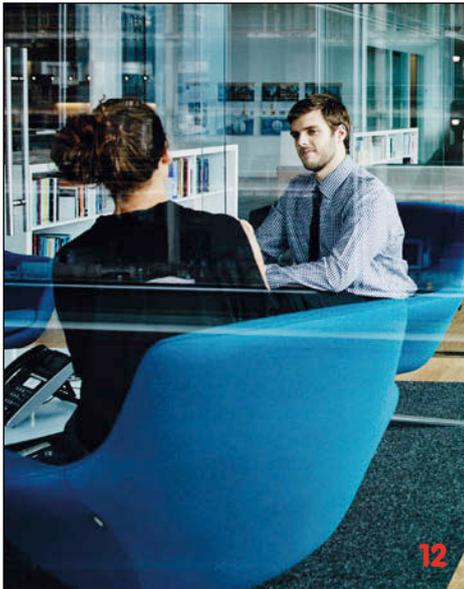
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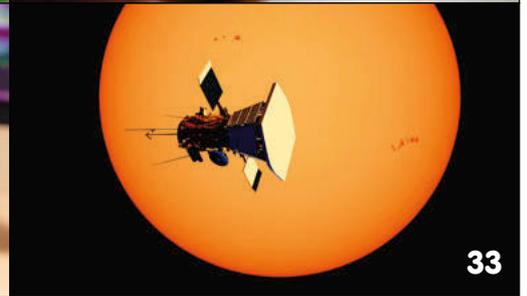
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A shock to the system

AS THE CORONAVIRUS CONTINUES TO SPREAD THE IMPACT ON THE ELECTRONICS INDUSTRY COULD PROVE SERIOUS



As the crisis around the coronavirus continues to grow the potential impact it could have on the global electronics industry is a concern. The production of electronics components - such as memory and displays - has already come under pressure. Prices are beginning to increase and automotive companies, like Hyundai, have started to report component shortages.

Wuhan, the city at the centre of the crisis, with a population of over 11 million is a major hub for industry producing automobiles, electronics, optics, and fibre-optics, and is home to hundreds of companies, including the likes of Google, Avnet, Apple and Facebook.

Analysts have started to issue warnings that the coronavirus could create massive problems for the global supply-chain.

Beyond factories in Wuhan, manufacturing throughout China could start to be affected. Having just celebrated the Chinese Lunar New Year other manufacturing hubs such as those in Guangdong Province and Shenzhen or in the Shanghai - Suzhou - Nanjing corridor could find themselves vulnerable as a result of workers who returned home from Wuhan to celebrate with their families.

Amazon, Facebook and Microsoft have already restricted travel to the area and suppliers and purchasers are scrambling to adjust to rapidly changing market conditions.

The longer the outbreak persists, so the greater the damage to industry's supply chains and the broader economy.

The coronavirus has been compared to SARs, which broke out almost twenty years ago, but that comparison is misleading.

Today, the Chinese economy is far more embedded into the global economy than it was in 2002 and is now an essential part of the global supply chain - supplying components to all four corners of the planet.

China has also become an enormous market in its own right and its annual economic output has multiplied more than eightfold since 2002 to nearly \$14 trillion, up from \$1.7 trillion, according to the World Bank.

Customers in China accounted for about \$20 billion of Intel's revenues in 2019, that's 28 percent of its total for the year, while for Qualcomm, China accounts for 47 percent of its annual revenue - something like \$12 billion.

The virus comes at a difficult time for the electronics industry after what had been a challenging 2019. Its effect on supply chains, which have grown increasingly complex, is going to be hard to predict. The longer this crisis goes on, the greater the risk will be for the entire industry.

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

“Analysts are already warning that the coronavirus could create massive supply chain problems for the electronics industry.”

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Number of 5G devices breaks 200 barrier

THE GSA REPORTS THAT THE NUMBER OF ANNOUNCED 5G DEVICES HAS BROKEN THE 200 BARRIER FOR THE FIRST TIME. **NEIL TYLER** REPORTS

The Global mobile Suppliers Association (GSA) has reported that the number of announced 5G devices has broken the 200 barrier for the first time.

With 208 5G devices now announced from 78 vendors, the number of commercial devices has more than doubled in the last five months, having surpassed the milestone of 100 devices from 41 vendors in August 2019.

“During 2019, the number of announced 5G devices grew rapidly, starting with a few announcements and then gathering pace as operators in various parts of the world launched their first commercial 5G services,” said Joe Barrett, President, GSA.

“This growth has continued into 2020 with the number of announced 5G devices exceeding 200 for the first time. Not only is this a symbolic milestone, but it also means we are starting to be able to identify trends in spectrum support and form factors. The diversity of both further reinforces how the industry is working hard to deliver on the 5G promise to markets and operators around the globe.”

The latest market data reveals that over two-thirds (66.8%) of all announced 5G devices are identified as supporting sub-6 GHz spectrum bands and just over one-third (33.6%) are understood to support the mmWave spectrum. Slightly more than 27% of all announced devices are known to support both mmWave and sub-6 GHz spectrum bands. The bands known to be most supported by announced 5G devices are n78, n41, n79 and n77.

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Secure Thingz achieves SESIP certification

Secure Thingz has announced that its Secure Boot Manager has been assessed and certified according to the Security Evaluation Standard for IoT Platforms (SESIP).

The assessment has been conducted by the independent security lab, Brightsight, which is fully licensed by TrustCB, a commercial Certification Body specialising in certifying IoT security products.

Secure Thingz' SBM is a secure bootloader for microcontrollers, which delivers a set of core features including the implementation of a formal Root of Trust plus robust lock-down of the device, provisioning and management of cryptographic keys, and fully authenticated loading of applications, patches and updates. The SBM is implemented dynamically based on developers' decisions and device-specific functionality.

Independent audit and certification of IoT devices help operators to manage cyber risks and supplier security claims.

DesignSpark 'Power Technology Hub'

RS Components has announced the creation of a new technology hub on its DesignSpark website.

A new resource for design engineers and students, it includes free design tools and a breadth of key product and system development information.

Sponsored by Maxim Integrated, The DesignSpark 'Power Technology Hub' features learning material, application examples, new products, reference designs and free software tools for use by design engineers working on the next generation of power systems for the diverse requirements across a multitude of applications.

“Our new power tech hub is not only an excellent learning resource for design engineers who are new to power design but is also a point of reference for seasoned designers looking to discover the latest power products and technologies,” said Mike Bray, Vice President of DesignSpark at RS.

Samsung unveils Gen 3 high-bandwidth flash

Samsung has announced the launch of 'Flashbolt', its third-generation High Bandwidth Memory 2E (HBM2E).

The 16-gigabyte (GB) HBM2E is intended to maximize high performance computing (HPC) systems and help system manufacturers to advance their supercomputers, AI-driven data analytics and state-of-the-art graphics systems.

The 16GB capacity is achieved by vertically stacking eight layers of 10nm-class (1y) 16-gigabit (Gb) DRAM dies on top of a buffer chip. This HBM2E package is then interconnected in a precise arrangement of more than 40,000 'through silicon via' (TSV) microbumps, with each 16Gb die containing over 5,600 of these microscopic holes.

According to Samsung, the device is able to provide a highly reliable data transfer speed of 3.2 gigabits per second (Gbps) by leveraging a proprietary optimised circuit design for signal transmission, while offering a memory bandwidth of 410GB/s per stack. The HBM2E can also attain a transfer speed of 4.2Gbps, the maximum tested data rate to date, enabling up to a 538GB/s bandwidth per stack in certain future applications. This would represent a 1.75x enhancement over Aquabolt's 307GB/s.

Samsung expects to begin volume production during the first half of this year.



UK self-driving record

NISSAN LEAF BREAKS UK RECORD FOR LONGEST SELF-DRIVING CAR JOURNEY. **NEIL TYLER REPORTS**

A Nissan Leaf, fitted with GPS, radar, Lidar laser measurement technology and cameras, has successfully driven itself for 230 miles in what is the longest and most complex journey yet to be undertaken by an autonomous vehicle in the UK.

During the journey, from the company's technical centre in Cranfield, Bedfordshire, to its manufacturing plant in Sunderland, the car travelled on a range of roads alongside traffic, from country lanes to the M1 motorway.

Nissan said that the vehicle's advanced positioning technology allowed it to assess its surroundings and make decisions about how to navigate, and its autonomous technology was activated whenever the vehicle needed to stop, start or change lanes.

Part of the £13.5m HumanDrive project, which is jointly funded by the British government and an industry consortium of nine partners including Nissan and Hitachi, the aim is to develop an autonomous vehicle control system that resembles a natural, human driving style. The vehicles have also been driven on test tracks as part of the project.

The Society of Motor Manufacturers and Traders has said, in a 2019 report, that the UK has significant advantages over other countries in pushing autonomous vehicles and that it could provide a £62bn economic boost by 2030.

Next generation micro-LED tech

EpiPix, a new spin-out company from the University of Sheffield that is developing the next generation of micro-LED technology, was officially launched at the end of January.

The company is developing and commercialising 'game-changing' micro-LED technology for photonics applications, such as micro-displays for portable smart devices, augmented reality (AR), virtual reality (VR), 3D sensing and Li-Fi.

Underpinned by research from Professor Tao Wang and his team at the University of Sheffield's, the company is collaborating with global corporations on next generation micro-LED product developments.

This pre-production technology has

already been demonstrated for multi-colour micro-LED arrays on single wafers with high light efficiency and uniformity. EpiPix is developing micro-LED epiwafers and product solutions for red, green and blue wavelengths with micro-LED pixel size ranging from 30 microns down to 10 microns and with less than five microns diameter prototypes demonstrated successfully.

Dennis Camilleri, CEO and Director of EpiPix, said: "This is an exciting opportunity for turning excellent science into profitable micro-LED products. We are already engaged with industry customers in order to align EpiPix with their technology roadmaps."

Plessey and WaveOptics announce strategic partnership

COMPANIES LOOK TO DEVELOP NEW OPTICAL MODULE. NEIL TYLER REPORTS

Plessey, a developer of microLED technology for the augmented reality (AR) and mixed reality (MR) display market, has announced a strategic partnership with WaveOptics, a designer and manufacturer of diffractive waveguides.

The partnership will focus on the creation of a new optical module, designed specifically for the next generation of smart glasses. The module will incorporate Plessey's high brightness microLED, native green full HD display along with WaveOptics' Katana waveguide technology and projector design.

According to the companies, the module will be the smallest and lowest mass AR display module available on the market. The full HD microLED display from Plessey is the result of its previously announced partnership with Compound Photonics, to combine Plessey's GaN/Si microLED display technology with Compound Photonics' leading digital low latency backplane and high-performance NOVA display driver architecture.

"For the first time, customers will be able to buy the lightest, ultra-low power module which combines our unique technologies."

Dave Hayes

The next generation of AR and MR systems depends on a technological leap in the performance of the optical module, with advances in image quality, brightness, resolution, and efficient power consumption being sought to ensure new AR and MR systems are able to offer an improved practical and visual experience.

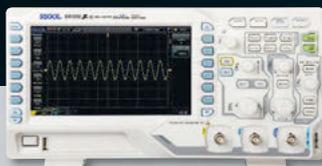
The collaboration between Plessey and WaveOptics will bring together Plessey's GaN/Si microLED display technology and WaveOptics new generation waveguide technology and projector design.

"This partnership will create a new product opportunity for companies building AR wearables," commented David Hayes, CEO WaveOptics. "For the first time, customers will be able to buy the lightest, ultra-low-power module which combines the unique combination of WaveOptics and Plessey technologies. This is a crucial development to enable this technology to reach the consumer market in 2020."

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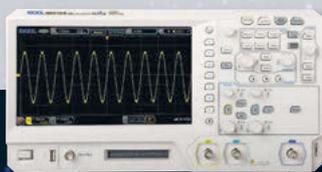
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According to new research from Global Market Insights, the global market for wireless charging is set to be worth in excess of \$14 billion by the end of 2024.

The technology landscape of global wireless charging market is categorised into three broad types: electromagnetic inductive charging, electromagnetic resonant charging, and uncoupled radio frequency (RF) wireless charging.

The study found that the wireless charging concept is being utilised extensively across a number of industrial domains, from manufacturing, to healthcare and automotive. Its growing popularity is characterised by the technology’s potential to enhance charging mobility of numerous IoT-powered devices.

In the automotive landscape, remote charging technology is being used by key industry players like BMW, that has revealed plans to commercialise a wireless charging pad, designed to charge its hybrid 530e iPerformance model. The charging station will connect to a power outlet in the garage, charging the car wirelessly when parked in the correct position.

The charging station will allow the 9.5kWh battery to reach full charge in just 3.5 hours.

Charging-on-the-go is also being explored by Qualcomm, with their development of the Halo wireless charging system, which is leveraging a remote charging technology called Dynamic Electric Vehicle Charging to

Wireless charging market set to boom

THE GLOBAL MARKET FOR WIRELESS CHARGING IS SET TO EXCEED \$14 BILLION BY 2024, ACCORDING TO NEW RESEARCH. **NEIL TYLER** REPORTS

supply power to vehicles moving at speeds of up to 70 mph. This is achieved through a 100m test track, with a wireless charging system installed underneath, designed to provide power specially for modified Kangoo electric vans, fitted with two 10kW charging pads.

Automotive applications are a major R&D focus for wireless technology researchers and research and development within the remote charging landscape tends to be largely focused on advancing futuristic technologies in the automotive sector, like dynamic wireless charging, which allows power supply even to moving vehicles.

In order to bring about progress in this space, smart roads are also being looked into by various authorities across the globe.

The Swedish government recently commissioned the

first smart road in the world, that is designed to power both an electric bus and a truck via inductive charging. The £11 million project, developed by ElectReon, and backed by the government, is performing initial tests on a 1.6km stretch of road.

Meanwhile, Volvo Group Venture Capital has also announced their intention to fund

Momentum Dynamics, which is working on delivering high-power inductive charging for EVs.

The investment is aimed at promoting higher adoption of wireless charging in electric vehicles, connected to an electrical power grid without cables or wires.

“The wireless charging industry has attracted a variety of companies,” explained Saloni Walimbe, Research Content Developer at Global Market Insights, “from start-ups to large conglomerates. Some major participants in the market now include, Qualcomm, PowerbyProxi, WiTricity Corporation, and Energizer Holdings.”

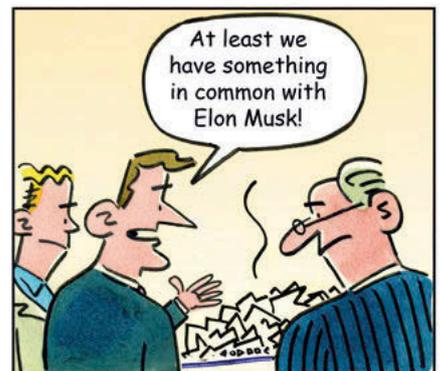
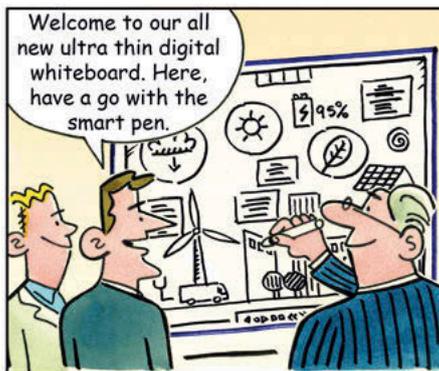
WiTricity, founded in 2007, is a pioneer in wireless charging technology, with several innovative and patented wireless electricity solutions. Spun-off from a wireless technology developed in the early 2000s by a team of physicists from MIT, and led by founder Professor Marin Soljacic, the company now offers several sophisticated wireless power transmission solutions to enable efficient long-distance power transfer in real-world applications.

According to Walimbe, “Many peripheral businesses are also embracing the technology, in order to inculcate a seamless charging experience into their offerings.”

For instance, OnePlus, the mobile phone manufacturer has recently joined the Wireless Power Consortium, which suggests that future product launches, including the impending OnePlus 8 launch, may feature wireless charging compatibility.



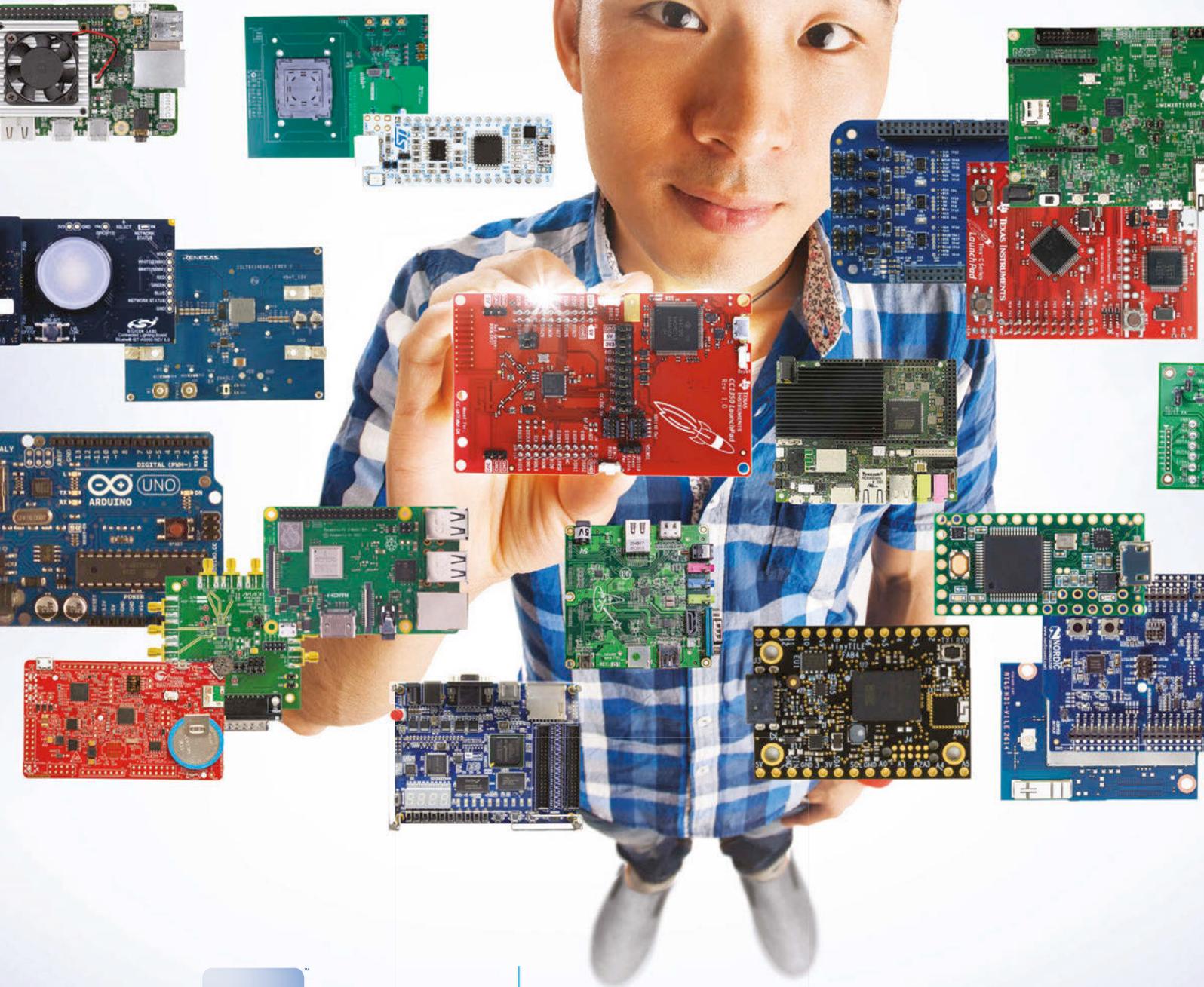
“The wireless charging industry has attracted a variety of companies, from start-ups to large conglomerates.”
Saloni Walimbe



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Today's modern office employs a growing number of smart technology solutions, whether that's multi-line VoIP phones systems or better data management, and technology is also being used to improve how office space and people are managed.

Artificial intelligence, the internet and new forms of communication technology are creating a modern workspace and the pace of change is accelerating.

While Industry 4.0 has tended to be associated with factories, technological improvements that support greater efficiency, interconnectedness, productivity and sustainability have also found their way into every aspect of office life.

Surveys show that a growing number of businesses expect, and are planning for, more of their workforce to work remotely. Business leaders are looking at radical approaches as research suggests that over 75% of employees could end up working remotely by the end of this decade.

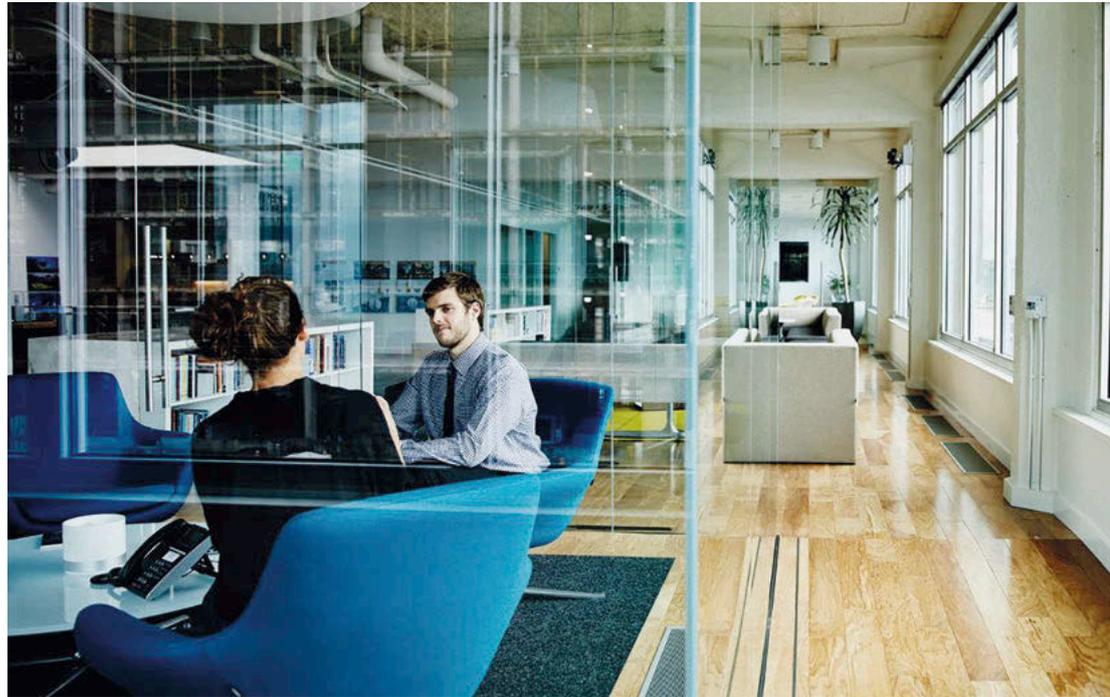
How can you use technology to combine productivity improvements with the increased levels of freedom and flexibility that remote workers say they enjoy? Flexible working has been found to make employees feel more valued and reduced levels of employee turnover – a significant cost to businesses.

In response, companies are looking at real time collaboration, integrated communication platforms and cloud computing to enable more of their employees to work more effectively – whether at home or in the office.

The Internet of Things is driving much greater connectivity and the interconnected smart office is empowering office workers, enabling them to work more effectively.

Over the years the way we communicate and interact has changed drastically, as Jeremy Keefe, Regional Vice President Sales, UK & IRE, Poly explains.

"The office has been around and



THE SMART OFFICE

The modern office continues to evolve embracing new technology to improve space, people management and deliver operational efficiencies. By **Neil Tyler**

been evolving for years. While there's a drive for more flexible working I think we, as humans, like to collaborate and that's not changed. What has changed is the way in which people communicate. There are three big drivers here and that includes: flexible office space; the growth in huddle rooms and mobility and they are massive commercial drivers for companies like Poly, who specialise in communications technology.

"Many companies now have regional offices offering the chance to be more flexible in the approach they take in how people work, and we are seeing innovative office spaces being developed."

Keefe makes the point that when people come into an office they now expect much greater flexibility, whether

that's in terms of a room system or when it comes to audio or video communication.

The successful office is one in which collaboration between individuals, regardless of location and proximity, is possible.

Offices are seeing more screen sharing and people are embracing real-time collaboration via the use of VR and AR, which is helping to expand the scope of projects on which different remote teams can work.

"Today, people want to be able to collaborate and share, wherever they are. That's the biggest challenge we face in this space and it's not helped by the complexity of systems that currently exist," says Keefe.

"Talk to any enterprise and the majority are using three or more

different platforms. So, embracing greater simplicity is critical.”

Efficient resource management

Using resources efficiently is a key driver in the office and, last year, Bridgetek expanded its PanL portfolio to better use assets within the office and significantly reduce day-to-day operational costs.

“The PanL Desk Manager (PDM) enables companies to automatically manage shared working facilities where ‘hot desking’ policies are in place. It makes it possible to book desks, so that companies can utilize all the available space,” explains Gavin Moore, customer support manager, Bridgetek.

Every desk within the PDM system has a PanL35L display unit placed on it, which is then connected to a web portal via the office Wi-Fi access points.

These displays have a 3.5-inch 320x240 resolution TFT, plus an RGB LED strip indicator, a built-in buzzer and have 802.11b/g/n-compliant Wi-Fi connectivity.

“Staff can set everything up remotely through Microsoft Outlook or by utilising a downloadable mobile app,” says Moore. “By referring to the Desk Viewer (which gives an accurate depiction of the office floorplan), it is possible to see where desks are available without having to waste time searching throughout the building.”

In addition, it is possible to determine who has been assigned desk space - allowing them to book neighbouring desks if they are working on a particular project with colleagues.

“The reserved desk space can be claimed via a QR code,” Moore explains, “while an automatic release feature means that if the person who has booked the space fails to show up on time, it can be made accessible again to other prospective users.”

The electronics at the heart of each PanL35L in the PDM system comprises of a dual-core 32-bit LX6 microcontroller and a sophisticated

BT813Q graphic controller.

The PDM’s web portal gives facilities managers a detailed overview of all the desks in their inventory and this can be applied to a floor, an entire building or even to multiple sites.

“This system makes it possible to analyse supply and demand - so that further desk resource may be brought in as required. Users can also examine booking profiles, set time slot duration, allocate desks to certain employees, determine the maximum number of desks that can be booked and add new desks onto the system,” according to Moore.

The company’s PanL Room Manager (PRM) comprises of display units, MEMS microphones, ambient light sensors, buzzers and speakers and is located at the entrance to a room and connected to a centralised hub, with the booking software capable of interfacing with Microsoft Outlook. Office workers can see which meeting rooms are free and make alterations to existing bookings. Access to the room requires entry of a passcode on the display’s touchscreen or swiping of an RFID tag in the office worker’s identity badge.

Embracing new technology

As with every aspect of modern life artificial intelligence (AI) has established itself in the modern smart office and is being used to increase productivity and boost overall levels of efficiency.

IBM has recently introduced AI into its TRIRIGA solution to help facility management to use their office space and deliver a more engaging workplace



“The PanL Desk Manager enables companies to automatically manage shared working facilities.”

Gavin Moore

experience.

TRIRIGA is an Integrated Workplace Management System that looks to combine occupancy data from sources, such as WIFI and/or IoT sensors, with newly embedded AI.

Through the smart application of data TRIRIGA can be used to generate information and insights into how office space is being used and can enable a much smarter data-driven decision making process about the way workspaces are managed - reducing space wastage and saving on operating costs.

According to a report from commercial real estate services firm JLL, 30-40% of commercial space is underutilised. Embedded AI can help identify occupant trends and patterns, down to a single floor, to better anticipate and manage employee occupancy needs, adjust office layouts and address relocation requests.

TRIRIGA comprises of an Assistant, which is a smart, conversational AI tool which uses natural language processing to help users engage with the spaces around them. It can be used to coordinate staff schedules and reserve conference rooms, as well as service requests such as lighting and catering, or locate a colleague’s assigned workspace.

“Employees are a key element to organisational growth and development, driving companies to create cost-effective and engaging workplaces that help attract and retain top talent,” explains Kareem Yusuf, Ph.D., general manager, AI Applications, IBM. “The implementation of TRIRIGA with embedded AI provides corporations and facility managers with insights into how they can more effectively utilise space across their enterprise.

This technology can help companies address the growing expectations of today’s modern

Below: The PanL desk management system





workforce and achieve better business results.”

By enabling these types of tasks to be handled by AI, a lot of time and money can be saved and productivity can be given a real boost.

Alongside AI, however, diverse technologies such as 3D printing and virtual and augmented reality are predicted as having a revolutionary impact on the smart office.

A large number of VR/AR devices have come on to the market, including the Oculus Rift and the HoloLens from Microsoft and while their impact is limited, at present, they are expected to change the workplace in terms of how people work together.

In the future we could be doing everything in an immersive virtual world or an augmented world that has been integrated into the real world of the office.

When we talk about the office we tend to focus on the technology with which users interact, however, underpinning all of this is the development of cloud computing.

With billions of pounds being invested in the growth of cloud computing Amazon, Google and Microsoft are all providing cloud solutions to businesses and the market is booming.

Businesses using the cloud will be able to grow significantly without having to move office or even buy more hardware, with applications being stored and operated online. Not only that, as more workers are

expected to work remotely the cloud will make it easier to manage them.

Workers will be able to access the office from anywhere, collaboration among teams will be enhanced and communication will be simpler and easier.

Energy efficiency

With the focus on climate change energy saving and environment friendly solutions are also being applied to the office workplace.

Companies are looking to use energy-saving lighting and more office buildings are integrating renewable energy solutions, such as solar and wind, to meet high energy needs.

AI is being used to monitor energy usage and to improve energy efficiency while more efficient air conditioners, advanced window controls and better building materials are being used to make offices even greener.

“We want to make people more comfortable and productive and the office more efficient,” explains James Thackrah, Segment Lead at Schneider Electric.

“People are working in new ways and building managers need to improve space management, people management and operational efficiencies. By optimising space it is possible to free-up as much as 15 per cent of the property which means you can use the facility more effectively.

“A comfortable environment in which people can find a desk or book a room can provide a productivity gain of 25 minutes a day per employee, but more than that by actively monitoring

light, temperature, humidity, CO2 and noise levels you can improve occupant well-being.”

The company’s EcoStruxure platform uses wireless sensors, the cloud and real-time data to provide workplace analytics.

“This suite of tools and services has been designed to make it easier to implement the IoT and simplify the collection of data from devices around the organisation. It uses standard open communication protocols and the data can be analysed in the cloud or at the edge,” according to Thackrah.

The company has developed the Workspace Advisor Service that delivers data and analytics that can be used to monitor well-being, space optimisation, the employee experience and operational efficiencies.

“For example, the operational phase of a building accounts for 75 per cent of a building’s costs, so if we can open up space or close off those areas that aren’t being used we can cut costs in terms of heating and lighting, for example. That not only saves money but is much better for the environment.”

The company has also developed the EcoStruxure Engage Enterprise app which, as Thackrah explains, is intended to deepen the employees’ connection to the workplace environment.

“The workplace environment is the number one priority for most businesses, and this app enables users to access rooms, navigate through offices, file a maintenance report or manage temperature, lighting or blinds. You can add to the app and it is easily refined so that it grows with the needs of the business.”

Simply put this, along with other smart technology, is helping to translate data into actionable intelligence helping office workers to work smarter and making it possible to do so in a better environment, which is both energy efficient and more sustainable.

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On the charge

Nexeon CEO, Dr Scott Brown, talks to **Brain Wall** about the company's new Li-ion battery technology

The UK throws away around 600 million household batteries every year, with two-thirds, many containing heavy metals such as lead and mercury, sent to landfill. These will eventually break down and the dangerous chemicals may leach out, resulting in soil and water pollution, in turn causing damage to our natural ecosystems and wildlife.

But it doesn't have to be that way, insists Dr Scott Brown, chief executive officer, Nexeon, this being the company whose new Li-ion battery technology uses silicon in place of carbon as the anode material.

What advantages does that bring?

"Our approach at Nexeon has the potential to improve significantly the performance of rechargeable batteries and, I believe, can have a major impact on environmental sustainability. Compared with carbon, silicon has ten times the capacity for lithium on a weight basis and three times its capacity by volume."

In basic terms, that means better batteries, which are key to the faster adoption of electric vehicles, for example. By the same token, renewable energy technologies – e.g. wind and solar – need better energy storage systems to increase their effectiveness, while rechargeable batteries in consumer devices help to reduce the impact that batteries have on the environment.

"It is now widely accepted that silicon materials are the key to improved energy densities in Li-ion batteries," Brown points out, "and that the winning technology will be both high performance and low cost."

As a battery materials and licensing company working with product OEMs and battery companies to enable the next generation of lithium-ion batteries, Nexeon's silicon materials enable much greater energy density and battery capacity to be achieved, providing lighter batteries with more power and longer lifetime between charges.

In the UK, Nexeon has commissioned a state-of-the-art process development and manufacturing facility at Abingdon, Oxfordshire. This has been built to be highly versatile and to handle a wide range of

materials and reagents. It also enables the company to understand how its materials will perform in commercial production conditions. What Brown describes as the 'drop-in' nature of Nexeon's materials means they do not require substantial changes to existing Li-ion battery manufacturing processes.

"Getting the highest performance from Li-ion rechargeable batteries requires research and a sound understanding of each of the component parts of cells and the way they interact," he points out. "Anode materials must be optimised to work in conjunction with conductive additives, electrolytes and binders. Real-world operating conditions are as important as theoretical parameters in delivering user benefits across challenging applications. Equally importantly, at Nexeon we are fortunate to be working with some of the best carbon, electrolyte and binder companies in the industry."

Lithium-ion rechargeable batteries will remain the technology of choice for the foreseeable future, he believes, citing a number of advantages that Li-ion delivers when compared with other mature technologies by offering the best combination of: Energy density (light weight, small volume); low self-discharge (retains its charge when not in use); established and low-cost manufacturing and a wide range of formats.

"Other battery technologies are in development, but none is yet ready to challenge the performance of lithium ion. Today's applications demand ever greater battery performance, so lithium ion batteries need to work even harder, as that is where the future lies. The lithium ions in a Li-ion cell move from the cathode to the anode as the cell is charged, and back again on discharge. To achieve ever-improving energy density, we need a cathode that contains more lithium and anodes that can absorb more lithium."

Expansion issues

Traditional lithium-ion batteries use graphite in the anode: a graphite-based battery in a smartphone stores enough energy to watch movies for about two hours.

"Replacing the graphite with silicon will extend the viewing time significantly," confirms Brown. So, why don't all lithium-ion batteries already use silicon anodes, instead of graphite?

"Current forms of silicon expand on charging – and an expanding battery would break the phone."

How exactly do you get over these expansion problems? Nexeon has identified a class of material that the company believes will be one of the 'best-in-class', in terms of energy density, while maintaining physical anode dimensions for long cycle life.

"The rate of take-up of electric and hybrid vehicles is limited principally by anxiety over the range available between charges. Advanced battery technology based on silicon anode lithium-ion batteries accelerates the progress of this important social development. Carbon anodes – the incumbent technology used in lithium-ion batteries – have almost reached their theoretical capacity limit and their future potential is limited."

All of which makes the £10 million SUNRISE project on which Nexeon is embarked timely.



“Project SUNRISE addresses the silicon expansion and binder system issues, and allows more silicon to be used, further increasing the energy density that can be achieved in the cell,” explains Brown.

Innovative silicon anode material with a polymer binder represents a ‘drop-in’ replacement for current graphite anode systems. Lower cost and better performance power sources will reduce the time required for EVs to achieve mass adoption.

“We are about halfway through and have already produced silicon battery materials that have performed better than expected. Samples are now with potential customers for evaluation and initial feedback has been very positive.”

SUNRISE might well prove to be the gateway to creating far better materials for Li-ion batteries – an essential step to achieving electric vehicles (EVs) with greater range (400 miles and above), where range anxiety, cost, charge time or charging station availability are almost all related to limitations of the batteries. Silicon-enhanced batteries with longer life and higher energy density will also be of benefit in consumer electronics products and static energy storage applications.

Spice project

Nexeon is also embarked on a new project to optimise coating technology for its silicon material. This approach will result in improved cell performance and also extend the system compatibility

of silicon anode materials, allowing use of lower-cost electrolyte formulations and lower overall battery cell costs. The project, named SPICE (Silicon Product Improvement through Coating Enhancement), is expected to take 18 months to complete. Focus will be on the use of an optimised coating for improved surface morphology, leading to improved conductivity of the underlying anode material for faster charge rates and sustained capacity of the battery during charge/discharge cycles.

“Using an optimised coating has several important performance advantages, and will further strengthen the case for adoption of silicon anode technology by OEMs and

battery makers globally,” says Brown.

Nexeon’s CEO is greatly encouraged by the rate of take-up of silicon amongst EV manufacturers, notably its use in the fully-electric Model 3 Tesla, which has been winning high praise and garnering awards. “The fact that silicon has already been adopted in EVs is really good news, because the automotive industry is by nature very conservative and Tesla are proving a powerful, positive force in helping to break down such barriers.”

As for Nexeon itself, while taking care of the here and now, it would appear to be a company with its sights firmly fixed on exploiting the substantial future market opportunities that exist for advanced battery materials.



Left: Part of Nexeon’s state-of-the-art manufacturing facility. Below: Nexeon’s pilot and manufacturing plant is based near Oxford.



A real-time operating system (RTOS) is a fast, deterministic operating system that is typically small enough to be suitable for use in microcontrollers (MCUs), making RTOSes suitable for embedded and IoT applications. Developers are moving towards RTOSes because they can help reduce code complexity, guarantee hard timing deadlines, and facilitate reuse of software modules. The structure imposed by RTOS increases the application's maintainability and makes adding features simpler.

Subtle coding choices can, however, result in elusive errors or performance issues in the final product that are not apparent in the source code. To ensure reliable operation, all parts of the application code need to follow best practices in RTOS-based design.

Debugging can be a nightmare since the circumstances that caused the problem are often not known in detail and are difficult to reproduce. RTOS trace visualization, which can be thought of as a slow-motion video of the application's internals, is a good way to detect and correct bugs quickly.

RTOS-based design

The main job of an RTOS is to provide multitasking, which allows for separation of software functionality into multiple "parallel" programs, known as tasks. Unlike general-purpose operating systems, an RTOS gives the developer full control over the multitasking and therefore enables deterministic real-time behaviour.

An RTOS takes control over program execution and brings a new level of abstraction in the form of these tasks. When using an RTOS, the control-flow of the program is no longer apparent from the source code, since the RTOS decides which task to execute at any given moment. This is a fundamental change, similar to the shift from assembly to C programming, as it allows for higher productivity using higher abstraction, but also

STOP GUESSING

Now developers will be able look inside RTOS firmware by using visual tracing. By **Dr. Johan Kraft**

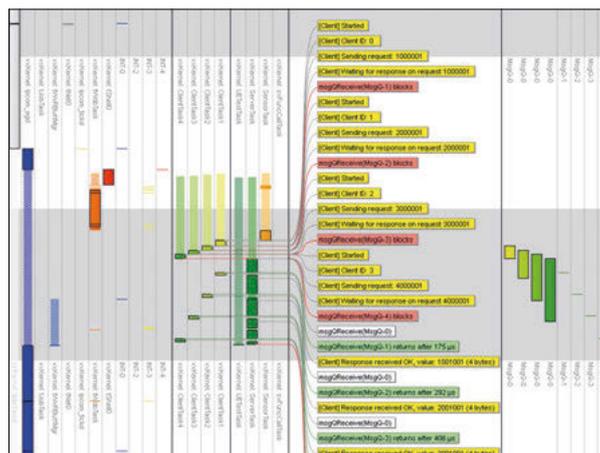


Figure 1. The trace view in Percepio Tracealyzer, showing a vertical timeline of the trace data

means less control over the details.

This double-edged sword can make it easier to design complex applications, but they may turn out to be difficult to validate and debug. While an RTOS can reduce the complexity of the application source code, it does not reduce the inherent complexity of the application itself.

The developer needs to determine how the tasks are to interact and share data using the RTOS services. Moreover, the developer needs to decide important RTOS parameters such as task priorities (relative urgency) that can be far from obvious. Even if your code is written according to best practices in RTOS-based design, other parts of the system may not follow the same principles.

The fundamental problem that makes RTOS-based design difficult is that RTOS tasks are not isolated entities but have dependencies that may delay or stall the task execution in unexpected ways.

There is at least one kind of dependency between the tasks: they share the processor time and tasks often use shared software resources

that require blocking synchronization calls to prevent access conflicts.

Such issues are not visible in the code and often not detectable in unit tests, but show up in the integrated product. This makes them difficult to reproduce for debugging, unless the developer knows the exact sequence of software events.

When the embedded industry moved from assembly to C programming, debugging tools quickly followed with source-level debugging, which made the C code perspective the normal debugging view. Unfortunately, the tools generally haven't evolved beyond this level. An RTOS debugging tool must understand the concept of time, be able to correlate events, and allow developers to observe the real-time behaviour of an application.

This calls for RTOS tracing in the RTOS kernel and optionally also in the application code, intended for host-side analysis.

Good visualization is key to understanding RTOS traces. Many embedded systems exhibit a cyclic behaviour, which means that a trace mostly consists of repetitions of the "normal" pattern. The interesting part

Figure 2. A CPU load graph shows processor usage per task over time



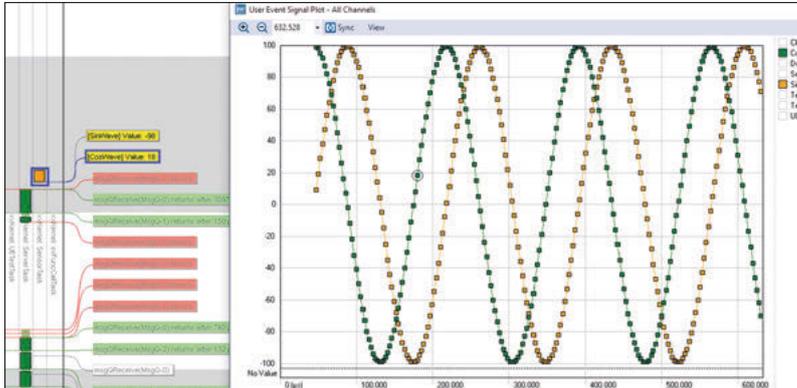


Figure 3. Percepio Tracealyzer supports application data logging and plotting over time

can also be enabled for production use, continuously active to record behaviours and catch errors post-deployment.

Hardware vs. Software Tracing

Tracing can be performed either in hardware (in the processor) or in software. Hardware-based tracing generates a detailed instruction-level execution history, while software-based tracing focuses on selected software events. Hardware-generated trace provides details regarding control-flow and does not impact the execution of the traced system, but it does require special equipment and a trace-enabled hardware platform.

Software-generated trace does not require any special hardware and can even be deployed in shipped products similar to a black-box flight recorder used in aviation. Moreover, software trace allows for storing any application data at these events, while hardware trace is often limited to only the control-flow and possibly global data accesses, assuming a high-speed trace port. Software tracing does induce some CPU overhead, but this is typically not noticeable (a few percent).

Software tracing relies on target-system RAM for temporary buffering of the trace data, but the RAM buffers are usually configurable to allow for balancing RAM usage vs. buffer sizes.

Tracing is especially important for systems that integrate a real-time operating system. A central feature of RTOSes is multitasking, however, this makes software behaviour more complex, and affords the developer less control over run-time behaviour as execution is pre-empted by the RTOS.

The debugging of RTOS-based systems can be dramatically simplified with better insight into their real-time execution. This requires RTOS-level software tracing, where good visualization is key to make sense of the data. More sophisticated visualization makes it far easier to understand the trace, spot important issues, and verify the solutions.

is usually the anomalies, but they can be very difficult to spot in a raw data stream. A graphical presentation makes any anomalies stand out.

Moreover, a debugging tool that understands RTOS events and data structures can extract much more information from a trace than just the basic execution flow.

Seeing is understanding

The primary job for a software tracing tool is to capture events in the target system, from scheduling and RTOS calls to timer ticks and application-specific log messages. A look at a typical event log makes it clear that although this might be useful, textual presentation does not scale to the large amounts of data resulting from software tracing. An RTOS trace spanning over a few minutes can contain millions of events.

To get to the next level the developer needs suitable tools for data visualization.

A better way to present large amounts of RTOS trace data is to use a graphical Gantt-style trace view, which allows for displaying the trace data on an interactive timeline. The developer can zoom out and view a vast amount of trace data, identify abnormal patterns, and zoom in to see the details. A graphical trace view may include not only the RTOS task execution but may also include API calls, application log messages, and other events.

One common issue for embedded system developers is that target

systems tend to be constrained in terms of both CPU power and memory. That is why a diagram can be helpful: it can display the amount of processor time used by each task and interrupt service routine. Armed with this information, a developer can quickly see any hot spots where the load approaches 100 percent over longer periods as well as the amount of remaining CPU time available for adding more features without upgrading the hardware.

To connect back to the debugging aspect of tracing, a runaway task in an application that consumes more CPU than intended will be clearly visible as will tasks using inefficient “busy waiting.”

Tracing API calls captures dependencies between tasks that a tool can visualize in a dependency graph which provides confidence that the application code works as intended and can also reveal bugs related to incorrect API calls.

A good tracing tool should also allow the developer to log custom application-specific data in the trace stream. These events can be used for almost anything, but one common usage is to log important variable values and state transitions from the application code.

Tracing allows developers to detect and prevent these types of issues. It entails recording software behaviour during runtime, allowing for later analysis of collected trace data.

Tracing is most often a development bench activity, but tracing



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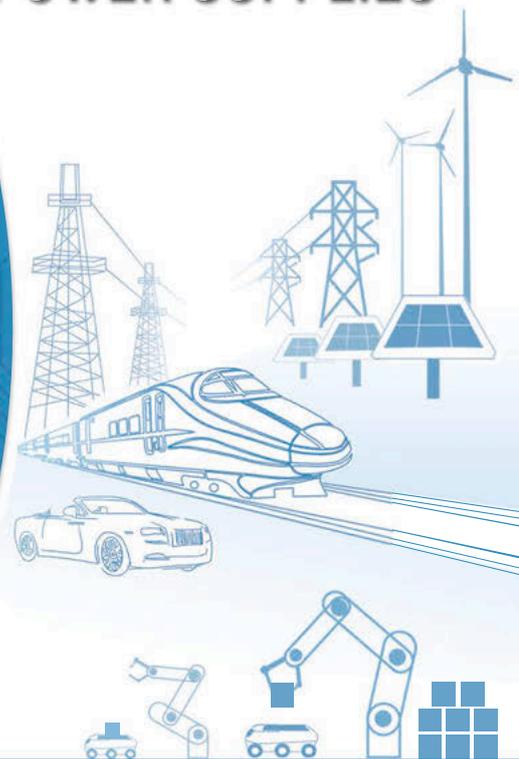


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The leading trade fair for embedded systems

Embedded World returns to Nuremberg providing the embedded community with access to the latest developments and technologies. By **Neil Tyler**

Later this month, Embedded World, the leading international trade fair for embedded systems returns to Nuremberg. It looks to provide engineers with the opportunity to learn about new developments across all aspects of embedded system technologies as they look to address the changing needs of the market.

From the reliability of electronic systems and distributed intelligence, to the internet of things and solutions for future themes such as e-mobility and energy efficiency, Embedded World looks at some of the key issues currently impacting the embedded sector and industry.

According to the organisers, around 1,100 exhibitors will be present representing state-of-the-art technology in all facets of embedded technologies, from construction elements, modules and complete systems through to operating systems and software, hard and software tools right up to services covering all aspects of embedded systems.

Exhibiting companies will display innovations in the field of display technologies, flexible displays, graphic user interfaces, human-machine interfaces, touch screens and 3D displays, while an embedded vision area will see image recognition and processing systems.

Other areas of interest include the M2M Area and the Safety and Security Area where visitors will have the chance to find out how to structure hardware and software to make sure it is attack-proof, and how to protect embedded systems against attack.



Conference Programme

While the Embedded World Conference programme – which includes sessions on Embedded Vision, Internet of Things, Software and Systems Engineering and Embedded Graphics and HMI, is charged for, the Keynote address from Hassane El-Khoury, President and CEO of Cypress Semiconductor (1.30pm NCC Ost, Hall Sydney Feb 25th) is free to attend and will look at how the IoT is driving the convergence of man and machine.

The Conference looks to cover all aspects of the application and development of embedded systems, but there are also a series of free presentations and expert panel discussions across the exhibition.

For further details visit: www.embedded-world.de/en/events

Among the 1000 companies exhibiting we've details below as to what some of them are planning to show at this year's show.

Analog Devices (Hall 4A, 4A-240) will be showing a wide range of demonstrations showcasing its embedded-technology offerings. Highlights include technology that integrates complete signal chains into a "More-than-Moore" semiconductor solution, as well as a range of solutions to simplify the design and deployment of the highest-performance measurement systems.

Arrow Electronics (Hall 4A, 4A-340) will have an extensive range of products and services that assist businesses in transforming innovative ideas into full production. Start-ups and established companies can all benefit from a suite of tools that, combined with Arrow's breadth of suppliers and global logistical capabilities, will enable shortened time to market. Live demonstrations of condition-based monitoring, predictive maintenance, gesture recognition, speech recognition, vision-based smart systems, and automotive solutions will be available.

Avnet's (Hall 3A, 3A-221) many business units, Avnet Abacus, Avnet Silica, EBV Elektronik and Farnell will be at Embedded World and demonstrating their capabilities and support across the product lifecycle – from concept to design, from prototyping to mass production, and right through to end-of-life management. Engineers and technical specialists from all the business units in Avnet EMEA will be on hand to discuss current and future projects of customers.

Cadence Design Systems (Hall 4, 4-126) will be showcasing its Tensilica DSPs and design and verification tools for automotive and embedded applications, including: Digital Home Assistant Speech Recognition, 3D Radar Imaging Sensing; AI-based Pedestrian Detection; Complete Electrical-Thermal Co-Simulation for System Analysis and Cadence

Prototyping and Green Hills Multi Debug.

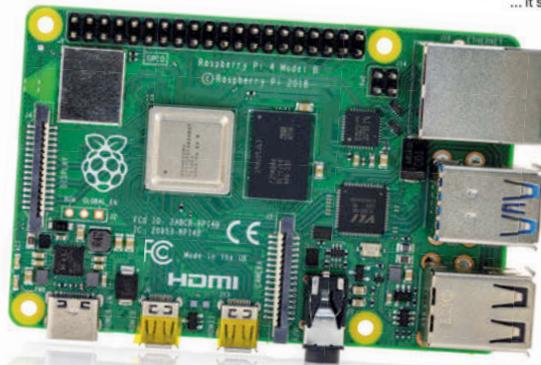
Digi-Key Electronics (Hall 4A, 4A-633) is returning to Embedded World and plans to have interactive and technical demonstrations in their booth area, as well as more traditional games and giveaways. The company is also an official sponsor of the Student Day on Feb. 27, when 1,000 final-year engineering students from around the world gather to meet potential employers.

Digi-Key's demonstrations will feature Digi-Key's IoT Studio, IoT sensor technology, infrared devices, board level solutions, value-added design tools and augmented reality.

Digi International (Hall 3, 3-225) will have a stand packed full of their latest products and demonstrations, providing an opportunity to learn more about mission-critical IoT and M2M connectivity products and services. Of special interest is a display of the Digi XBee Ecosystem, which offers a complete range of rapidly deployable drop-in networking solutions for seamless wireless communication between devices, adaptors and gateways.

LDRA (Hall 4, 4-509) develops software that automates code analysis and software testing for safety-, mission-, security-, and business-critical markets. At Embedded World it will show developers how its tool suite automates software verification, requirements traceability and standards compliance.

Mouser Electronics (Hall 3A, 3A-111) will be giving away over 1,000 development kits from manufacturers such as Microchip, NXP and Texas Instruments. These kits, which will be displayed on the stand, can be won in the "Spin for a chance to win a dev kit" draws which will take place throughout the duration of the exhibition. This year's stand will also



feature an immersive "Future Cities" augmented reality area where visitors can visualize the technology that cities of the future could offer.

Perceptio (Hall 4, 4-305) is a provider of software diagnostics tools and will be showcasing upgraded versions of its flagship product Tracealyzer (with many Linux-specific new features) and Device Firmware Monitor at the Embedded World show. Tracealyzer is an intuitive visualization tool that allows developers to look inside the runtime system in a new way, while Device Firmware Monitor (DFM) is a cloud-based service for IoT product organisations that provides awareness of firmware problems in deployed devices and speeds up resolution.

Perforce Software (Hall 4, 4-568) will be showing both Helix QAC and Klocwork static code analysis tools for embedded software design. This follows on from Perforce's acquisition of Klocwork in early 2019, and how the two products complement each other to address the needs of a wide variety of embedded projects, large or small, cloud or on-premise, compliance-driven or not, across C, C++, C# and Java.

Below: Xilinx will be showcasing a collection of demos, highlighting its ACAP (Adaptive Compute Acceleration Card), Alveo, Industrial IoT (IIoT) and automotive solutions

Rigol (Hall 4, 4-528) will not only be presenting proven device families, but also a number of new innovations. With the newly introduced digital oscilloscope series MSO8000 and MSO5000, Rigol has made a significant addition to its UltraVision II oscilloscope portfolio. The core of the UltraVision II architecture is the Phoenix chip set with two ASICs developed in-house, which build the analogue front end and deliver the signal processing performance.

Rutronik (Hall 5, 5-467) will be demonstrating the power of the latest Bluetooth, IoT and 5G technologies. Visitors will have the opportunity to discover the latest solutions, including system concepts ranging from connected sensor nodes and gateways to customer-specific display customisations. Displays, storage media, embedded boards, along with data-logging applications, antennas, boards, and storage devices will also be at its booth.

Silicon Labs (Hall 4A, 4A-128) will be showcasing its latest wireless IoT connectivity and security solutions for the smart home, commercial and industrial IoT solutions. Interactive demonstrations, along with presentations, will look to help attendees learn how to simplify development and speed up the development process.

Xilinx (Hall 3A, 3A-235) will give visitors a chance to experience adaptive and intelligent computing – from Cloud to the Edge. It will be showcasing a collection of demos, highlighting its ACAP (Adaptive Compute Acceleration Card), Alveo, Industrial IoT (IIoT) and automotive solutions. In addition it will also demonstrate Vitis, the unified software platform, that enables a broad new range of developers – including software engineers and AI scientists – to take advantage of the power of hardware adaptability.



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The very fabric of our business and personal lives is inextricably linked to two important forces: data and energy. Data has succeeded in its journey from a wired to a wireless world. We expect it to be available on-demand through increasingly powerful devices and networks. However, the electricity that runs our technology-dependent world has not yet made that transformation, despite the fact that Nicholas Tesla first experimented with wireless power more than 100 years ago.

Electricity has remained tethered to a cable and an outlet, despite the fact that none of us like wires and cords. The fixed reality of a wired physical outlet has hampered innovation in many areas. But now, the key barriers to taking wireless power mainstream - power level, efficiency, and performance - have been removed with the arrival of mass market uses of GaN (gallium nitride) technology in second and even third generation product designs.

We are poised for the world of wireless charging to go mainstream in many important areas. There is already increased global demand for wireless power, with 600M receiver/transmitter units shipped in 2018. This is an increase of 37% over the prior year. And by 2023, the number should skyrocket to more than 2.2B.

Cutting the last cord -

The world of wireless charging looks set to go mainstream in many important areas, as **Paul Wiener** explains

What will our world look like with ubiquitous wireless power?

Robots and Industry 4.0

Autonomous intelligent mobile robots become increasingly productive with the ability to drive and park themselves adjacent to or over high-speed high-power charging pads that don't require human operators. With wireless charging, robots from diverse manufacturers can share the same charger as the limiting factor of incompatible physical connectors has been eliminated. When freed from fixed charging locations and connector-specific hardware form factors, the flexible and highly reconfigurable smart factory and warehouse environments of Industry 4.0 can become a reality.

IoT Sensors and 5G Networks

With the lower latency and 10x data transmission capacity of 5G versus 4G networks - greater intelligence is possible in the next generation of industrial and urban networks. But the loss of power to even a single key

IoT sensor can shut down a factory assembly line or an important urban safety or monitoring system. This problem is removed when sensors that communicate data wirelessly are also powered wirelessly.

Additionally, with wireless power and data transmission made possible through walls and windows, 5G receivers can be placed outside a building. And they deliver three times the performance of a receiver inside a building.

Transportation

As we move to more autonomous modes of transportation, particularly in the case of vehicle fleets for both 'mobility as a service' and mass public transportation, autonomous (unmanned) wireless charging become increasingly important. The 'new gas or refueling station' that accelerates the evolution of true autonomous mobility will require wireless recharging with a level of 'spatial freedom' that does not demand precision of placement on a recharging area.

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Portable and Handheld Devices

The ability to charge portable consumer devices (laptops, tablets, phones, watches, wearables) and commercial/industrial devices (power tools, first responder radios, professional microphones) just by placing them on a surface will finally deliver on the convenience that users have long demanded. This will be true if the recharging is at home, a coffee shop, a job site, or business.

Spatial Freedom

Spatial freedom is about the placement of a device on a charging surface (X and Y-axes), and the gap or space (Z-axis) between a device to be charged and the charger. For most practical applications of wireless power, spatial freedom is a system requirement. The less precision required in the placement of a device, or parking a car or robot, to recharge - the greater the ease of use and

the levels of spatial freedom that makes wireless charging practical and desirable in both consumer and industrial uses.

Charging device size is important both in terms of the aesthetics of consumer design and the practicality of business uses. Smaller and thinner transmitter and coil electronics are possible when operating at high frequency with GaN technology. Additionally, high efficiency and cooler-running power systems mean that fans and heatsinks can be made smaller or even removed. This results in the design of smaller chargers that can simultaneously handle multiple high-power devices.

- The power cord

Overcoming silicon limitations

The use of highly efficient, high frequency GaN technology in power systems design overcomes the former limitations around high power, spatial freedom, and device size that have hampered mainstream wireless power development and deployment. The ideal frequency to minimize heat loss and maximize spatial freedom is 6-13MHz – and that is where GaN significantly outperforms Silicon technology that can heat-up and become inefficient.

High Power Capability

Wireless power systems need to be capable of transferring power from 30 watts up to several hundred watts. High power is required to wirelessly charge today's laptops (75 watts and above) and robots (200-500 watts), as well as to simultaneously charge multiple devices. Without the high efficiency of GaN in a high-power situation, there is significant heat generated and power lost through that heat, rather than transferred and used for charging a device.



hence the market acceptance and adoption of the solution. Increased spatial freedom is enabling new kinds of applications including within 5G networks - where 200-300mm gaps through walls and 20-30mm gaps through windows make the wireless transmission of reliable power a reality. Operating at high frequency maintains high power efficiency, even when the coupling of the transmitter and receiver is reduced (weakened). Only GaN technology delivers the high switching frequency and high efficiency needed to achieve

Above: Qualcomm's halo wireless charger for EVs

Efficiency and high power

With high frequency systems using GaN power semiconductors, it is possible to power devices and systems up to 500 watts with the power transmitter and receiver separated by a distance up to 500mm. Low frequency silicon-based wireless power solutions are typically only able to deliver 20 watts at a distance of 5mm. Now wireless power can deliver at the same efficiencies and high-power levels as wired power, with the additional key benefit that industrial and consumer environments need of untethered delivery at a distance.

GaN used to be considered an unproven technology. Now it is used in many applications in consumer, commercial, industrial, and automotive markets. GaN technology provides the high frequency power switching that enables wireless charging solutions ranging from handheld consumer devices charging anywhere on a table to large industrial robots autonomously parking and recharging on pads in factories. With GaN, our lives will no longer be shackled to cables and cords. And both power and data will finally be wireless.



Mentor, a Siemens Business, is a technology leader in electronic design automation (EDA), provides software and hardware design solutions that enable companies to develop better electronic and mechanical products faster and more cost-effectively.

The company offers innovative products and solutions that help engineers overcome the design challenges they face in the increasingly complex worlds of board and chip design.

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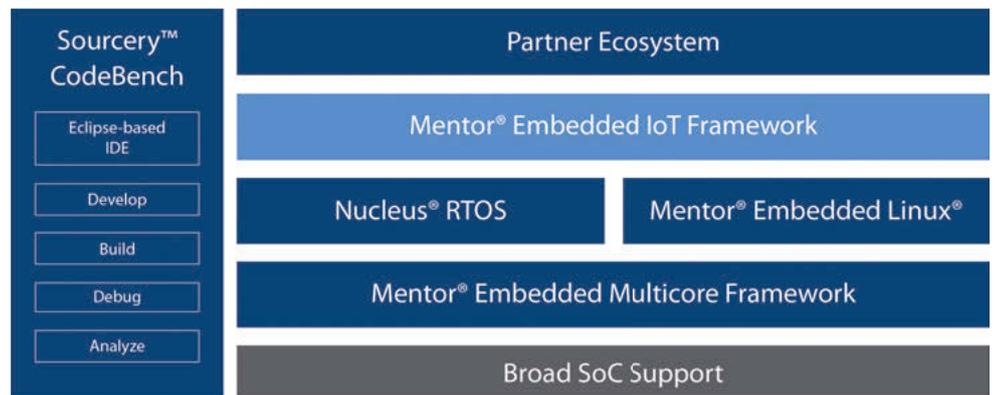
Driven by the Internet of Things (IoT), embedded systems are growing rapidly, particularly the development of connected devices used across a broad range of industries. Embedded device manufacturers need to find ways to quickly deploy and simplify connecting devices to the cloud. With security threats and the need to update these embedded systems with agility, OEMs need to seek a reliable solution. Today, the Linux open-source operating system is used globally for connected devices due to its rich capabilities. To ease adoption and ensure security and customization, Microsoft Azure and Mentor Embedded are providing a robust integrated solution that enables OEMs to deploy their IoT and cloud-based connected devices.

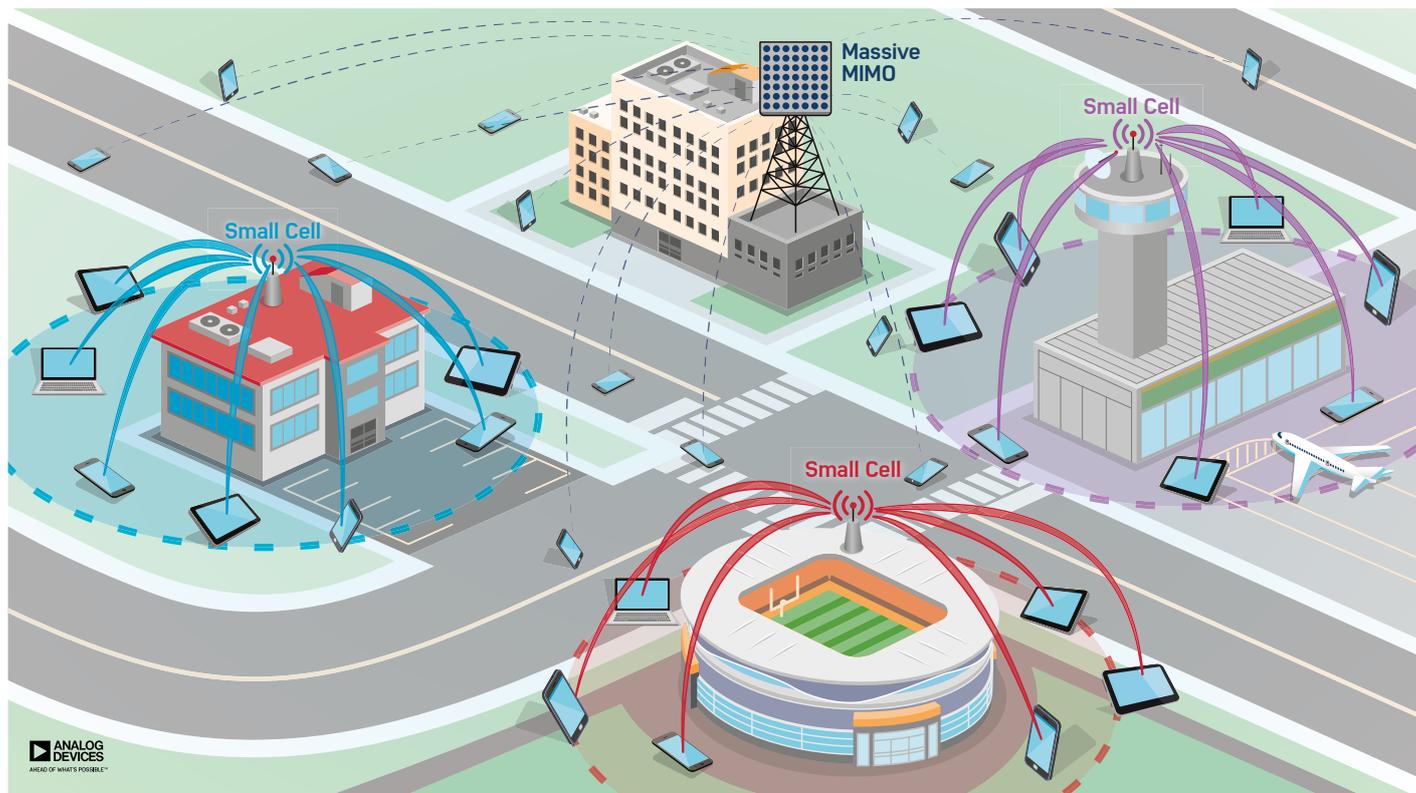
Mentor® Embedded Linux® empowers embedded device manufacturers to simplify development and improve ROI with two industry leading, commercial embedded Linux solutions, one based on the Yocto Project and the other on Debian. Both solutions are customizable, with out-of-the-box support for rich graphics and

comprehensive development tools. Mentor Embedded Linux solutions come pre-integrated with Azure IoT Edge using the Mentor Embedded IoT Framework (MEIF), enabling developers to turn any device into a highly secure edge gateway with advanced analytics and other IoT services.

The Mentor Embedded IoT Framework (MEIF) is a cloud solution that enables secure IoT architectures while reducing complexity and costs associated with device porting, scaling, and backend integration. MEIF integrates and extends the functionality of services offered by cloud backend providers. It enables secure cloud connectivity, device management and monitoring, remote software updates, alarm/events, and device remote debug/diagnostic capabilities.

These capabilities are scalable from microcontrollers (MCUs) up to multicore application processors, and across processor architectures including Arm® and x86. Developers can use the operating system of their choice from open source Linux® to deterministic operating systems such as Mentor's Nucleus® RTOS.





SPECTRAL EFFICIENCY

Data consumption is continually increasing but spectrum is not infinite. Danish Aziz talks to **Charlotte Hathway** about the RF and microwave technologies Analog Devices has developed to bridge that gap

A convergence of different technologies means the wireless communications industry is continually pushed to do more with less. Consumers, industry and government are all contributing to an explosion in sensing, communications and big data processes and applications.

This insatiable need for more data, faster speeds and lower latency is pushing semiconductor companies to develop new technologies that can keep pace with demand. Danish Aziz is a Staff Field Applications Engineer at Analog Devices (ADI) and helps design connectivity architectures that can meet shifting requirements.

Aziz explains, "In mobile communications, spectrum is a

precious resource and you don't have unlimited capabilities. If you want to increase capacity, then you have to either increase power consumption or the channel bandwidth."

One technology that is gaining a lot of momentum is massive multiple-input, multiple-output (MIMO). In massive MIMO systems, more typical eight transmitter, eight receiver systems can be scaled to a much larger number of antennas, such as within 64T64R systems.

Aziz says, "Massive MIMO technology was developed to improve capacity despite bandwidth limitations. One of the key driving needs is to make more bandwidth efficient or spectrally-efficient systems by using multiple antennas."

Above: Analog Devices has a broad set of capabilities, with expertise and technologies spanning the entire RF spectrum.

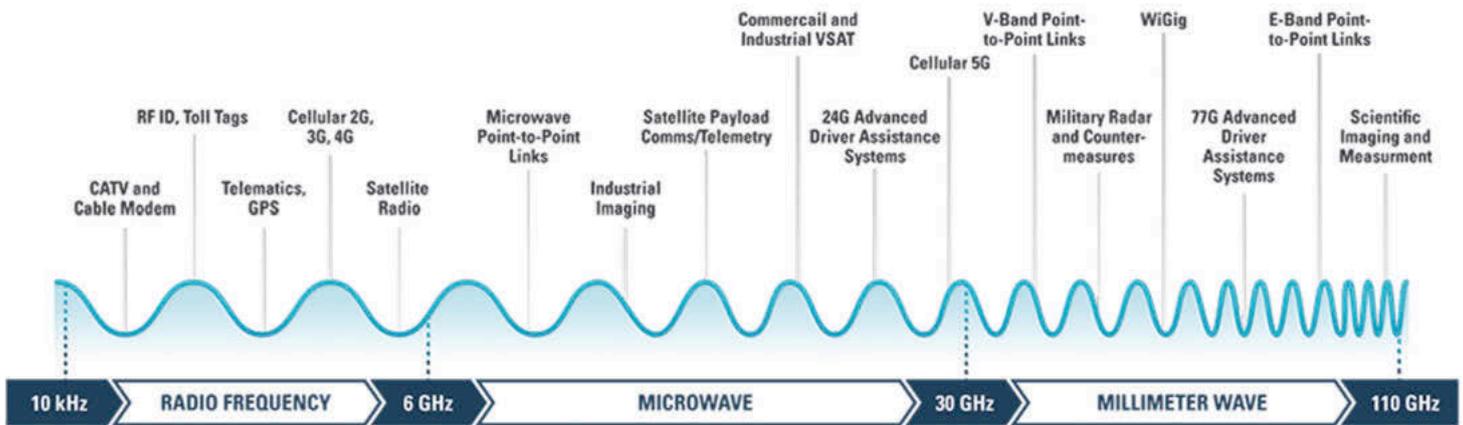
In simple terms, using spectrum more efficiently means more data can be sent over the available spectrum. Those 64T64R systems, for example, have been shown to deliver up to five times more capacity.

Tackling interference

Increasing the number of antennas, however, doesn't only mean the system can handle more cellular traffic – more antennas also means more potential interference. As such, massive MIMO systems often make use of beamforming techniques to increase the effectiveness of the transmission.

Beamforming is emerging as a key element of 5G network development. Instead of blasting signals out in every direction, beamforming can direct and adjust radio waves to make them more powerful and targeted. This can transmit data directly to a user and even extend the range of RF transmissions.

Radar applications have used beamforming since the 1960s, but its use in communications has



demanded some adaptations. Aziz explains that a radar system could use a “totally analogue beamforming system” because there were no size constraints. “It could take up a whole building if necessary. With communications equipment, that’s not feasible.”

As such, Aziz says, analogue is not an option and most 5G networks that use beamforming will likely use hybrid beamforming techniques. Aziz adds, “The most efficient and beneficial would be to have a system with completely digital beamforming but, at the moment, we are limited because of the hardware that is available.”

Designing the right products

Towards the end of last year, ADI added a wideband transceiver to its RadioVerse portfolio. Aziz explained that the ADRV9026 is designed to support base station applications, massive MIMO and small cell systems. What is unique about that transceiver, Aziz says, is that “in the past, we kept the number of channels the same but increased the bandwidth. Here, we have kept the bandwidth the same, but we have increased the number of channels from three to four.”

He adds, “At the same time, we changed the process technology. Usually, increasing the number of channels in a given system means the power consumption also increases. We based this product on 28-nanometer CMOS technology as changing the process technology

means we can also reduce or maintain the power consumption.”

The ADRV9026 is also designed to be synchronisable. This is essential, Aziz says, as “when we talk about multi-antenna or multi-channel systems, one of the most important things is the synchronisation durability. We can synchronise multiple backends through a digital interface, which is sometimes called multi-chip synchronisation.”

5G networks will also make use of mmWave, the band of spectrum between 30 and 300 GHz. There was a need for a single platform that could cover the entire 5G mmWave band. Analog Devices developed the ADMV1013 up-converter and ADMV1014 down-converter to meet this need. These integrate I/Q mixers with an on-chip programmable quadrature phase shifter, configurable for direct conversion to or from baseband from DC to 6 GHz or an IF between 800 MHz and 6 GHz. The up-converter contains a transmit power amplifier driver, while the down-converter includes a receive LNA.

These are designed to support all broadband services and ultra-wide bandwidth transceiver applications. Aziz explains, “Whatever application is being examined in the mmWave space, we have integrated and individual components targeted to that application.”

The path from 4G to 5G

The rollout of 5G networks is creating new opportunities for small cells.

Above: Different frequencies are typically used for different applications

Network operators are densifying their networks by using small cells to reuse spectrum more frequently. This means small cells are increasingly being deployed to provide capacity improvements, and that trend looks set to continue with small cells acting as building blocks in the transition from 4G to 5G.

As Aziz explains, “Our integrated transceivers have special features that help vendors set up a small cell very easily and cheaply. One of those is digital pre distortion (DPD), which is required when a base station is operating at high power.”

DPD shapes the data before it gets to the power amplifier (PA) to counteract the distortions the PA will produce. DPD technology has historically been used in FPGAs and ASICs, but Analog Devices has incorporated it into the transceiver. This lowers power consumption, as well as enabling the use of other technologies that enhance wireless network coverage and capacity.

The range of integrated designs offered by Analog Devices aims to simplify system design, shorten time to market, and provide performance for the range of short-range wireless systems, from LTE up to emerging 5G networks.

As 5G networks mature, and data generation and processing increases, there will continue to be pressure to use spectrum more efficiently. Through making use of these technologies, operators can reuse spectrum and improve capacity to keep pace with demand.



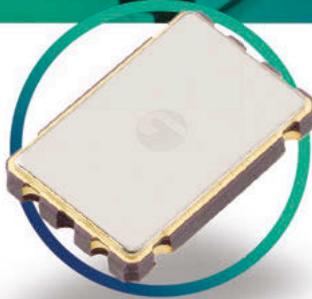
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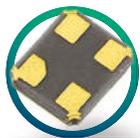
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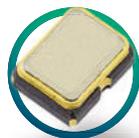
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THE GPU OF EVERYTHING?

At the end of last year Imagination unveiled what they claimed was the fastest GPU IP ever released. **New Electronics** takes a look at the A-Series

At the end of 2019 Imagination Technologies made one of its biggest announcements in years with the launch of a new GPU architecture. The A-Series is, according to the company, its most important GPU announcement in over 15 years and it claimed that the series has the world's fastest GPU IP.

The A-Series is an evolution of the company's successful PowerVR graphics architecture and has been developed to meet the graphics and compute needs of a broad spectrum of next-generation devices.

According to Imagination it is the "GPU of Everything" as it is intended to address multiple markets from automotive, AIoT, and computing through to DTV/STB/OTT, mobile and the server market.

The announcement is certainly important for Imagination as the company is looking to show that the architecture is better than the

custom GPUs currently being made by the likes of Apple and Qualcomm, and it's seen by many as a bid by the company to make licensed GPUs more competitive in what has been a tough market for IP companies like Imagination and Arm.

As Dr. Ron Black, CEO, Imagination Technologies, said at the launch of the GPU: "The A-Series is our most important GPU launch since we delivered the first mobile PowerVR GPU. It offers the best performance over sustained time periods and at low power budgets across all markets."

The launch follows a turbulent few years for Imagination and while the UK-based company remains a leading player in the mobile GPU space, licensing its GPU technologies, its PowerVR-branded GPUs are found in far fewer products than in the recent past having, in many cases, lost out to competitors such as Qualcomm,

In the past its high-end mobile

GPUs had been used extensively by Apple in the company's A series SoCs, up until the Apple A10 in 2016. In the low to mid-range, Imagination's GPUs were also used by companies including MediaTek and Rockchip.

In a serious blow – at the time – for Imagination, its close relationship with Apple appeared to have ended when the tech giant announced that it was set to develop its own custom GPUs, replacing Imagination's, and in a matter of months of the news breaking Imagination was put up for sale and bought by a Californian equity firm Canyon Ridge.

The relationship between Apple and Imagination has been renewed, however, with the signing of a new multi-year, multi-use license agreement at the turn of the year under which Apple will have access to a wide range of Imagination's IP.

The strained relationship between the two companies had left

Imagination without a key customer for its high-end GPUs at a time when it also found itself coming under increased competitive pressures.

In fact, by the middle of last year, the licensed IP from companies such as Arm and Imagination were being described as being significantly inferior to the custom IP that was then appearing from companies like Apple and Qualcomm.

That custom technology is unlikely to be licensed to third-party SoC vendors so that trend was starting to cause real problems for the wider industry.

Both Arm and Imagination responded with the launch of new products. The former with the Mali-G77 with the new Valhall GPU architecture; while Imagination launched the A-Series.

The A-Series has certainly delivered significant improvements, at the same clock and process, offering 2.5x the performance, 8x faster machine learning processing and 60% lower power than current PowerVR devices that are being shipped, according to Imagination.

Commenting Jon Peddie, principle and founder of Jon Peddie Research, said: "The simple fact is that for mobile SoCs the market leader owns its own GPU technology and is increasing market share at rate of 5% year-on-year. In order to stop the losses to their own potential share the other mobile SoC companies need a compelling GPU that will deliver some real competition."

His point being that if licensed IP had continued to remain inferior to custom IP, then the wider market would have become increasingly uncompetitive.

The A-Series architecture is Imagination's 10th generation GPU architecture and consists of three categories of GPUs: the XE, XM, and XT product lines, which represent the low-end, mid-range and high-end segments.

The A-Series architecture has

four configurations in the XT series and one for the XM configuration. The AXT-64-2048 is a flagship GPU with 2.0 TFLOPS, 64 gigapixel/s fill rate, and 8 TOPS of AI performance; the AXT-32-1024 is described as a premium mobile GPU with 1 TFLOPS, 32 Gigapixel/s fill rate, and 4 TOPS of AI performance. The remaining configurations are the AXT-48-1536 and the AXT-16-512, while the AXM series has the AXM-8-256, which is rated for 256 GFLOPS, 8 gigapixel/s fill rate, and 1 TOP of AI performance.

Delivering for gaming

In part the A-Series has been developed to meet the needs of the gaming market.

"We have been working hard to develop this next generation of GPUs in terms of both the architecture and performance and I think we have created a GPU that our customers have been looking for," said Graham Deacon, VP of Marketing – PowerVR Graphics IP at Imagination.

"With the A-Series we have focused on delivering a quality experience for gamers, especially when 47 per cent of the gaming market is now focused on the mobile phone.

"The A-Series has been about delivering a traditional gaming experience - we didn't want the user to lose that experience - but via a mobile platform and at low power."

According to Deacon, most mobile GPUs struggle to deliver consistent gaming experiences due to thermal constraints – they are fast for a short while, then slow and then never recover, resulting in a disappointing user experience.

The A-Series looks to deliver a more sustained performance for extended game play at consistent frame rates avoiding thermal panic clock throttling, glitches or overheating.

"The A-Series' PowerVR architecture benefits from an inherent bandwidth and power advantage

because its tile-based deferred rendering technology means it only draws what is visible on screen. This is combined with advanced direct flexible power signalling using Pro-Active DVFS (Dynamic Voltage and Frequency Scaling) and Deadline Scheduling algorithms, which deliver fast power control with an ultra-low latency response. If parts of the GPU aren't fully utilised or needed for processing, they are immediately slowed down or even put to sleep to ensure optimal power efficiency," Deacon explained.

To deliver this high power efficiency is necessary and is provided by PowerVR's smart flexible firmware based low-latency DVFS algorithms with a direct GPIO control path into the system.

The A-Series also features Imagination's HyperLane technology that comprises of individual hardware control lanes, each isolated in memory, enabling different tasks to be submitted to the GPU simultaneously for secure multitasking.

With this Dynamic Performance Control, the GPU is able to spread its performance across multiple tasks, executing them all, while maximising GPU utilisation. Priority HyperLanes deliver a dynamic split; for example, prioritising graphics and delivering all the required performance for that application while an AI task could then be run alongside using the remaining performance.

In the coming year Imagination is planning to reveal a new B series architecture which will include 30% performance improvements, which in turn will be succeeded with a C and D series in 2021 and 2022, again with 30% performance improvements being promised.

Imagination's announcement of the A-Series architecture has been welcomed and been described as providing a healthy dose of new competition into the mobile GPU market.

**"The A-Series
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the first mobile
PowerVR GPU
some 15 years
ago. It offers the
best performance
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time periods and
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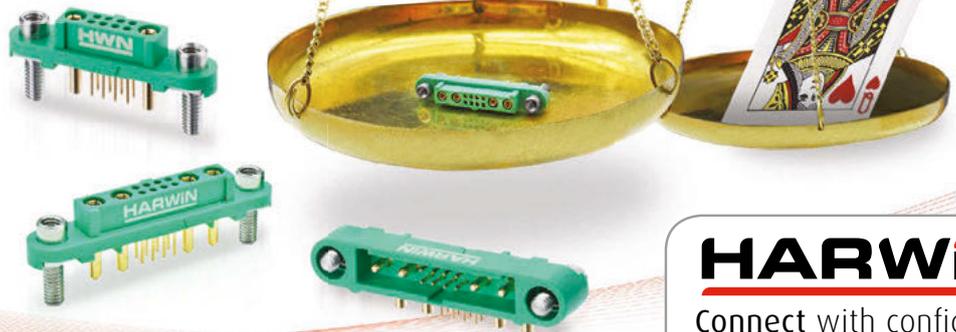
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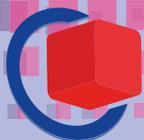
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NÜRNBERG MESSE

After 60 years today's space market encompasses not only traditional space companies but private ventures promising and, in some cases, providing launch services, space tourism, the commercialisation of near zero gravity and the introduction of constellations of low earth orbiting satellites delivering high speed connectivity and near real-time imagery.

Space is one of a few sectors where growth has remained remarkably resilient and this has been possible due to an increasingly diverse range of satellite enabled broadcast and connectivity services, while government/institutional customers have continued to seek to improve the ability to navigate, monitor and observe the environment, climate, resources and each other.

The desire to be able to do this must be supported practically, safely and affordably. The space market is a complex eco-system of orbital networks, ground support and control and of course the most noticeable, the ability to launch and position satellites into precise orbits so they can begin interplanetary journeys.

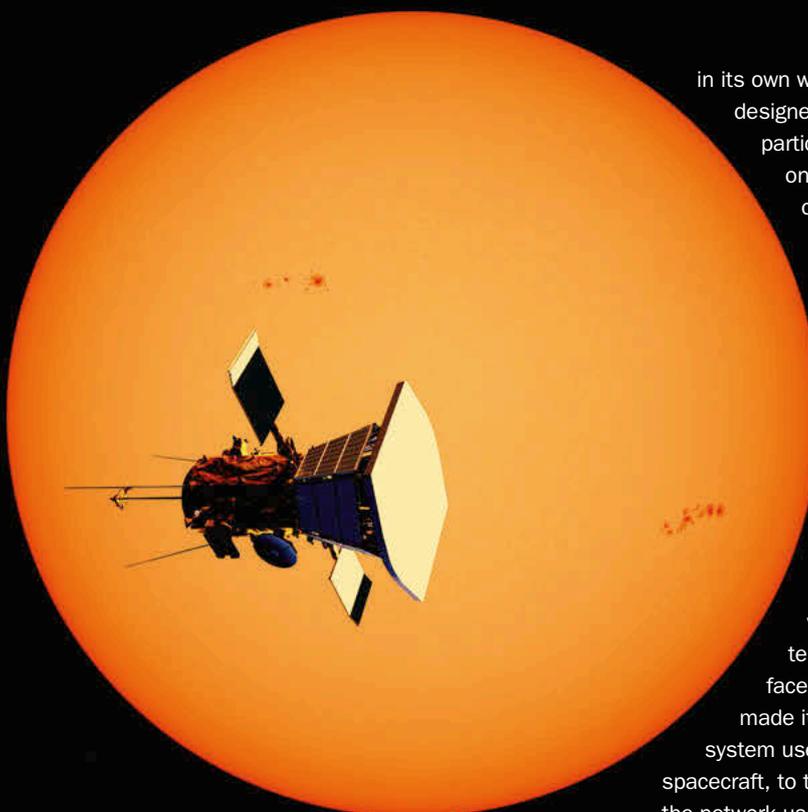
From the early space flight heritage in 1968 (the Olympus satellite), through the first ESA qualification in 1975, to today, Smiths Interconnect has provided connectivity products and expertise to prime and equipment contractors who produce the launch vehicles, payloads and ground systems. The company's solutions have been integrated into over 800 satellites and deep space probes.

That engagement has been built on a number of critical steps that have included the establishment of ESA qualification that commenced in 1975 and which remains today, as well as investments in processes, facilities, product development and skilled staff who conceive, design, produce and ensure the efficacy and reliability of the products where failure is simply not an option.

It is not an option in space

Resilient growth within space technology

A leading supplier to the space industry Smiths Interconnect understands the need for high reliability in harsh environments, as **Alan McNeil and Roberta Rebora** explain



Above: NASA's Parker Solar Probe

applications, because there is no physical access for maintenance, and they cannot be returned to base for repair. Such harsh environmental conditions require space products and systems to be highly rugged, reliable, and durable. They require that the primary functions, like navigation and communication are supported by the safest and most high performing connectivity solutions of all the mission-critical systems.

Unique designs

Each of the product types supplied by Smiths Interconnect is unique

in its own way with almost all designed specifically for a particular application based on our understanding of the rigours that the products are expected to endure during manufacture, test, launch and the mission itself.

For example, ruggedised D-sub miniature connectors, supplied by Smiths, are designed to withstand the high vibration and extreme temperature fluctuations faced in space – and have made it possible for the data system used on NASA's Orion spacecraft, to transmit more data than the network used in the Space Shuttle era while also eliminating extraneous signal noise.

Orion, part of NASA's Artemis programme, also uses Smith's ultra-reliable KA family of PCB connectors in its power systems, featuring Hypertac Hyperboloid technology.

The shape of the contact technology (a basket of wires) allows the socket points to be completely surrounded by the length of the mating pin. This provides a far greater and a more reliable contact surface than in traditional connector designs which means that there is less likelihood of contact failure even when

the component is subject to extreme mechanical shock and vibration.

The company's high-speed D-sub connectors and harnesses were part of NASA's successful Orion test flight to conduct a full-stress test of the Launch Abort System (LAS). The test proved that Orion could pull astronauts to safety in the event of an emergency during launch.

The connectors had to withstand the extreme levels of mechanical shock and vibration produced by the LAS and test data from 890 sensors was sent in real-time to ground sites, as well as recorded by 12 on-board data recorders for evaluation by NASA scientists.

Smiths Interconnect's microwave high power waveguide circulators, loads and transitions are also being used within the data and control transmission systems of the Parker Solar Probe, a NASA robotic spacecraft. It was launched in 2018, with the mission of repeatedly probing and making observations of the outer most part of the Sun's atmosphere. In 2024 it is expected to approach to within 3.83 million miles from the centre of the Sun, achieving a top speed of about 430,000 miles (700,000Km) per hour.

The Parker Solar Probe has just successfully completed its second close approach to the Sun.

In the Cosmo SkyMed Second Generation constellation that has been orbiting since December 2019, the company provided high performance microstrip circulators embedded into the active antenna Transmitter/ Receiver modules, as well as low profile solderless interposers for the core electronics of the satellite. The interposer's reduced size adapts well to limited space constraints, allowing for a smaller, lighter design of the main equipment and easy installation and replacement.

Also included were high performance coaxial isolators for the equipment payload, as well as right angle spring probe connectors for the

antenna harnessing connection. These connectors provide streamlined routing of the cable harnessing, simplifying the antenna's mechanical structure and allowing for a plug-in modular approach.

These connectivity solutions are equipped with IDI spring probe contact technology, designed to optimise performance in high reliability, multi-cycle applications while offering excellent resistance to shock and vibration.

Manufacturing challenges

Space standard design and test approaches allow delivery of highly reliable products by ensuring the capability of the product before it enters into service. The manufacture of space products is challenged by what most would consider extreme product requirements for faultless operation and maintenance.

In May 2019 Smiths Interconnect committed to create a centre of excellence in Dundee for product qualification and testing. The investment demonstrates the company's optimum commitment towards being world class and the partner of choice for such innovative connectivity solutions.

The laboratory offers a one-stop shop for critical qualification and testing of Smiths Interconnect's products in Europe. The structure is equipped with in-house multipaction

Above: Smith Interconnects' high speed D-sub connectors



testing and SRS mechanical shock testing system, both in dedicated and environmentally controlled areas.

The facility can now replicate deep space in terms of vacuum and heat with high power amplifiers and vacuum systems. It can therefore analyse high power devices that are used in space with regards to their breakdown voltage behaviour in a vacuum or near-vacuum environment.

This effect, called multipaction, can render a device useless and, thus degrades the reliability of the satellite. Being able to offer multipaction testing is a major benefit and a real point of competitive differentiation for Smiths Interconnect.

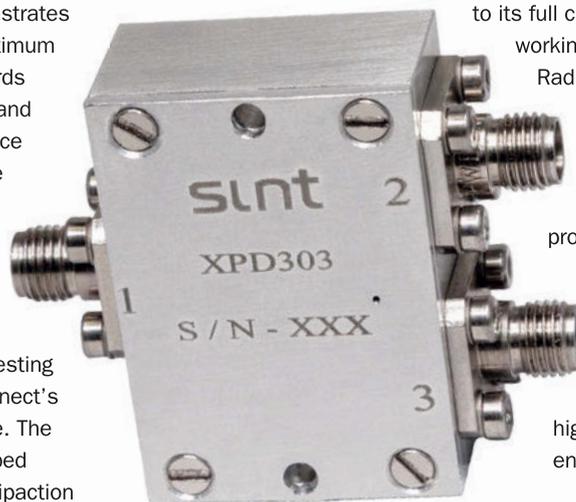
The facility also has a machine that can replicate the G-force for a rocket launch to assess what happens to products when they are launched. At maximum shock testing the SRS shock testing equipment generates up to 105dB+ of noise, and therefore requires a special soundproof room. Being in a dedicated and controlled area allows the use of the equipment to its full capacity during normal working hours for the first time.

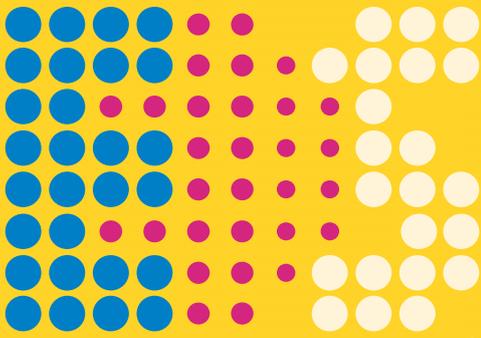
Radioactive sources can also be used in the laboratory to simulate the sun's radiation which is quite a complicated test process.

In summary, in space applications, whether satellites, manned space flights, or ground support equipment, high reliability in really harsh environments is a necessity.

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Below: The SpaceNXT MWC connector





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