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COMMENT 5
With robotics and AI affecting many different sectors, what impact could they have on the provision of healthcare?

NEWS
Researchers come up with flexible, sensitive and self-healing electrically conductive hydrogel 7

Daimler and Xilinx work together to deliver AI-based automotive applications 8

Cadence unveils the first broad Cloud portfolio for the development of electronic systems 9

UK Government announces a project to develop technology to help drive much faster drug discovery 10

COVER STORY
Sustainable healthcare
Healthcare and medical research are witnessing profound change. How can technology transform the provision of services? By Neil Tyler 12

SECTOR FOCUS
Keeping track
With more trains running on the UK’s crowded network, effective track maintenance has become essential, as Bethan Grylls explains 17

NEW ELECTRONICS AT 50
The changing face of electronics
As New Electronics turns 50, we look back at half a century of electronic innovation and celebrate today’s electronics industry 21-55

RF & MICROWAVE
Breaking barriers
RF amplifiers are going wide and high to meet wider frequency ranges and the need for more bandwidth, according to Keith Benson 56

COMMUNICATIONS DESIGN
Overloaded spectrum
With more connected devices, how do we ensure good Wi-Fi performance? 58

ADVANCED PROCESSES 60
New analytical approaches
Innovative device architectures containing novel materials require new solid-state analytical capabilities

SEMI MANUFACTURING 62
Stuck in the middle
While the dominance of 300mm continues it has come under unexpected pressure from its immediate predecessor. By Chris Edwards

DESIGN PLUS 65
Together, WIE can change the world
Engineers are fundamental to shaping the lives of everyone. International Woman in Engineering Day celebrates this inclusivity and looks to extend it. By Debbie Ash

MISSION STATEMENT
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<table>
<thead>
<tr>
<th>Team</th>
<th>Team</th>
<th>Team</th>
<th>Team</th>
<th>Team</th>
</tr>
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<tbody>
<tr>
<td>AMD</td>
<td>Xilinx Logic</td>
<td>Colibra</td>
<td>Dialog</td>
<td>Diodes</td>
</tr>
<tr>
<td>Infineon</td>
<td>Maxim Integrated</td>
<td>Microchip</td>
<td>LUMILEDS</td>
<td>Marvell</td>
</tr>
<tr>
<td>Intel (Authorized Distributor)</td>
<td>Micron</td>
<td>Microsoft</td>
<td>Nexperia</td>
<td>Nordic</td>
</tr>
<tr>
<td>NXP</td>
<td>ON</td>
<td>Quectel</td>
<td>Renesas</td>
<td>Semtech</td>
</tr>
<tr>
<td>STI</td>
<td>Texas Instruments</td>
<td>Western Digital</td>
<td>Xilinx</td>
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A crisis in healthcare

WITH ROBOTICS AND AI AFFECTING MANY SECTORS, WHAT IMPACT COULD THEY HAVE ON HEALTHCARE PROVISION?

It’s the ‘summer of anniversaries’. New Electronics turns fifty this month, likewise Intel in July. One of the biggest celebrations however, will be for the UK’s National Health Service (NHS) which turns 70 in a matter of weeks.

While politicians will look to celebrate this milestone, frontline services will still have to manage the 700,000 people who use the NHS each day.

Long term conditions such as strokes, arthritis and dementia are increasing as a result of an ageing population - over 11.6million people in the UK are aged 65 or over and that is expected to reach 19million by 2045. As a result, health and social care services are under unprecedented pressure.

Spending on health runs into billions and is set to increase further, as the Government unveils an additional £20bn in funding.

While it seems obvious to many that we need to invest more, what role has technology to play in easing the care burden?

In this issue’s cover feature, we look at how wearable devices, robotics, artificial intelligence and better data management could be used to improve patient outcomes and how the setting up of the new Rosalind Franklin Institute (RFI), at the Harwell Campus in Oxfordshire, will be looking to use new technologies to accelerate drug discovery.

Technology can deliver more targeted and effective treatments and, if deployed correctly, could save the NHS billions.

But, if it is to play a role, its application needs to be done with care, and with due consideration being given to both ethical and societal issues.

Any developments in new technologies should take place through close collaboration with the very people who are in need of care, as well as with the public and those organisations involved in providing care services.

The Government has called on the NHS to set out reform plans to match the new funding it has announced. While the NHS has a poor record when it comes to embracing new technologies, now is surely the time to pursue them as a matter of urgency.

Neil Tyler, Editor (neil.tyler@markallengroup.com)
E-paper Displays

Electronic paper and e-paper are display devices that mimic the appearance of ordinary ink on paper. Unlike conventional backlit flat panel displays that emit light, electronic paper displays reflect light like paper. This may make them more comfortable to read, and provide a wider viewing angle than most light-emitting displays.

Available sizes are 2.9", 5.65", 6", 9.7" 10.3" and 13.3" all with evaluation kits.

Applications include electronic Pricing labels in retail shops and digital signage, time tables at bus stations, electronic billboards, health and fitness displays, IoT devices.

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Stretching to new limits

FLEXIBLE, SENSITIVE AND SELF-HEALING ELECTRICALLY CONDUCTIVE HYDROGEL CREATED BY KAUST. BETHAN GRYLLS REPORTS

The King Abdullah University of Science and Technology (KAUST) has developed a composite of the water-containing hydrogel and a metal-carbide compound known as MXene. As well as being able to stretch by more than 3400%, the researchers say that the material can quickly return to its original form and will adhere to many surfaces, including skin. Also, when cut into pieces, it will quickly mend itself upon reattachment.

“Our material outperforms all previously reported hydrogels and introduces new functionalities,” claims Professor Husam Alshareef of KAUST.

The team believes there is “real potential” for the material in various biosensing and biomedical applications.

For example, a thin slab of the material attached to a user’s forehead can distinguish between different facial expressions. While strips of the material attached to the throat have the ability to convert speech into electronic signals.

Other possibilities lie in robotics, the researchers add, where the material could serve in touch-sensitive finger-like extensions for machinery.

There are also anti-counterfeiting possibilities, with slabs of the material and integrated electronics proving highly sensitive at detecting signatures as they are written.

Flexible, blue vertical micro LEDs

A low-cost production technology for thin-film blue flexible vertical micro LEDs (f-VLEDs) has been developed by a team from KAIST, in South Korea.

The current display industry has utilised the individual chip transfer of millions of LED pixels, causing high production cost. To widely commercialise micro LEDs for mobile and TV displays, the transfer method of thin film micro LEDs requires a one-time transfer of one million LEDs.

The team developed thin-film red f-VLED in previous projects, and now has realised thousands of thin-film blue vertical micro LEDs (thickness < 2μm) on plastics using a one-time transfer.

The blue GaN f-VLEDs achieved optical power density (~30 mW/mm²) three times higher than that of lateral micro LEDs, and a device lifetime of 100,000 hours by reducing heat generation. These blue f-VLEDs could be “conformally” attached to the curved skin and brains for wearable devices, and stably operated by wirelessly transferred electrical energy.
Tiny chip helps drones navigate

Researchers at MIT, who previously designed a tiny computer chip tailored to help honeybee-sized drones navigate, have announced that they have shrunk their chip design even further - both in size and power consumption.

The ‘Navion’ chip is just 20nm² and consumes only 24mW of power, yet according to MIT, is able to process camera images in real-time at up to 171 frames per second, as well as inertial measurements.

The chip can be integrated into ‘nanodrones’ to help the vehicles navigate, particularly in remote or inaccessible places.

To shrink the chip further in size and power, the team built a chip from the ground up, rather than reconfiguring an existing design.

It is designed to minimise the amount of data that is stored on the chip and optimise the way this data flows across the chip. Applications could include low-energy robotics and digestible medical devices.

New frequency band for telecom satellites

Reaktor Space Lab and VTT Technical Research Centre of Finland are participating in a European Space Agency project, which involves investigating a new frequency band for next-generation telecommunication satellites.

This activity aims to demonstrate the use of the 75GHz frequency band for future telecommunications satellites. The test flight will be carried out using a Finnish-made CubeSat satellite, weighing less than 5kg, and is scheduled to launch next year.

The satellite’s mission is to send, for the first time, such a high-frequency signal from space to Earth. The transmission of the signal through the atmospheric layers must be substantiated before telecommunications satellites that utilise the new frequency band can be designed with the desired features.

Xilinx and Daimler to develop AI solutions

Xilinx and Daimler AG have announced that they are collaborating on an in-car system using Xilinx technology for artificial intelligence (AI) processing in automotive applications.

Powering by a Xilinx automotive platform, consisting of system-on-a-chip (SoC) devices and AI acceleration software, the scalable solution will deliver high performance, low latency and improved power efficiency for embedded AI in automotive applications.

“We are accelerating our product development using AI technology by engaging our global development centres with Xilinx experts,” said Georges Massing, director user interaction & software, Daimler. “Through this strategic collaboration, Xilinx is providing technology that will enable us to deliver very low latency and power-efficient solutions for vehicle systems which must operate in thermally constrained environments.”

The strategic collaboration will see experts from the Mercedes-Benz Research and Development centres implementing AI algorithms on a highly adaptable automotive platform from Xilinx. Mercedes-Benz will productise Xilinx’s AI processor technology, enabling the most efficient execution of their neural networks.

According to Willard Tu, senior director, Automotive, Xilinx, “Xilinx’s adaptable acceleration platform for automotive will provide Daimler with high levels of flexibility when it comes to deploying neural networks for intelligent vehicle systems.”

Nanowire FETs for nodes beyond 5nm

Imec used this year’s 2018 Symposia on VLSI Technology and Circuits to announce its progress in enabling germanium nanowire pFET devices as a practical solution to extend scaling beyond the 5nm node.

In a paper, the research center unveiled an in-depth study of the electrical properties of strained germanium nanowire pFETs. A second paper then presented the first demonstration of vertically-stacked gate-all-around (GAA) highly-strained germanium nanowire pFETs.

“With a number of scaling boosters, the industry will be able to extend FinFET technology to the 7- or even 5nm node,” said An Steegen, EVP at imec’s Semiconductor Technology and Systems division. “The GAA architecture appears to be a practical solution since it reuses most of the FinFET process steps. But, one important challenge of using lateral nanowires is the decrease of the channel cross-section compared to conventional FinFETs. To improve the drive per footprint, several nanowires have to be stacked, but this comes with the penalty of increased parasitic capacitance and resistance. A solution is to replace the silicon nanowires by a high-mobility channel material such as germanium, providing the necessary current boost per footprint”, added Steegen.

She continued, “These new studies show that solution is indeed feasible, reaching the cost, area and performance requirements for nodes beyond 5nm.”

“These studies establish germanium GAA nanowire technology as a valid contender for the sustained scaling that will be required to fulfill the requirements for the data-driven IoT-era,” Steegen concluded.
Cadence unveils first Cloud portfolio

FIRST BROAD CLOUD PORTFOLIO FOR THE DEVELOPMENT OF ELECTRONIC SYSTEMS AND SEMICONDUCTORS. NEIL TYLER REPORTS

Cadence Design Systems has launched the Cadence Cloud portfolio, the first broad Cloud portfolio for the development of electronic systems and semiconductors.

The Cloud portfolio consists of Cadence-managed and customer-managed environments that will enable electronic product developers to use the scalability of the Cloud to securely and better manage design complexity.

Unveiled at the 55th annual Design Automation Conference (DAC) being held in San Francisco, Cadence said that customers would gain access to improved productivity, scalability, security and flexibility, through scalable compute resources that would be, ‘available in minutes or hours, instead of months or weeks, achieving better overall throughput in the development process.’

The portfolio includes support for customers who establish and manage their own IT and business relationships with Amazon Web Services (AWS), Microsoft Azure, or the Google Cloud Platform.

The Cadence Cloud Passport model includes Cloud-ready Cadence software tools that have been tested for use in the Cloud, a Cloud-based license server for high reliability, and access to Cadence software through familiar contract mechanisms.

The initial Cadence products that are Cloud-ready and benefit significantly from the scale of the Cloud include tools for circuit simulation, power and EM analysis, logic simulation, formal verification, physical verification, timing signoff, extraction, power integrity and library characterisation.

Part of the Cloud portfolio, the Cadence Cloud-Hosted Design Solution provides software tools in a fully-supported, managed and EDA-optimised design environment built on AWS or Microsoft Azure that has been customised for company-specific infrastructure requirements.

Start-ups and small companies will benefit from a customised Cloud environment as it will reduce the need for capital infrastructure investments and certain computer-aided design (CAD) and IT costs.

Cadence has also introduced the Palladium Cloud, a directly-delivered, Cloud-based emulation environment that addresses peak needs of existing Palladium customers and brings emulation hardware access and benefits to new customers and markets.

Commenting, Dr. Anirudh Devgan, president of Cadence, said, “By leading this industry shift to the Cloud, we’re enabling our customers to adopt the Cloud quickly and easily, enabling them to be more productive and get to market faster.”

Automotive-grade sensor IC

ams has released the AS5200L, a dual-die magnetic rotary position sensor with an I2C interface that will enable the development of new space-saving designs in safety-critical automotive applications.

Focused at electrified powertrain drive-by-wire control functions, such as shift-by-wire for both traditional stick and rotary shifters, and pedal applications, the AS5200L benefits from inherent immunity to stray magnetic fields and produces highly accurate and repeatable measurements even in noisy magnet-IC environments.

The AS5200L is intended for automotive system designers seeking to implement accurate rotation position sensing in vehicle electrification applications and the provision of an I2C interface allows for easy programming of operating parameters by a host microcontroller without the need for a dedicated programmer.
Earlier this month, the UK Government announced a unique project that is intended to develop technology that will help to drive much faster and more effective drug discovery.

The Business Secretary Greg Clark, launching the new Rosalind Franklin Institute (RFI) in Harwell, Oxfordshire also announced a first wave of major projects.

The aim is to develop an integrated suite of new technologies to accelerate the discovery of high-quality lead molecules, dramatically reducing the cost of drug discovery.

According to Clark the new project will pioneer fully-automated hands-free molecular discovery that will help to radically speed up drug development.

“We’re looking at drug development that will be up to ten times faster than at present and this could help to transform the UK’s pharmaceutical industry,” explained Professor James Naismith, Director of the Research Complex at Harwell.

New drugs are discovered through a slow process that can take up to ten years and is extremely expensive. Drug development relies on optimising candidate molecules to allow the discovery of a drug that can treat an underlying disease.

The discovery of drugs relies on the design, synthesis and testing of sets of molecules and, according to Professor Adam Nelson from the University of Leeds, “is a rather conservative process - using a small number of building block types and a limited suite of reactions means we are only exploring a very small area of chemical space.”

According to Professor Naismith, “The institute will have a unique design and harness robotics and AI to automate the discovery process, allowing hundreds or thousands of candidate molecules to be investigated at a time.

“We want to find higher quality starting points for drug discovery to maximise the chances of success at later stages in the discovery pipeline.”

At the heart of the new facility will be new instruments that will allow the direct observation of the interactions between drug candidates and target proteins.

“At the moment, the methods for doing this are slow and often don’t allow you to directly see the detailed hydrogen bonding interactions - understanding how proteins and drug candidates recognise each other is crucial for enabling effective drug discovery,” said Professor Ian Walmsey, Pro-Vice-Chancellor Research & Innovation at the University of Oxford and Chair of the RFI’s Interim Board.

“The RFI will look to pioneer disruptive technologies and new ways of working, leading to new diagnostics, new drugs, and new treatments for millions of patients worldwide”

The Institute is an independent organisation funded by the UK government through the Engineering and Physical Sciences Research Council (EPSRC) and operated by ten UK universities.

Among the projects that Clarke announced, amounting to £6million, are an advanced real-time video camera, a crucial component in a new technique that uses light and sound to eradicate some of the most lethal forms of cancer; a project that will be pioneering fully-automated hands-free molecular discovery to produce drugs faster and a new facility that will revolutionise the way samples are produced and harness Artificial Intelligence (AI) to generate new drugs for clinical testing within a few weeks.

Commenting Professor Philip Nelson, EPSRC’s Executive Chair, said: “Research here at the Harwell hub, and at the universities that form the spokes of the Institute, will help the UK maintain a leading position in the application of engineering and physical sciences to problems in the life sciences.”

The RFI will operate on a ‘hub and spokes’ model, with a central hub at the Harwell Campus in Oxfordshire, delivered by the Science and Technology Facilities Council (STFC).

The hub, which is due to open in 2020, will be home to 150 researchers and will work closely with neighbouring facilities that include the Diamond Light Source and STFC’s Central Laser Facility.
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With the National Health turning 70 in July it will provide an opportunity to celebrate one of the most enduring institutions to have been created by the UK since 1945, but it is also likely to highlight growing concerns that an increasing number of key services are being overwhelmed in the face of rising demand from an ageing population.

The extra billions recently announced by the UK Government will help, but health and social care services are likely to remain under unprecedented pressure, despite figures, supplied by the King’s Fund, which shows that healthcare is taking up an increasing proportion of the UK’s resources accounting for around 8% of GDP, compared to 3.4% fifty years ago.

Could technology square this circle? Many believe it could, delivering a more modern, efficient and responsive health service that’s better prepared for future challenges, but in truth, the challenges facing the health service can’t be solved by technology alone.

The digital health landscape is changing rapidly and as a global market is expected to be worth £400bn by 2025.

That rapid growth provides opportunities for innovative solutions that could transform the delivery of services and tackle some of the health challenges facing healthcare systems.

For example, the NHS deals with over 700,000 patients every day. Over 18million Britons are thought to have chronic health conditions and a quarter of the UK’s population is set to be over 65 by 2040.

“There are numerous successful tech innovations happening at the frontline of health and social care,” according to the Institute of Public Policy Research, “but the current under-utilisation of both medicinal and digital technology means that there is a real opportunity to unleash a new wave of innovation that could have a revolutionary impact on how care is delivered, and how patients interact with professionals and manage their own health and care.”

From opening up new possibilities to treat patients remotely, as well as improving patient flow through digital appointments and access to medical records, to the sharing of information between emergency services, the opportunities to use technology to improve health outcomes are profound.

Wearable technology could provide a vital component in solving many of these problems, reducing the demands on family doctors and other primary care providers. Wearable technology has the potential to reduce hospital admissions and
bed stays and could end up being placed right at the front of the patient ‘pathway’ into the NHS.

The problem with the greater adoption of wearable technology is that among NHS trusts, some 80% are unprepared for the impact of wearable technology.

Practitioners are also unwilling to use it unless there is evidence of benefits.

Data management
The NHS produces vast amounts of data. Technology can better provide and store that information, making it easier for patients to organise appointments as well as monitor their symptoms more easily.

A report from Reform, the think-tank, found that 12% of us already use wearable fitness trackers. That data could be analysed to potentially help detect, diagnose, treat, or manage many different medical conditions.

Combined with electronic medical records, remote monitoring, and information captured from other sensors or apps, there are real opportunities to deliver healthcare more efficiently.

The use of data, however, poses challenges for managers and operators in terms of safety, security and ethical concerns.

According to a survey, the results of which were published at the HIMSS Healthcare Security Forum, recently held in San Diego, California, over a thousand patients suffered harm when their medical devices were hit by cyber-attacks.

The research, undertaken by the University of California, highlighted the importance of security in maintaining the safety of patients, according to Garrett Sipple, managing consultant at Synopsys’ Software Integrity Group.

“Medical devices often move through long product development cycles that can make them slow to react to new cybersecurity threats, especially if cybersecurity wasn’t even a key consideration in the development process,” Sipple suggests.

Sipple warns that where it was found that the security of medical devices had been breached, inappropriate healthcare had been delivered to the patient as a result.

“One of the key themes in this research is the critical role that systems must play in the healthcare sector, because there is shared responsibility among regulators, manufacturers, healthcare providers, and patients,” he explains.

“While software security has been discussed for many years, fewer people are talking about systems security and integrating security into systems engineering. The healthcare industry must solve this problem at the system-of-systems level, as well as for individual products like MRI machines and patient monitors.”

According to Sipple, “The key is evaluating security at every layer in a product or system lifecycle – systems, software, firmware, hardware.”

Despite the security risk, better use of data will be crucial to improving patient outcomes.

Speaking at TechXLR8 in London, earlier this month, Juliet Bauer, Chief Digital Officer, NHS England, said, “We all know the challenges facing the NHS and the importance of improving communications between patient, carer and professional. Used collectively, data and information could improve our health system beyond recognition.

“If we are better able to connect services, we know we will see better outcomes and experiences. We can use data to use our resources more effectively as well as encourage the development of personal healthcare plans.”

The introduction of remote monitoring, the Internet of Things, wearable and smartphone technology could be used to help empower individuals.

Robotics and AI
Beyond the use of data, many technologists are focused on the role of robots and artificial intelligence (AI) in providing key services in the NHS.

Could we see robots being deployed to help patients eat their meals, or diagnose a serious illness or help patients recovering from operations?

In a new report looking at the possible impact of AI on the NHS, it was suggested that machines could take over a wide range of tasks currently done by doctors, nurses, healthcare assistants and administrative staff.

“Given the scale of productivity savings required in health and care - and the shortage of frontline staff - automation presents a significant opportunity to improve both the efficiency and the quality of care in the NHS,” said the report from the Institute for Public Policy Research (IPPR).

The report stipulated that widespread adoption of AI and the NHS embracing “full automation” could free up as much as £12.5bn worth of staff time for them to spend interacting with patients each year.

As well as “bedside robots” helping patients, the report suggested that, “someone arriving at hospital may begin by undergoing digital triage in an automated assessment suite. AI-based systems, including machine-learning algorithms, would be used to make more accurate diagnoses of diseases such as pneumonia, breast and skin cancers, eye diseases and heart conditions.”

AI could be used to help predict which individuals or groups of individuals are at risk of illness and allow the NHS to target treatment more effectively.

The UK Prime Minister, Theresa May, has already pledged to bring forward a long-term funding plan that will look to transform care models and make the most of new technologies and data in healthcare.
The challenge for health providers is to ensure that new opportunities can be grasped, that NHS staff have the right digital skills and the right technology is in place to improve care. But it is not just in the NHS where innovation can help meet care demands. A huge potential benefit of remote technology is that people can more easily remain in their own homes whilst being properly monitored. They can also be monitored whilst in care homes instead of having to be admitted to hospital. Given that the annual cost to local Government of adult social residential care is approaching £10bn, there is potential for digital technology adoption to help local authorities meet demand in social care.

It appears too, that a previously sceptical public is coming around to the idea of increased use of AI and robotics in healthcare. Research undertaken by PWC found that 39% of people would be willing for a computer or robot to diagnose medical conditions and even recommend treatments. More than a third (36%) said that they would have no issue with a robot carrying out minor, non-invasive surgery on them, while 26% said that they would be happy for a robot carrying out major, invasive procedures.

However, Andrew Foster, chief executive of the Wrightington, Wigan and Leigh NHS trust says that while it’s realistic to assume that significant elements of patient care could be improved by robotics and artificial intelligence. “We must never forget the fundamental importance of human care, compassion, empathy and even the importance of a gentle, physical, human touch. For it to be welcomed, health services will have to sensitively blend new technologies with old-fashioned care.”

**Drug discovery**

But it is not just the cost of delivering health that is straining budgets. The cost of making and developing a pharmaceutical drug is expensive and typically takes around twelve years. Drugs need to be thoroughly tested before they can be licensed, and the cost of drug developments is soaring, causing real problems for the NHS, which in some cases is forced to ration expensive drugs.

In response, a new project has been set up to develop technology that will help to drive faster and more effective drug discovery.

Based at the Rosalind Franklin Institute (RFI) in Harwell, Oxfordshire, this Government-backed project will look to pioneer fully-automated, hands-free molecular discovery to produce new drugs up to ten times faster in a project that could help to transform the UK’s pharmaceutical industry.

New drugs are discovered through a slow and painstaking process that relies on optimising candidate molecules to allow the discovery of a drug that can treat an underlying disease.

The RFI will look to develop an integrated suite of new technologies that will accelerate the discovery of high-quality lead molecules, which will help to reduce the cost of drug discovery.

The project will be developed through a collaboration between large companies, SMEs, several universities, and the Medicines Discovery Catapult.

According to Professor Adam Nelson from the University of Leeds, drug development is, “A rather conservative process, using a small number of building block types and a limited suite of reactions means we are only exploring a very small area of chemical space.

“It costs around $2bn to bring a new drug to market because for each new marketed drug you have to start with around 50 drug discovery projects.

“This won’t be a traditional chemistry lab. It will have a unique design and harness robotics and AI to automate the discovery process. It will allow hundreds or thousands of candidate molecules to be investigated at a time. Our aim is to increase productivity by 5 to 10 times.”

At the heart of the new facility will be a number of new instruments that will allow the direct observation of the interactions between drug candidates and target proteins, harnessing disruptive new technologies such as AI and robotics.

Commenting, Professor Ian Walmsey, Pro-Vice-Chancellor of Research & Innovation at the University of Oxford and Chair of the RFI’s Interim Board, said: “The RFI will pioneer disruptive technologies and new ways of working to revolutionise our understanding of biology, leading to new diagnostics, new drugs, and new treatments.”

The NHS has been criticised for being slow to embrace new technologies. That’s not surprising when you are dealing with people’s well-being, but the increased use of data, robotics, and AI has the potential to transform healthcare in the UK, whether that’s on the frontline in operating theatres or A&E, in reducing administrative work or, as described above, in transforming the delivery of new drugs.
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With the number of trains using the rail network doubling in the last 10 years and the number of passengers anticipated to rise by a further 40% by 2040, managing increased capacity is its biggest challenge, according to Network Rail.

The rail network in the UK was not designed to cope with this level of demand, which is causing track lifetime to tumble and raise the importance of effective maintenance.

As technology has developed, rail maintenance has become easier to perform and manage, allowing a transition from traditional, labour-intensive, manual upkeep to much faster, safer, more accurate and efficient solutions.

Sensors, for example, are being used to monitor areas of the track such as point machines and track circuits, and their use is growing, according to Network Rail.

The sensors are fixed ‘in location’ and comprise of Edge processing which is transmitted via GSN with o2 sim cards to Network Rail’s SCADA system, Wonderware.

“This allows us to monitor the condition of the track and prioritise where we need to focus our efforts,” Tim Flower, Head of Maintenance at Network Rail, says.

“Rail maintenance is about understanding that failure is going to happen,” he adds. “We use the data gathered by technology, like sensors, to trend failure, so accurate predictions can be made. That way we can identify what’s going to fail, when it’s going to fail, and hopefully, why it’s going to fail.”

To support rail operators, Konux, a German sensor company, has developed an intelligent, IoT sensor solution system called KORA that monitors and analyses switch health.

The switch or ‘point’, according to its CEO, Andreas Kunze, is “one of the most crucial elements of the track”, and accounts for 20% of train delays maintained is essential to the train service.

KORA monitors the condition of rail assets, wirelessly measuring elements like acceleration, vibration and communication via GSM. The raw data is pre-processed in the sensor, selecting only the necessary data needed to allow for more efficient transmission. This data is then sent into the Konux backend system and fused with the data Konux has received from its customers. For example, information about weather, schedules, and the point machines (the closing and opening of the track).

Artificial intelligence is then used to identify and assess issues in this data – with the system comparing the ‘digital footprint’ of the healthy assets with the results of continuous monitoring, flagging up any anomalies.

“This is how we help train companies move away from the very costly inspection protocols that were previously needed,” Kunze contends.

He points to the importance of a wireless system. “In rail, you don’t want cable everywhere – every metre costs thousands. But, going cable-free
means battery management is vital. “The development of both low powered systems and communications have really helped rail maintenance to progress,” he continues. “Advancements in communication technology enables us to send more data, more quickly. While the control we have over power, means we can limit the maintenance of the sensor device itself. Rail companies don’t want to have to go out every month to replace parts.”

According to Kunze, the materials used were another crucial consideration. “It has to be robust, not just from a mounting perspective, but the whole device has to be able to cope with shock and adverse weather conditions.”

Whilst developing its piezoelectric MEMS hybrid sensors, Kunze explains that Konux dedicated three years to proving the product could survive in the harsh environment.

**Harsh conditions**

A harsh environment, however, isn’t always a problem. In fact, Network Rail actually uses these conditions to its advantage. Its sensor system, supplied by Perpetuum, harvests energy from the movement of the train to power itself.

Along with the 60 thousand sensors it has deployed, Network Rail also uses machine vision systems and ultra-sonic testing to inspect track damage – a task that is difficult, time-consuming and unsafe for human workers.

Network Rail has a series of trains that measure different types of equipment to understand how they’re performing against baseline parameters. This technology is used to measure the track geometry and plain line pattern using linescan, 3D and thermal imaging cameras to scan the track as it passes below the ‘measurement train’.

These cameras record raw images at up to 76 kHz, allowing images to be captured at speeds up to 125 mph. The cameras store the information on the device and this is then downloaded to an on-board computer and decoded by a machine vision software, synchronised with real-time positioning system and geometry data, and analysed by an on-train inspector. Reports are dispatched to the ground teams, helping them locate any faults.

Ultra-sonic testing is used to identify cracks naked to the human eye, which often occur in the railheads, due to stress concentrations at these geometrical discontinuities.

One team of researchers from the University of California is developing a solution to overcome the issue of ‘air gaps’ currently experienced in traditional probing methods. According to Assistant Professor Sheng Xu of the University of California, due to the curved nature of railheads, it’s difficult to get solid interfacial contact and therefore, good coupling with irregular nonplanar surfaces. This can lead to large acoustic energy reflections and wave distortions, resulting in unreliable test results. Defects, like detail fracture and transverse fissure, can’t be tested from the top of the railhead, and require the operator to hold the transducer on the side of the track. According to Assist Prof. Sheng, this is time-consuming, labour intensive and can result in inaccurate measurements.

Assist Prof. Sheng and his team are developing a low-profile membrane-based stretchable ultrasonic probe which exploits an array of thin 1-3 piezoelectric composites as transducers, multi-layered serpentine metal traces as electrical interconnects, and low-modulus elastomer membranes as encapsulation materials.

“The soft elastomer encapsulation materials allow the device to intimately conform on the side of the railhead, providing excellent acoustic coupling. The ‘island-bridge’ layout offers biaxial stretchability of more than 50% with minimal impact on the transducer performance so that the device can work on nonplanar complex surfaces railway tracks,” Hongjie Hu, part of the California team, explains.

Despite being “close to commercialisation”, the team say they need to first improve the spatial resolution to enhance the accessibility and image accuracy.

According to Flower, the most valuable transformation electronics has enabled is the real-time monitoring of asset performance. “We can monitor not just on a day-to-day basis,” he says, “but by the hour and minute. This has reduced the number of point failures by around 30% and track circuit failures by 25%.”

Flower believes the rail infrastructure will one day move completely away from manual maintenance to an “almost factory-type inspection system”. He points to big plans with Network Rail and technology, including automated tunnel inspection and pantograph monitoring.

The challenge, he says, is finding a balance between accuracy, repeatability, information and cost. “We need to improve maintenance without providing the person who has to deal with it, huge amounts of data to analyse,” he concludes.

And with Network Rail planning to introduce 7,000 new carriages on the railway network by 2021 and 6,400 new train services, let’s hope the balance is found quickly and these big plans keep on track.
Meeting the mil-aero challenge together

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<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Title</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>COMMENT</td>
<td>2018 marks the 50th anniversary of New Electronics</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>TECHNOLOGY’S IMPACT</td>
<td>Society today is very different from that of the 1960s. One thing is clear though, and that is the profound impact technology has had on the way we live. As Neil Tyler explains</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>A DANGEROUS CURVE</td>
<td>The idea of a learning curve dominates the electronics industry. But it is also one where a small change in technique quickly scales into a disruptive competitive advantage. By Chris Edwards</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>HOT AND COLD</td>
<td>In Britain, the microelectronics industry has been subject to Government involvement, lurching from hands-on to arms-length. Dick Selwood takes a look back over the past 50 years</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>FROM FET TO 5G</td>
<td>In the 1960s, microwave technology was a specialist niche. In the five decades since then, it has become the key enabling technology for cellular communications, as Helen Duncan explains</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>MOUSER</td>
<td>Only 50 years old?</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>ANALOG DEVICES</td>
<td>Where one plus one truly exceeds two</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>ANGLIA COMPONENTS</td>
<td>Anglia continues to outgrow the market</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>XILINX</td>
<td>The Ages of the FPGA</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>ARM</td>
<td>The future depends on designing fearlessly</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>BINDER</td>
<td>50 years and we are still innovating</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>COMPONENTS BUREAU</td>
<td>Wireless Solutions for IoT and M2M</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>FISCHER</td>
<td>Breakthrough technology makes connectivity EASY</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>OMC/LEDTECH</td>
<td>LEDs have come a long way in 50 years; Ledtech opens UK facility</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>INTEL PSG</td>
<td>Intel at 50</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>JAUCH QUARTZ UK</td>
<td>Perfect timing</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>LEMO</td>
<td>70 years of innovation and enterprise</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>PICKERING ELECTRONICS</td>
<td>Celebrating five decades</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>RAPID ELECTRONICS</td>
<td>Helping you make it</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>GREEN HILLS SOFTWARE</td>
<td>Better tools, better process, better software</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>WILSON PROCESS SYSTEMS</td>
<td>The Wilson way</td>
<td></td>
</tr>
</tbody>
</table>
Here’s to the next 50!

The changing face of electronics over the past 50 years

A year of seismic social and political change 1968 saw anti-Vietnam war protests in London; the assassinations of Robert Kennedy and Martin Luther King Jr; the creation of Intel Corporation; and a music scene still being set by the likes of the Beatles and the Rolling Stones.

1968 also saw the launch of New Electronics and, while in no way am I drawing comparisons with those other momentous events, the fact that we have been around for half a century and are able to celebrate our 50th anniversary, is no mean achievement.

The electronics industry and technology on which we have reported, have changed profoundly in those 50 years, and it’s been fascinating to look back through past issues of New Electronics. It’s certainly surprising to find how far back it is possible to go tracing the origins of some of the technologies, that today, are deemed to be ‘state of the art’.

The 1960s saw a period of great social change and advances in communications technologies. Along with the space race it saw the invention of the cash dispenser, the commercialisation of the computer for business, and the development of the computer mouse. The first computer video game was also invented.

In the 1970s Microsoft appeared, along with the first portable computer. It also saw the first documented Internet connection.

Turning to the 1980s, which has been described as the decade that heralded the computer age, the birth of the IBM PC signalled the start of today’s personal computer, while Apple’s Macintosh heralded much greater things to come. Oh, and the first digital cellular phones appeared.

Looking back at the 1990s, the creation of the World Wide Web, the Internet protocol, and language laid the foundations of the Internet as we know it today. It also saw the arrival of 2G mobile phones.

And what of today? Autonomous vehicles, robots, artificial intelligence, virtual and augmented reality, crypto-currencies, the Internet of Things - much technology that was unavailable 10 years ago, let alone 50.

Across those 50 years, New Electronics has been there, reporting on new products, identifying new technologies and trends and interviewing leading industry figures.

As editor of New Electronics, I’d like to take the opportunity to thank our readers and advertisers, who have supported NE over the past 50 years, and I look forward to continuing to provide electronic designers with informative, practical and, on occasion, entertaining news, comment and articles.

And like the Rolling Stones, we intend being around for a few more years yet!

Neil Tyler, Editor (neil.tyler@markallengroup.com)
Only 50 years old?

50 is a big milestone, and I’m sure that everyone here at Mouser Electronics will join me in wishing New Electronics ‘happy birthday’ and congratulations on being the go-to source of information for UK design engineers for five decades.

Mouser, in fact, is just a little older – we were founded in 1964 by Jerry Mouser, a Californian physics teacher who needed components for an electronics program at his high school. Since that time, of course, we’ve seen many changes: changes which are necessary to stay relevant in a world which is much more competitive today than it was back when Mouser and New Electronics both started out. That’s the challenge for any organisation of any longevity – to remain a vital part of the customers’ ecosystem.

As far as Europe is concerned, Mouser’s history goes back a little over 10 years. In 2008 the company opened its headquarters in Munich, and followed that with branch offices – now nine – all across the continent. At that time, my colleague, Mark Burr-Lonnon, now Senior Vice-President, EMEA, Asia and Global Service laid out our plans: “We are not trying to be all things to all men”, he explained. “Our mission is to support design engineers with the latest parts and technologies – readily available from stock and delivered within two-to-three days – so that they can differentiate their designs and gain a competitive advantage.”

In an interview with a leading German publication a couple of years back, Mouser’s CEO Glenn Smith reiterated: “We are the NPI - New Product Introduction – distributor.” What this means to customers it that it can take many months for some of our competitors who broadly occupy the ‘catalogue’ or ‘high service’ space to be able to supply a new part, whereas we make it easy for our manufacturing partner suppliers to get their new products into our portfolio as quickly as possible – ideally on same day as they are released by the manufacturer. And we are stringent about the parts we advertise: they must be new releases and the latest technology – otherwise although you will still be able to find them on our website, they won’t be heavily promoted. We also will not promote a part until we have freely-available stock in our warehouse, immediately ready for shipping.

As the old saying goes: ‘Jack of all trades, and master of none’. Electronic component distribution – we believe – is no different in this respect to any other activity, and it is certainly our experience at Mouser that the needs of the design engineer differ considerably from those of the buyer looking to support full production. We have structured our business specifically to support design-in activity from initial conceptualisation through to prototyping and initial low volume production ramp-up.

Our position on supporting design and development activity has not changed in well over a decade. However, how we achieve that has seen many developments. But first, let’s talk about the other ‘unchangeable’ – the availability of stock. Simply put, many distributors do not hold as much inventory as they used to do. From a fiscal point of view, to the accountants, this must seem like a great policy. For the customer, however, he may not know he needs a part until he learns about it – from the web, through magazines and other promotions, a colleague, perhaps. At that moment, he needs that part as soon as possible. He can’t wait around for a distributor to put in a stock request to a manufacturer. Worse, for development purposes, he may only need a small number of parts; most distributors don’t want to deal with such small orders.

At Mouser, by contrast, all our stock listed on our website is immediately available for anyone to purchase. In as small a quantity as they like. In most parts of Europe, that means that an order placed by 5pm will be picked, packed & shipped the same next day and will arrive with majority of our customers throughout Europe in 2 days. And when we say anyone, we mean it. Mouser treats everyone the same.

OK, so much for ‘plus ca change, plus c’est la meme chose’, let’s now look at changes that Mouser is making to support changes in the market.

Infrastructure
A number of factors have come together to produce a vibrant market:

- The accelerating move to hybrid and electric vehicles plus Automotive in general
- The emergence of real IoT applications – Industry 4.0/factory automation; remote diagnostics; wearables; connected auto; smart grid/metering
- The realization of technologies such as GaN to deliver extreme performance
- Security issues
- The rise of the pro-maker sector

Mouser targets all industry sectors, supporting design activities from conceptual, through initial prototype and into low volume production. In Europe, the company has grown in excess of 30% year on year for many years: currently our run rate is above
With the so-called ‘democratisation of design’, it’s not only experienced electronics design engineers that are developing new electronic systems, other professions are taking advantage of the IoT to develop specific solutions inspired through their daily experience. So, for example, a nurse might envisage a patient-monitoring system that needs a complex sensor solution. An architect might come up with the most efficient home-automation product, or a machine operator might innovate a new way to record and communicate wear on the production line. Distributors need to support both electronics engineers and these emerging pro-makers.

We believe that distributors must become a knowledge center – perhaps the knowledge center – for their customers. Therefore, Mouser’s web site now also includes white papers, trend articles, technical articles, videos, blogs, applications notes.

Mouser works very hard to ensure we don’t bombard our customers with emails; we want only to deliver relevant information. Yet, of course in the light of recent political scandals there have been ever-stronger calls for personal information to be kept secure, and we are just seeing the implementation of new European GDPR data protection regulations. While many companies will view this as ‘more bureaucratic red tape’, Mouser believes that the steps that it has had to take to comply with the new laws have brought a closer understanding of customer needs. Previous ‘click box’ type permissions provided no information. With the GDPR regulations we have gained better visibility about our customers’ needs, so we can provide them with information that they find useful and interesting. We positively encourage customers to tell us what they like and don’t like."

These are just a few of the ways we’ve been changing to remain relevant and an essential part of our customers’ design processes. We know that New Electronics will similarly remain focused on its goals – yet flexible and welcoming of change. New Electronics is a key media partner for Mouser and as such we plan to continue to support the excellent work of the publishing team with more articles and joint promotions as well a the EDS show which has proved very popular with UK design engineers. Congratulations to all at the Mark Allen Group for continually developing your support for our industry.
Even with beginnings separated by 16 years and more than 3,000 miles, the union of Analog Devices (ADI) and Linear Technology Corporation (LTC) reveals two companies that share remarkably similar paths to success.

Both roads led through many of the same types of challenges and milestones, from taking risks to delivering industry firsts, and to always working at the leading technological edge of the industry. And through it all, both companies maintained a solid focus on their customers.

Risk-taking

Started as a manufacturer of high-performance operational amplifiers, ADI reached $5.7 million in sales after just three years. While many would be content with that level of achievement, ADI’s founders were focused on the future. In 1969 ADI acquired Pastoriza Research, a manufacturer of circuit boards and modules that converted analog signals to digital. That set the course toward developing innovations to bridge the world around us to the burgeoning digital world to come.

While ADI would parlay its success into other bold investments, the very establishment of LTC seemed to fly in the face of conventional thinking. Founded in 1981, Linear Technology focused on analog technology while much of the world was embracing the start of the digital age. Yet the vision and courage of the organization’s leaders helped LTC become one of the most prosperous and respected companies in the analog industry.

Together at the leading edge. Together leading the industry.

From the PC revolution and the birth of the CD layer, to industrial control and robotics, cellular communications, and automotive electronics, ADI and LTC have been at the forefront of new technologies and innovations. And in 2017, they came together as one company to take the industry even further.

With a shared culture of innovation and a passion for problem-solving, each company also brought complementary strengths to the newly combined organization. ADI is the industry’s biggest supplier of data converters, while Linear Technology has traditionally focused on power management. Together, the new organization is an industrial powerhouse that is able to offer a complete signal chain product portfolio to its customers—including expertise in RF, sensing, measuring, interpreting and other key capabilities that take silicon to software to cloud.

As the world accelerates toward greater digitization, solving the problems of tomorrow comes at the intersection of the physical and digital worlds. ADI continuously creates unmatched technologies that are taking digital to the next level, helping customers solve the toughest obstacles, and supporting them to create safer automobiles, faster networks, greener energy, better healthcare, and smarter buildings and machines. With over 4,700 patents and a workforce of 15,000 problem solvers, combined with know-how all along the signal chain, security and cloud, ADI is positioned to solve the most difficult and complex challenges across emerging disruptive markets. Through the achievements, innovations, and pioneering leadership of the past fifty years, ADI has evolved into the company ideally positioned to build the solutions of tomorrow and advance customers through the next 50 years and beyond.
wave applications.
2015 – The Future Turns 50 as ADI celebrates five decades.
2017 - 1 + 1 > 2: ADI and LTC unite to become a new industry leader

Linear Technology
1986 – LT1070 – First 5A single chip easy-to-use switching regulator
1989 – First CMOS low power RS485 chip (LTC485)
1992 – Hot Swap™ family
1993 – Burst Mode® DC/DC converters
1999 – High efficiency, multiphase synchronous switching regulators
2001 – Power over Ethernet (PoE) controllers
2008 – First precision battery monitor device for hybrid/electric vehicles
2010 – The AD5791, the world’s first 1 ppm 20-bit DAC, achieving a new level of precision, and once again raising the bar in converter technology and solutions
2013 – ADC precision broke yet another record as the AD7176 24-bit Sigma-Delta converter became the first device that could resolve 60 parts per billion – accurately
2014 – The acquisition of Hittite Microwave Corporation significantly reduces EMI emissions
2015 – With the introduction of the LTC4120, LTC enters the wireless battery charging space

Company Milestones
The successful run of both companies produced notable accomplishments along the way. Here are just a few from each organization:

Analog Devices
1967 – Analog Dialogue, the first issue of what would become the longest-running in-house publication in the electronics industry
1971 – AD506, first laser-trimmed linear IC FET-input operational amplifier
1973 – AD7520, First CMOS DAC
1978 – AD571, first monolithic ADC
1988 – World’s first complementary bipolar (CB) process, along with BiCMOS, combines logic and high performance analog on a single chip
1991 – First MEMS ADXL50 accelerometer making airbags safety systems more reliable and cost-effective
2000s – Virtually every cell phone call made anywhere in the world passes through an ADI chipset inside network base stations
2010 – The AD5791, the world’s first 1 ppm 20-bit DAC, achieving a new level of precision, and once again raising the bar in converter technology and solutions
2013 – ADC precision broke yet another record as the AD7176 24-bit Sigma-Delta converter became the first device that could resolve 60 parts per billion – accurately
2014 – The acquisition of Hittite Microwave Corporation greatly strengthens ADI’s innovation capability across RF, microwave, and millimeter
Fifty years is a long time to look back on, and when it comes to identifying those technologies that have made a real impact on our lives, the debate as to what should be included can be intense.

So many new technologies have appeared and the pace of change continues to accelerate. One thing that is clear though, is just how different society has become, due – in no small part – to the technologies that have appeared since New Electronics was first published in the summer of 1968.

Fifty years ago, we were seeing the first really significant advances in communications technology, and the US and USSR were locked into the ‘space race’, to see who could get a man to the moon first.

In the UK, arguments were raging over the delays and cost of two major technological projects: Concorde, and the ocean liner, the QE2. Plus ca change!

Likewise, concerns were growing over the competitive threat posed by Japan, especially in terms of technology. Fast forward 50 years and similar worries are now being expressed about China and other emerging economies.

The 1960s was the decade in which the computer was commercialised for the first time and the first computer video game invented.

Over the subsequent 50 years, new technologies and companies have appeared and then faded, historic names have come and gone.

Although open to debate, it could be true to say that the world we live in today was invented in the 1980s. It saw the start of the computer age when many of the most popular consumer products, that are still around today, first appeared. MS-DOS appeared, so too, did Apple’s Macintosh. The CD-ROM, disposable cameras, and the first 3D video game... called ‘Robot’ all made their first appearance in the decade of Thatcher, Reagan, and the collapse of Communism.

Since the 1990s and the turn of the century, innovation has accelerated at an unprecedented rate and given rise to all manner of devices that, until a few years ago, were often deemed ‘science fiction’.

No sector of the economy has avoided the impact of technology - and that’s not going to change.

We are now living in a modern, increasingly connected society. A brave new world, but one that brings with it fresh challenges. Technology can improve our lives, but, in the case of robotics, we need to consider both ethical and societal issues as we look to introduce them into all aspects of our lives.

As technology becomes more pervasive, calls are being made for national and international efforts to promote better global governance of technology development, and, with the growth in cybercrime, the issue of security is set to have an impact on every aspect of our lives.

The impact of technology

Looking at the technologies that have had most impact on the way we live over the past 50 years, those that spring to mind include: the Internet and the rise of the Internet of Things (IoT); space exploration; genetic engineering; the mobile phone, robots and artificial intelligence.

The first real robot appeared back in 1954 when industrial robots appeared. Built by George Devol, the ‘Unimate’ was the first material handling robot employed in industrial production work.

A few years later, the Massachusetts Institute of Technology (MIT) founded its Artificial Intelligence Laboratory as it looked to research into how we could mechanically mimic human minds as well as hands.

Fifty years on and hundreds of thousands or robots now assemble
products better, faster, and often, more cheaply than manual workers. New advanced software is helping us to work, play and travel more easily than ever before, and in San Francisco, IBM’s Project Debater was recently able to listen and argue with a human, in what is being described as a ‘ground breaking display of artificial intelligence.’

IBM has a pretty good track record when it comes to displays of technology. The Watson supercomputer was able to win the Jeopardy games show back in 2011, and years before that, Deep Blue stunned the chess world with the defeat of Garry Kasparov.

As for having an impact on the way we live, cellular phones would surely have to be top of any list. The first time the concept of a mobile phone was mooted was way back in 1947. The first call was made in 1973 in Manhattan, outside the Hilton hotel. Carried out by a Motorola researcher, Martin Cooper, it was to herald a profound change in the way people interacted with one another and with the world around them.

Nearly fifty years on, and the mobile phone is ubiquitous. Almost everyone has one. Look around. Texting, listening to music, shopping or simply surfing the Internet, the mobile phone has completely changed the world and made it a ‘smaller’ place.

Communication has become more affordable and cheaper and every user has access to vast amounts of knowledge.

But at what cost? Is the mobile now our preferred companion? Do we no longer need company, as long as we have our phones?

Back in 1968, the US was racing to place a man on the moon. It won! While we’ve yet to return, we’re now looking to send a manned exhibition to Mars.

In terms of conquering space, while we haven’t come as far as expected back in in 1968 - no Stanley Kubrick’s 2001 and certainly no Moon Base Alpha - the space race provided the foundation for the development of hundreds of enabling technologies, including integrated computer circuits.

IBM’s role in recasting the desktop computer from hobbyist’s gadget to office automation tool in 1983 - followed by Apple’s Macintosh a year later - helped to universalise computing and actually made the computer ‘cool’. Computers were no longer the size of a small car, and could be used to play games, send messages and help us work harder and more productively.

But, looming over all of this surely is the Internet, which has brought the greatest transformation to all our lives in the past half century.

The Net’s strength and weakness is that it’s the world’s largest library, but it’s also a global news channel, a social club, research archive, and shopping service. It’s a home for political debate, for good or ill. But crucially, it has been the most affordable mass medium ever devised.

As with any technology it has positive and negative impacts on society. More people now believe that it is a mix of ‘good and bad’, caused in no small measure by the activities of behemoths Facebook and YouTube.

Technology is moving at an ever-increasing pace and when it comes to the Internet, perhaps Mao Tse-tung’s misquoted comment about the French Revolution, that it was too early to say anything about its impact, could be equally true of the Internet.

For many, the technology that we use and take for granted today would have been unimaginable when New Electronics first appeared.

So, here’s to the next 50 years!
Congratulations to New Electronics on your 50th Anniversary and thank you for being part of our journey.
Anglia continues to outgrow the market as it celebrates 45 years

Anglia Components shows no sign of slowing down in its 45th year, having outgrown the market by a factor of five over the last ten years. Anglia’s turnover grew 52.4% between 2006 and 2016, while the market grew just 9.4% in the same period based on ecsn figures. Founded by Anglia President Bill Ingram in 1972, Anglia is now the UK’s largest privately owned component distributor with an on-target turnover of £60.8 million in 2017. Steve Rawlins, CEO of Anglia, discusses what makes the company special to its customers and the staff who work with them.

Q. What lies behind Anglia Components extraordinary growth over the last ten years?
A. We have stuck with our core business model, which hasn’t changed over Anglia’s history. We have always been privately owned, retained a UK warehouse and maintained one of the highest inventory levels in the business. Exceptional service and technical support set Anglia apart, providing the basis for stable and strong customer relationships. With no outside investors, we have more freedom to make long term decisions, and to partner with our customers to create success for them – which is also success for us. We have outgrown the market for the last ten years and are confident that we can maintain that growth to reach £100 million by the time we’re 50.

Q. What makes Anglia different from a customer perspective?
A. Anglia offers the accessibility of High Service Distribution, effective FAE support and competitive volume pricing. You can design with us for small quantities, and then move to volume at a sensible price.

We’ve just introduced more price breaks and smaller pack quantities to support customers in the design and prototype phases of a project. We’ve also hired more FAEs.

When we design with you, we recommend components that are not only technically suitable but also likely to be available for the life of the project, on a realistic basis, without high MOQs. For the volume production phase, Anglia holds higher stock levels in proportion to our business than most. This inventory is held in the UK and priced competitively, with flexible shipment options tailored to your needs.

Q. What does Anglia offer customers in the design and prototype phases?
A. Anglia is committed to supporting customers through all the phases of a project’s life from initial design through prototype to volume production. Customers looking to order low volumes for design and prototype phases can now access stock items on commodity Surface Mount parts in small quantities supplied in cut tape format. Up to ten breaks can now be shown for each part, giving customers much greater choice and complete transparency of pricing. With small pack quantities, our support in the early phases is now as comprehensive and flexible as our support during volume production.

Q. How are you developing Anglia Live?
A. Anglia Live has seen steady growth and we’re continually enhancing and improving it to broaden its appeal. Up to ten breaks can now be shown for each part. Other enhancements include improvements to loading speed and streamlining navigation. Vertical market sections have been added covering IoT, Industrial, Lighting and other applications.

Q. Finally, how does Anglia support customers with the component shortages that are currently impacting the industry?
This is a real issue and is becoming more widespread: chip resistors are the latest class of components to be affected. We are constantly looking at ways to help our customers and ensure that they are aware of the current market conditions. We foresaw that a shortage in chip resistors was coming about 6 months ago and invested heavily in inventory in order to protect our customers.

When the supply chain tightens, we focus on supporting regular customers with scheduled orders – customers that work with us get the best support. At the moment we won’t supply brokers with shortage parts even if invited to ‘name our price’! I would strongly advise our customers to get their orders in or take on inventory now whilst stock is still available.

“We have stuck with our core business model, which hasn’t changed over Anglia’s history.”
Steve Rawlins

www.newelectronics.co.uk  26 June 2018
Since their introduction, FPGA devices have progressed through several distinct phases of development. Each phase was driven by both process technology opportunity and application demand. These driving pressures caused observable changes in the device characteristics and tools. These Ages of FPGAs, are:

- The Age of Invention
- The Age of Expansion
- The Age of Accumulation
- The Age of System

The Age of Invention: 1984-1992

The first FPGA, the Xilinx® XC2064, contained only 64 logic blocks, each of which held two 3-input Look-Up Tables (LUTs) and one register. By today’s counting, this would be about 64 logic cells - less than 1000 gates. Despite its small capacity, the XC2064 die was very large and the 2.5-micron process technology was barely able to yield the device.

Die size and cost per function were crushingly vital. The XC2064 had only 64 flip-flops but cost hundreds of dollars because its die was so large. Yield is super-linear for large die so a 5% die-size increase would double costs and could have dropped yield to zero. Cost-containment was not a question of mere optimization; it was a question of corporate survival.

As a result of cost pressures, FPGA architects turned to architectural and process innovations to maximize FPGA design efficiency. Although SRAM-based FPGAs were re-programmable, on-chip SRAM dominated the FPGA’s die area. Antifuse-based FPGAs eliminated the on-chip area penalty for SRAM storage (at the loss of re-programmability). In 1990, the largest capacity FPGA was the Actel 1280, which was antifuse-based. Quicklogic and Crosspoint followed Actel and developed FPGAs based on the antifuse. In search of efficiency, architectures spanned the space from complex LUT structures to NAND gates, down to individual transistors.

During the Age of Invention, FPGAs were much smaller than the applications that users wanted to put into them. As a result, multiple-FPGA systems became popular and automated, and multi-chip partitioning software became an important component of an FPGA design suite.

Radically different FPGA architectures precluded universal design tools, so FPGA vendors took on the added burden of EDA development for their own devices.


FPGA startup companies were fabless, and typically could not obtain leading-edge silicon technology through the early 1990s. As a result, FPGAs began the Age of Expansion lagging the IC-process curve. Later in the decade, IC foundries realized that FPGAs made ideal process tools, so FPGA vendors took on the added burden of EDA development for their own devices.

Area was not as precious as it had been in the Age of Invention. Area could now be traded off against performance, features, and ease of use. Larger FPGA-based designs required synthesis tools with automatic placement and routing. By the end of the 1990s, automated synthesis, placement, and routing were required steps in the design process.

Most importantly, the easiest way to double the capacity and halve the cost for on-chip FPGA logic was to target the next process technology node so there was tremendous value in early access to new nodes. SRAM-based FPGAs realized a significant product advantage during this time because they were first to adopt each new node. Antifuse-based FPGAs lost their competitive edge.


By the start of the new millennium, FPGAs were common components in digital systems. Capacity and design size grew rapidly and FPGAs had found a huge market in data communications. The dot-com bust of the early 2000s created a desperate need for lower cost, which eliminated many “casual” ASIC users.

FPGAs were now larger than the typical problem size and increased capacity alone was insufficient to...
FPGA users were no longer working with simple systems. By 2020, over 50 billion devices and machines will be connected, and they must meet the growing demands of end users, at the same time process an exponentially growing amount of data, whilst consuming the lowest possible power. This article looks at the journey the FPGAs have taken over the last 30+ years and how the most dynamic processing technology in the industry is enabling rapid innovation, offering adaptable, intelligent computing to shape the next generation of systems.

Ivo Bolsens
Xilinx Inc., CTO and Senior Vice-President.

**A dynamic technology**

From the very first FPGAs in 1984, these astonishing devices have increased in capacity by more than 10,000x and increased in speed by 100x, with cost and energy consumption per unit function decreasing by more than 10,000x. By 2020, over 50 billion devices and machines will be connected, and they must meet the growing demands of end users, at the same time process an exponentially growing amount of data, whilst consuming the lowest possible power. This article looks at the journey the FPGAs have taken over the last 30+ years and how the most dynamic processing technology in the industry is enabling rapid innovation, offering adaptable, intelligent computing to shape the next generation of systems.

**The Age of SoC: 2008 - 2017**

Embracing the system design issues, FPGAs increasingly incorporated system blocks such as high-speed transceivers, memories, large amounts of DSP processing units and complete processor subsystems. They further incorporated important security features like bitstream encryption and authentication. In addition, system functions for powerful mixed signal processing and control functions for system temperature and power monitoring and management are often available. These features were first introduced by the Zynq™ - 7000 SoC product family and further extended by the Zynq™ UltraScale+™ MPSoCs and Zynq™ UltraScale+™ RFSoCs. During this period, a major step towards improving programming efficiency was introduced. Thanks to the introduction of High Level Synthesis (HLS), the traditional programming environment based on HW design languages such as VHDL and Verilog was extended by software-like flows using OpenCL™, C, C++.

**The Age of Compute: 2018 -**

As the merits of progressing Moore’s Law are slowing down, traditional computing systems face serious challenges in terms of improving performance, energy efficiency and cost. Moreover, requirements of real time performance, privacy and communication bandwidth, driven by emerging fields such as autonomous cars and 5G, create the need for more powerful and efficient computing capabilities at the edge. In this context, domain-specific computing is emerging which uses a customizable architecture and programming environment tailored to a particular application domain. Whereas faster compute hardware is essential to improve, other aspects such as efficient memory access, interconnect bandwidth, deterministic behavior and low latency can be of equal importance.

The adaptable compute acceleration platform (ACAP) will assume a central role in the implementation of future computing systems in the cloud and the edge infrastructure. It provides a parallel and heterogeneous programmable platform that can be customized to optimally meet the performance requirements of different application domains.

Programmability and adaptability have shown to be of fundamental value. Efficient customization of logic functions, of memory access, of connectivity for data movement, and of compute parallelism, will all be required to accelerate the workloads of the future. This technology is here to stay and will continue to evolve.
The idea of the learning curve dominates the electronics industry. But it is also one where a small change in technique quickly scales into a disruptive competitive advantage. By Chris Edwards

If there is one thing that has controlled the growth of the electronics industry over the past half century, it is the semiconductor-manufacturing learning curve. It has driven Moore’s Law to the point where even though the ‘natural’ scaling proposed by IBM researcher Robert Dennard in the early days of silicon technology have broken down, the learning curve still keeps going.

It has been going so long, the learning curve looks like a demonstration of inevitability. The industry just keeps delivering the improvements that keep everything ticking along nicely. But the graph is also a demonstration of survivor bias in much the same way stock indices imply betting on shares is a guaranteed winner. The index rises because it continually adjusts. What’s missing is the number of shares that plummeted to zero when the companies that issued them failed to keep up.

Events 50 years provide a key example of how small but influential changes can lead to dramatic shifts in leadership even if the overall market stays on a seemingly unstoppable course. A number of advances came together that would see the strand of metal-oxide-semiconductor field-effect transistor (MOSFET) technology finally take off and sweep the older bipolar technology to the side. MOSFETs showed promise but they had major problems.

Initially on secondment from Italy-based SGS, when he arrived at Fairchild to work on their MOSFET development Federico Faggin recalled: “Metal-gate technology, which was the technology of the day, was not a good technology. It was slow and unreliable, and not living up to the theoretical promise of MOS devices.”

The concepts behind the MOS transistor date back almost a century to patents filed by New York-based inventor Julius Lilienfeld, though he never had the opportunity to demonstrate them experimentally and died in 1964 just as his ideas were being put into action. His patents described the idea of modulating conductivity in a channel using an electric field. Even as late as 1962, researchers insisted in speeches in conference such as Wescon the MOSFET could never be practical because the metal-insulator interfaces led to the formation of electron traps that made the devices perform poorly.
In 1964, not long after General Microelectronics engineers had developed a number of key techniques, Fairchild said its team had succeeded in making the first enhancement-mode, p-channel MOSFET. Just a month later, RCA followed up with a complementary version, the depletion-mode, n-channel version.

A short internal marketing war broke out at Fairchild over the naming of the technology. The company’s specialists, Frank Wanlass and CT “Tom” Sah, wanted to name the device ‘MOST’. Gordon Moore disliked the name and, although Sah managed to squeeze it into a paper in IEEE Transactions on Electron Devices, the term MOSFET stuck. RCA’s preferred moniker of insulated-gate fi eld-effect transistor (IGFET) was a non-starter in the industry.

A decade later, RCA showed the capabilities of Wanlass’s idea of using complementary MOSFET to reduce power consumption with its CDP1802 microprocessor. But it would take time for CMOS to become mainstream. The RCA processor went into space. But through the 1970s and 1980s, CMOS on Earth was largely restricted to simple devices such as wristwatches because the need to double each transistor also doubled production cost. But the MOSFET train by then had become practically unstoppable thanks largely to the work that started at Fairchild.

Although a number of efforts proceeded in parallel, including Dennard’s use of an n-channel MOSFET as the control gate for the first DRAM, Fairchild’s efforts arguably had the greatest lasting impact, the biggest being the decision to take the metal out of MOS. It’s only during the last decade that metal has gone back into the gate stack and that move met significant resistance. Industry veterans were sceptical the new generation of metal gates would work because they could remember how bad things were with the original aluminium-based technology.

Faggin did not invent the concept of the non-metallic MOS gate. It was fellow Fairchild engineer, Tom Klein, who worked out that replacing the existing aluminium gate material with conductive polysilicon would lead to a much-wanted reduction in threshold voltage. Faggin came up with an etch process for that polysilicon and also helped develop the use of polysilicon not just as a gate material, but a cheap way to link together neighbouring transistors. Into the early 1970s, this was called “Freddy’s Etch”. But, by that time, Faggin, like many of his Fairchild colleagues, had departed for the venture capital-funded Intel.
Faggin claimed he had inadvertently helped Fairchild’s competitors. Gordon Moore and Andy Grove along with Faggin’s manager encouraged him to give a presentation on the technology at the International Solid State Circuits Conference and so publicly disclose some of the techniques. But, after many departed Fairchild for Intel, the then larger company chose to focus on its traditional bipolar technology. Intel, in contrast, was almost fully committed to the new polysilicon-based MOSFET.

During the 1970s and 1980s, Japanese suppliers took advantage of the survivor-bias effect by pooling resources on the development of key technologies such as memory. This quickly led to the then memory-dominated Intel stumbling over its heavy investment in 256Kbyte DRAMs. But, having been selected as the core for the IBM Personal Computer, investments from the computer giant helped stabilise the chipmaker and propel it towards market dominance. A second injection of cash helped Intel over a second slump – the bursting of the home-computer bubble in the mid-1980s.

By the end of the 1980s, manufacturers had finally embraced the lower power CMOS. Problems with power density that threatened further integration forced their hand. Other problems loomed as the CMOS wave swept away another group of industry laggards.

For a long time, people believed 1µm would prove a fundamental scaling limit. In practice, another more subtle problem emerged: the inability to move past three layers of metal for interconnect. This threatened further integration. You could make the transistors but not wire them up into anything useful.

The chemical solution to the problem seemed unthinkable: rubbing the delicate wafer with a roughened pad and a corrosive slurry.

Wilf Corrigan, then head of LSI Logic and who had been the chief of Fairchild in the 1970s, said at the end of the 1990s, chemical mechanical polishing effectively reset the leadership of the industry. He argued Japanese suppliers distrusted the technology. But the US manufacturers embraced the technology and were, as a result, able to design much more complex microprocessors than their more cautious competitors. By the end of the 1990s, many of the chipmakers had learned the lesson of collaboration taught by the Japanese. Some abandoned manufacturing altogether in the face of increasing cost and signed up with foundries. Faggin had played a pivotal role in the early history of the foundry business when he set up Zilog. But Texas Instruments alumnus Morris Chang provided the ability for much smaller companies to challenge the giants with the formation of the independent foundry TSMC in 1987.

The result in recent years has been a matching of capabilities. Although Intel has proved capable of introducing technologies such as high-k, metal-gate production and finFETs more quickly than others. The foundries have proved able to put together their own versions quickly enough to accommodate customers who want to challenge Intel. The problem that faces companies designing CMOS integrated circuits now is the rapidly escalating cost. Only those with the deepest pockets are able to stay on the learning curve.
A lot of innovation happened in the past 50 years, and its pace is only quickening. In 1968, digital systems were in their infancy. Silicon and systems weren’t that complex and featured a small number of logic gates. Most devices and end systems were closed as well, so the need to think about security was limited.

Today billions of gates are packed on to a chip, the systems are complex, machine learning is being done on edge nodes and device security is featured in the news constantly. How did we get here? Relentless innovation.

The rise of ubiquitous computing

Arm emerged as a pioneer in IP design in early 1990s, starting with a unique low-power, small-footprint microprocessor architecture that silicon vendors could license and around which they could build their own special functionality. In the ensuing years, Arm not only evolved the microprocessor architecture but added security and system IP, subsystems, tools and software to enable system-level solutions.

Companies embraced Arm technology because it was trusted, fully verified and widely used to support the mobile-computing revolution. Arm is an established, trusted standard for SoC design that relieves customers of the design implementation and verification steps that make design costly and risky.

Today, Arm invests in each CPU upwards of 97 person-years and 1,600 CPU years of testing (even using ML algorithms to speed the process) with over 156 GB of data generated per nightly run. Arm invests at this level because hardware is not like software – you can’t patch silicon bugs in the field.

Arm continues to push boundaries of what can be done in silicon. Who would have thought that a device containing a tiny Arm Cortex-M CPU would be capable of complex digital signal processing, being able to perform keyword spotting from an audio stream, or other machine learning algorithms? Arm remains committed to removing barriers to creating custom SoCs, now you can even access the Cortex-M0 or Cortex-M3 CPUs, example systems and Arm’s broad ecosystem for $0 upfront through Arm DesignStart. Arm also have a variety of validated IoT SoC solutions, which include built-in security and can be customized.

Today, our industry is poised to deliver 1 trillion connected devices in the near future in the Internet of Things (IoT), transforming how we work and play. But at the same time, more attackers realize the potential gains that can be made in IoT. Even the most difficult non-invasive techniques now require only inexpensive equipment and limited amount of time, making them cost effective.

Security has been part of the Arm portfolio for quite some time, covering all types of attacks. It started almost 20 years ago with our SecurCore family of tamper-resistant CPUs, which are found in billions of smartcards out there, and since then we have added a lot of foundational security capabilities. Recently, Arm extended its physical security portfolio to support the broad IoT market with the Cortex-M35P processor equipped with tamper resistance and TrustZone for software isolation, along with a suite of security IP beyond the processor to guard against side-channel attacks.

Arm’s dedication to the constant and collaborative work around effective security extends to the Platform Security Architecture (PSA) program we announced in 2017 (a three-stage process that provides a common and holistic framework to approach IoT security) and secure identity for cellular IoT, announced in early 2018.

Conclusion

The electronics industry has evolved massively over the past 50 years, and both Arm and the Arm ecosystem of over 1,600 software, tools and service providers have been instrumental to this. More is yet to come. We can’t revert to the old framework of closed systems. If we want electronics in the next 50 years to transform our lives, buildings and cities, then we need smarter connected devices built with trusted IP and reusable software that have a common, consistent approach to security.
ELC

- ELC 570 series
- Locking system with snap hooks
- IP67
- For medical applications
Circular connectors are the natural choice for applications needing a reliable connection, as David Phillips binder UK, explains.

Firstly, let me wish New Electronics a very happy and successful 50th anniversary. There aren’t too many publications serving our industry that have been around for so long and everyone associated with New Electronics over the years can be immensely proud of its longevity in a rapidly changing publishing World. It has always done a great job reporting and providing information on the electronics industry and all of us at binder UK hope we can keep reading “NE” for many years to come.

Although a little older (binder was established in 1960) we share a 50th anniversary with New Electronics for it was back in 1968 that we made our first circular connector. Originally developed in the 1930’s for the aircraft industry, circular connectors have since become the natural choice for applications that need a reliable connection in “difficult” environments.

Interconnection in all its forms, is a vital and fundamental part of any electronic product or system. To satisfy the incredibly wide variety of applications that require connectors, our industry has developed a range of different formats and evolved performance and environmental standards that make selection easier for the user and specifier.

As everyone knows, interconnection in all its forms, is a vital and fundamental part of any electronic product or system. To satisfy the incredibly wide variety of applications that require connectors, our industry has developed a range of different formats and evolved performance and environmental standards that make selection easier for the user and specifier.

The company founder, Franz Binder, chose to concentrate exclusively on the circular connector format because he rightly saw its importance within key industrial sectors and today’s increasing move towards applications such as the “Smart” factory – the so-called industrial Internet of Things - continues to prove him right. Electronics technology has found its way into applications not necessarily foreseen 50 years ago and today it has never been more important to reliably provide the means to transmit power, signal and high-speed data.

binder occupies an enviable position at the professional end of the interconnection marketplace with products specified across a number of industry sectors including automation, measurement and control, medical, geophysical, food and beverage and renewable energy.

Each of these sectors make different demands on the connector manufacturer and we, along with other connector manufacturers, respond to their needs with developments such as new variants, new materials and new performance levels. A particularly good example is the food and beverage sector where the need to meet stringent hygiene requirements for machinery, systems and components is paramount. Here, binder’s latest models use high-quality materials such as stainless steel and special plastics with very smooth contours to prevent dirt adhesion. In addition, a high protection class (IP68 and IP69K) is provided to meet the requirements of high pressure cleaning and the often aggressive chemicals widely used across the industry.

Marcus Binder, the son of the founder, is now in charge of the company. He says “In a family run business it is essential to maintain traditional values while ensuring continuous development and product innovation.”

binder’s Easy Locking medical connector

The female panel mount connector provides protection against the ingress of liquids, water splash and accidental electrical contact and, when mated, the ELC 570 locking connector offers protection to IP54.

Company Milestones
1960 – Franz Binder establishes binder as a manufacturer of turned parts and components
1968 – binder manufactures its first circular connectors
1972 – binder opens its headquarters in Neckarsulm, Germany
1992 – Massive further investment in automated manufacturing capacity
2001 – present day
Formation of binder subsidiaries in China, The United States, France, The United Kingdom, Sweden, Holland, South East Asia and Austria. binder also partners with 45 distributors across five continents.
2018 – Yet another binder innovation, the Easy Locking Connector is specifically for the critical area of medical systems. Designed to be used more than 5000 times, it has an intuitive locking system to ensure positive mating while mis-mating is prevented thanks to a mating position clearly defined by the “shape” of the mating area.
Established in 1985, Components Bureau provide a range of passive, opto and wound component solutions for the lighting, power supply and transportation markets.

In keeping with their business strategy, the company is expanding their offering to include a range of wireless solutions, adding Chinese manufacturers Bivocom and High Flying to their portfolio.

Bivocom is a leading provider of industrial wireless transmission terminals. The manufacturer offers high quality NB-IOT, 4G/3G/2G industrial modems, DTU, Gateway, Router, Android IPC and LoRa modules, which are widely used within smart grid, smart city, oil and gas, irrigation, intelligent transportation, kiosk and vending, mining, weather station and industrial automation applications.

High-Flying specialise in wireless communication, supplying products from system chips and IOT WiFi modules to Bluetooth modules.

Commenting on the new product range, Business Development Manager at Components Bureau, Darren Silver said: ‘We are excited to be the first UK representative for these two great manufacturers, we feel their products are a great addition to our portfolio as we look to expand into new markets.’

To find out more about the range of products available from Components Bureau, call +44 (0) 1480 412233, email info@componentsbureau.com, or visit www.componentsbureau.com.

The Components Bureau portfolio is truly diverse, with offerings from capacitors and resistors to die-castings, bespoke metal fabrication, PCB assembly and wire harnesses.

In 2013, the company launched Precision, a range of fully custom wound components suitable for lighting and power supply applications.

In 2017, the company launched CBL Online, an e-commerce platform for industrial grade memory components.

The TG451 Gateway Series is the latest range from Bivocom, suitable for applications including charging, gas and underground pipelines.

Components Bureau provide a range of passive, opto, wireless and wound component solutions.

Visit www.componentsbureau.com Call +44 (0) 1480 412233 Email info@componentsbureau.com

26 June 2018 www.newelectronics.co.uk
Fischer Connectors continues to push the boundaries of technological innovation that fulfills customers’ needs for connectivity miniaturization, high-speed data transmission, sealing and ruggedness. The brand-new product line, the Fischer Freedom™ Series, has been developed to maximise efficiency, usability and performance, facilitate integration and optimise cable management.

The first product in this series, the Fischer LP360™, is a breakthrough low-profile connector. No key code means 360° mating freedom for optimized cable management. Membrane-sealed contacts ensure a fully cleanable connector (both plug and receptacle). Low profile allows for easy integration in any environment.

This breakthrough solution is ideal for a large variety of applications, primarily for portable and wearable applications, in such markets as defense & security, medical, and industrial & civil engineering – to name just a few.

**Company Milestones**

- **1954**
  - W W Fischer founded in Morges, Switzerland
- **1960’s**
  - International patent filed for its push-pull locking system
  - In 1962. 1964 developed the world’s first hermetic connector
- **1988**
  - UK subsidiary set up
- **2010’s**
  - Continuous technological innovation sees launch of the Fischer Rugged Flash Drive, the robust Fischer UltiMate™, the miniaturized Fischer MiniMax™ and ultra-resistant Fischer FiberOptic series.

**June 2018**

- Launch of breakthrough technology in the brand-new Fischer Freedom™ Series and Fischer LP360™ connector

**About Fischer Connectors:**

A pioneer in high-reliability and rugged connector technology, Fischer Connectors has kept the spirit of innovation alive for more than 60 years, reimagining connectivity, and delivering breakthrough technologies, high-quality products and highly responsive customer service.

Fischer helps its customers produce innovative and reliable applications by designing, manufacturing and distributing high-performance, rugged connectivity solutions that withstand the most demanding environments.

With its HQ in Saint-Prex, Switzerland, where its R&D Center and manufacturing facilities are also located, Fischer has cable assembly sites in EMEA, the United States and Asia. The Group also includes local subsidiaries and a wide network of distributors and agents all over the world.

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THE RELIABLE EXPERT
In 1962 Dr Nick Holonyak and his team of researchers at General Electric created the first practical visible spectrum LED. Six years later, Hewlett Packard integrated LEDs into early hand-held calculators. It was in the 80s that the use of LEDs really soared in the industrial sector, as specialist companies took this core technology and applied it to a vast range of applications. One such company, who pioneered the adoption of LEDs in a range of sectors, continues to move from strength to strength all these years later. Founded in the mid-80s as the Fibre-Data Group, OMC is one of the longest-established specialist manufacturers of optoelectronics in Europe, headquartered in Cornwall, UK. Accredited to ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2007 and winners of the UK National Electronic Component Award for Innovation, OMC is a pioneer in the development, manufacture and application of cutting-edge LED and fibre-optic technologies for a wide range of industries and companies worldwide, and places a major focus on research and development, engineering and innovation. The company has four key manufacturing divisions: Fibre Optics; LED Backlights and Optical Mouldings; Discrete Optoelectronic Components; and Semiconductor (LED) Lighting, and its commitment to the highest standards of quality, performance and engineering support is widely recognised within the industry.

Last year, the company completed the move into a new purpose-built manufacturing facility, reflecting an increase in demand for its bespoke and off-the-shelf opto-electronic products. The company - known for its optoelectronics expertise as ‘the problem solvers’ - has grown at between 10-15% year-on-year, with significant expansion in two areas, custom backlighting for LCD displays, and fibre optic cable assemblies and transmitter/receivers for use in industrial applications. The new facility has enabled the company to continue this growth and develop new solutions with dedicated development and production areas, plus a separate department set aside for the specialist tests it needs to perform in order to deliver tightly matched, high-reliability optoelectronic systems.

For Ledtech, one of the world’s largest capacity LED manufacturers, 2018 is a significant year. Unlike New Electronics, the company is still working towards its first half century, having been founded in Taiwan in 1977, yet earlier this year it announced the opening of a European facility in the UK. The addition of a direct facility adds a range of value-added manufacturing services, design-in support, volume availability and security of supply on a wide range of opto parts including discrete LEDs, LED displays, lighting components and luminaires. Additionally, later this year, the company will install a full LED production line in the UK facility.

Ledtech’s solid-state lighting products and components are used by some of the best respected names in the industry and most innovative SMEs alike. Ledtech addresses sectors with products specifically designed to fit the particular requirements of each application. Key markets include commercial, consumer, industrial, office, retail, business & finance, transportation, signage, instrumentation, healthcare, gaming machines, hotels, restaurants & leisure and public spaces. Ledtech products meet international standards and lead the way in performance.

Comments Frank Liu, Founder, Group Chairman and CEO, Ledtech Electronics Corporation: “We constantly invest in people, technology and research & development to ensure that we can offer the solutions our customers need. The opening of our UK facility in Redruth, Cornwall, UK means that we now have design centres in Europe, Asia, and the USA, available to develop custom solutions for applications that require a specialised approach.”

Added William Heath, Director of Ledtech UK: “Whether our customers require a discrete LED, display, lighting component or luminaire we manufacture a vast range of standard devices – and if you need something custom-made, we are fully equipped to design a bespoke solution to suit your application. Ledtech UK can now offer the technical, engineering and commercial support to back up our leading, innovative product range.”
In Britain, the microelectronics industry has - like all forms of British industry - been subject to Government involvement lurching from hands-on to arms-length and covering most stages in between. Equally broader economic forces have also had their impact. By Dick Selwood

Taking a look at the industry’s development we’ll seek to draw together the threads of the past 50 years, using every ten years as a milestone.

1978: Now the chips are down
1978 marked the beginning of British Government interest in microelectronics. The sweeping intervention in technology that was Harold Wilson’s “white hot heat of technology” was not even a glowing ember, but a number of results from the 1975 Industries Act were encouraging technology. Scotland and Wales had Development Agencies (SDA and WDA) with the charter of improving their economies. Importantly, there was the National Enterprise Board (NEB), which was initially set up to extend public ownership of industry, but very quickly became a source of funds for industrial investment. It was also tasked with encouraging industrial co-operation, including mergers and as a third, less welcome role, it became a home for lame ducks, such as Ferranti, Sinclair Radionics, British Leyland and Rolls Royce. It was in this context that the BBC in March screened a programme, ‘Now the Chips are Down’, which highlighted the way in which the US was forging ahead in microelectronics and suggested that Britain was lagging behind.

Prime Minister James ‘Jim’ Callaghan watched it and apparently demanded to know what the NEB planned to do about it. They were able to put in front of him a proposal from a Briton and two Americans for a new semiconductor company, that would have design and manufacturing in the UK and the US. The company would initially make memory chips (a 64K DRAM and a 16K SRAM) and then a revolutionary microprocessor. All this for a mere investment of £50million. The application was accepted and INMOS began a short and complicated life.

1988: Mixed results
By 1988 INMOS was no more. After five tumultuous years as a political football, the NEB sold its 75% stake in 1984, at a profit, to Thorn-EMI, a company with interests in consumer electronics, music, defence and retail. In 1989 Thorn passed control to Franco-Italian SGS-Thomson.

The inward investment programme, particularly that of the SDA, was charging ahead, with Motorola, NEC and others receiving financial support for building fabs in an area that became known as Silicon Glen. A major failure was the Alvey Programme which closed in 1988. Launched by the UK Government in 1983 as a response to the Japanese 5th Generation Computer project, it was intended to look at areas including VLSI, AI, software engineering, man-machine interfacing and language processing, and architectures for parallel processing.

While it made some steps forward in getting better collaboration in R&D, the costs were high. It was reported that £200m of public money and a further £150m from industry was spent. Where it failed, according
A LOOK BACK OVER 50 YEARS

Brian Oakley, who headed the project, was translating the R&D into commercial success.

He said that British industry didn’t spend enough on commercialisation and marketing.

Japan’s microelectronics industry was now a world presence, backed as Oakley had recognised, by cheap money and the Japanese Ministry of International Trade and Industry. When their products, particularly memory devices, entered the market, US companies claimed that they must be dumping. It emerged that Japanese companies were getting more working die per wafer than their US rivals, and US companies discovered that when they transferred production to new, overseas fabs, they too saw an increase in yields.

The EU also established a programme to improve European competitiveness. The first of the family of ESPRIT programmes also began in 1983 and continued until 1998. The UK Government’s support for this and other EU programmes ranged from lukewarm to almost total denial.

A first sign of a major change in manufacturing was the opening in 1987 of TSMC, the first pure-play foundry.

1998: Bubble close to bursting

Perhaps the most important technology event in the UK in 1998 was the flotation of Advanced RISC Machines or ARM. A spinoff from Acorn Computers, by this time part-owned by Olivetti, ARM was very unusual in that it concentrated on Intellectual Property (IP), an Instruction Set Architecture, which it licensed to developers to build their own processors, either stand-alone or as part of an SoC. The architecture families it developed became the de facto standard for much embedded computing, and ARM became the world’s largest supplier of IP.

The inward investment approach, however, was faltering: Fujitsu closed a fab in County Durham, Siemens another in Northumberland (just 15 months after the Queen had opened it), Motorola merged two plants and shed staff, while a promised major investment by LG in Newport was never started.

This was against a tumultuous technical world background. The dotcom bubble was beginning its steepest inflation, and the concerns over the Y2K problem, of computers having problems at midnight on December 31st 1999, were growing.

When the dotcom bubble burst in 2002, there were dire predictions about the future of the Internet and those companies building chips for communications saw their markets shrink and share prices hammered.

While the broader semiconductor industry also declined, by 2008 things were beginning to pull back towards normal only for the world financial crisis to hit.

Inventories were run down, capital projects were put on hold, and general gloom spread across the industry. IDMs were increasingly abandoning fab ownership and using foundries.

It wasn’t helpful that Freescale and NXP had both been acquired by venture capital companies and loaded with debt.

2018 Mixed signals

The world is seeing an explosion in confidence and all the forecasts are for serious semiconductor growth today and new fabs are under construction around the world. It can be argued that the move to foundries has gone too far and there are regularly questions over the dominance of TSMC, which has well over half the world’s foundry business.

In the UK uncertainty over BREXIT is surely the most important factor in considering investment, but in parallel with that the last few years has seen significant start-up growth.

Both Bristol and Cambridge have continued to grow and companies like XMOS, UltraHaptics, UltraSoC and Graphcore are successfully taking on the rest of the world, backed by British VCs.

Both ARM and Imagination Technologies have both been sold to overseas owners, although the British Prime Minister, Theresa May, was able to pronounce, to some incredulity, that the purchase of ARM by a Japanese holding company was a vote of confidence in Britain.

However, with all the ups and downs, the chip business has, for the last fifty years, been an exciting industry to work in, and while the swash-buckling sixties and seventies have been replaced by a much more corporate, and risk-averse approach, the future still holds much for the thousands of companies and millions of people employed in this dynamic industry.

IN 1984
The Macintosh from Apple appears. It competes with the Commodore 64 and the IBM PC
It’s not just New Electronics celebrating 50 years this year, in July Intel also hits this milestone and the company is taking the opportunity to honour its heritage and look to the future. It’s a future that will be built on the technologies it invents, delivering experiences once thought to be impossible.

Fifty years ago, Robert Noyce and Gordon Moore founded Intel with the vision to ponder what might be possible. To imagine, to question and to do wonderful things in pursuit of a better future. Noyce issued an inspiring challenge: “don’t be encumbered by history, go off and do something wonderful.” Little did he know how passionately this challenge would be pursued, resulting in the Intel of today that invents at the boundaries of technology to make amazing experiences possible.

Harnessing the capability of the cloud, the ubiquity of the Internet of Things, the latest advances in memory and programmable solutions and the promise of always-on 5G connectivity, Intel is disrupting industries and solving global challenges.

The integrated circuit was only 6 years old in 1965 when Gordon Moore articulated “Moore’s Law,” the principle that would guide microchip development from that point forward. His famous prediction that the number of components it was possible to fit into a state-of-the-art microchip would double approximately every year for the next 10 years proved remarkably accurate. The precise rate of growth the law called for would be tweaked over the years, but its basic premise of steady, predictable improvement would continue to the present day. One historian has even called it “the metronome of modern life.”

Through milestone after milestone of cutting edge innovation, the fifty years have not been without their challenges. In 1975 a fire broke out in the moulding room of the company’s first production facility outside of the US, in Penang. It was probably the result of a faulty light but despite everything except the cafeteria burning to the ground, at an estimated $2.5m of damage, the recovery efforts were one of Intel’s greatest manufacturing triumphs. Next came the turbulent 80s when Intel underwent the worst recession in its history, but this prompted company leaders to refocus operations that would leave it stronger. Its resurgence in 1987 would prove to be the beginning of 11 years of record-setting revenues, clearly indicating it was the undisputed industry leader in its field.

So, this year – officially July 18th 2018 - Intel has a lot to honour, but all year long the company will bring together its people, its partners and communities to celebrate a bright future for Intel today and a better world for tomorrow. And of course, with sincerest congratulations to New Electronics too for reaching this milestone and wishing you continued success in the future.
1986 saw the entrance into the UK & Irish market of Jauch Quartz via the distributor, Logic Electronics. At the time, Logic were distributing various components for multiple manufacturers and the opportunity arose to begin trading with Jauch, a well-respected manufacturer of Frequency control and Battery products. The relationship advanced rapidly, and Jauch opted to purchase 40% of Logic Electronics in 1990. In 1995 the current MD of Jauch Quartz UK, Nicholas Ribton, went to Germany to work at the companies’ HQ; subsequently returning to Logic as Sales Manager and being a key interface between the two companies, enabling their continuing development.

In 1998, Logic secured agreements with NIC Components and Jianghai Capacitor to service the UK & Irish market, relationships that are still very much active today in Jauch Quartz UK Components Division. In 2007, the Directors of Logic Electronics sold the remainder of the business to Jauch which satisfied the strategy to establish global Jauch sales presence. Nicholas Ribton was appointed as Managing Director in 2009 and new staff were employed strategically, in the subsequent years, from Manufacturing and European distribution backgrounds. The UK & Irish turnover has also increased considerably from around £1.5M in 2008 up to a £6M forecast for 2018.

Perfect Timing

In the 1980’s most Electronic products communicated via a physical link. In 2018 we have a crystal range specifically for RF communication.

Company Milestones

1986 – Jauch Quartz enters UK & Irish market
1990 – Jauch Quartz buys a share of Logic Electronics
1998 – Logic Electronics signs Jianghai and NIC
2007 – Jauch Quartz completes the purchase of Logic Electronics
2017 – Jauch Quartz UK moves to bespoke new premises

The company has since gone through a series of operational improvements that has seen us increase warehouse capacity 4 times since our inception. In 2017, a significant investment was then made on a bespoke new building in Frimley, Surrey. The facility, at 900m2, is 3x larger than our previous premises and caters for our new custom Magnetics partner – Superworld Electronics.

Jauch Quartz goes global with Digi-Key Electronics

Jauch Quartz, one of the leading specialists for quartz crystals, crystal oscillators and battery technology, is proud to announce that we have entered into a worldwide distribution agreement with Digi-Key Electronics, a global electronic components distributor.

“A major focus of Jauch Quartz business growth strategy was to team up with a leading distribution channel partner. We are delighted to join forces with Digi-Key, one of the fastest growing distributors of electronic components in the world. Digi-Key’s leadership and market reach will bring our high technology products to a wide range of customers across numerous markets,” said Paul Benson, Strategic Business Manager, Jauch Quartz. “The combination of our innovation, including state-of-the-art wireless dedicated solutions, and Digi-Key’s expertise with assisting engineers through the entire design process will help customers develop and deliver solutions that enhance the value and performance of their products and help take them to market rapidly.”

“We’re excited to partner with Jauch Quartz and offer their leading-edge products to our global Engineering community,” said David Stein, Vice President, Global Supplier Management at Digi-Key. “Our worldwide customers will find great value in Jauch Quartz’ experience, quality products, and industry expertise.”

For more information about Jauch Quartz and to see their entire product listing, please visit their Supplier Center page on the Digi-Key website https://www.digikey.com/en/supplier-centers/jauch

About Digi-Key Electronics

Digi-Key Electronics, headquartered in Thief River Falls, Minn., USA, is an authorized global distributor of electronic components, offering more than 500,000 products, with over 1.3 million in stock and available for immediate shipment, from over 750 quality manufacturers. Digi-Key also offers a wide variety of online resources such as EDA and design tools, datasheets, reference designs, instructional articles and videos, multimedia libraries, and much more. Technical Support is available 24/7 via email, phone, and website. Additional information and access to Digi-Key’s broad product offering can be found by visiting www.digikey.com.

About Jauch Quartz GmbH

The Jauch Group is one of the leading specialists for quartz crystals, crystal oscillators and battery technology. Established in 1954, we are a European market leader in the frequency control products industry, most recently with innovative MEMS timing and RF-specific devices. We underline our claim to leadership with our broad product portfolio, high application and certification expertise, alongside in-house, advanced test environments with high availability and fast delivery of products. Our competent staff at our subsidiaries Jauch Quartz France, Jauch Quartz United Kingdom, and Jauch Quartz America are available to assist with pioneering technology solutions.

www.jauch.com Phone: +44(0)1276 605900 E-mail: sales@jauch.com
Just over 70 years ago, Léon Mouttet, an innovative engineer and entrepreneur, founded LEMO in Morges, Switzerland, as a manufacturer of specialist electrical contacts. The business quickly evolved, and it wasn’t long before it offered complete electrical connectors.

1957 saw the invention of the first ever push-pull coupling system for electrical connectors. A revolutionary product it provided a user-friendly alternative to the traditional screw or bayonet coupling systems.

Its success led to the business expanding into the American and German markets in the 1960s, and into the UK and Japan a decade later.

The expansion of the nuclear power industry presented unique challenges. The hazardous conditions of the industry required many of the processes to be controlled, monitored and maintained remotely. Connectors specifically designed for use in remote-handling applications were developed.

The early 1980’s saw the company introduce the first generation of plastic push-pull connectors specifically designed for the medical market.

Next came the HDTV revolution in the early 1990s and the subsequent development of a broadcast range of specialist hybrid fibre optic push-pull connectors.

By the mid-1990s, LEMO had further expanded its global footprint and introduced a dedicated range of rugged, light weight and high-density connectors specifically designed for the motor-sport market.

The arrival of the 2000’s saw the business expand into Asia with the opening of a Chinese subsidiary. In parallel, changes in the communication technology saw LEMO enter the defence market, albeit with adapted motor sport connectors that were leading the industry from a packaging density perspective which made them a highly desirable addition to this market sector.

Today, LEMO has 20 subsidiaries operating across the globe and plans further ranges of industry specific push-pull connectors in support of the evolution of hi-tech markets.
Celebrating five decades

Just like New Electronics, Pickering Electronics, the manufacturer of high-quality reed relays, is also celebrating its 50th anniversary this year. Pickering Electronics was founded in 1968 by the late John Moore. Five decades later its future is looking bright, with sales in 2017 up by 30% on the previous year.

“Fifty years of designing, manufacturing and distributing reed relays means that we have a very good understanding of the product we are selling and consider ourselves to be the leaders in reed relay technology,” said Graham Dale, technical director at Pickering Electronics.

“Since 1968, we have gradually evolved our reed relays from very large, relatively crude parts to the small, ultra-reliable parts we have today. Production methods and quality systems have improved a great deal over that time, and costs reduced.

“When I started designing reed relays in the late 1970s some were saying that these electromechanical devices would have a limited lifetime. Instead, the market for high-quality reed relays has increased into areas that were inconceivable in those days.”

In 1983 Pickering Electronics established SoftCenter® technology and former-less coil construction, setting it apart from other reed relay manufacturers. SoftCenter protects the sensitive glass/metal seal of the reed switch capsule, thereby increasing contact resistance stability and improving the life expectation of the relay. Former-less coil construction maximises magnetic drive and increases packing density.

The Pickering Group now comprises two privately owned companies: Pickering Electronics, a specialist in reed relay design and manufacture, and Pickering Interfaces, which since 1988 has been designing and manufacturing modular signal switching and simulation for electronic test and verification systems. Pickering employs over 380 people worldwide, with manufacturing facilities in the UK and Czech Republic.

So happy birthday New Electronics, and happy birthday Pickering!

Said to be the world’s smallest footprint reed relay, the Series 120 4mm²™. A new low profile version is just launching.

The Industry's Smallest Through-Hole Reed Relay is Here!

Introducing the New Series 124 4mm²™

- Stacking on 4 mm x 4 mm pitch, providing the highest available packing density
- Switching up to 5 Watts 0.5 Amp
- Very fast operate times making these ideal for high speed test systems
- Choice of 3 or 5 Volt coils
- 1 Form A (energize to make)

An example of packing density showing a high density module populated with a total of 606 Series 124 4mm²™ relays.

For Free relay samples please scan the QR code, or alternatively, email sales@pickeringrelay.com

Actual Size

Highest Grade Reed Switches | Custom Designs | Internal Mu-Metal Magnetic Screen | Ideal for ATE and Semiconductor Switching

pickeringrelay.com
Two years ago James Bates took over as Managing Director of Rapid. It has been a time of significant change at the Colchester-based company, repositioning itself from a broadline electronic components distributor to one that is engaged in focusing on individual sectors and developing a service-led approach.

“Identifying and focusing on our strengths, we revealed our new customer proposition – ‘Helping you make it’ – giving customers everything they need to design and manufacture innovative products, services, solutions and technologies. This includes high service levels and innovative online solutions as well as components, consumables and equipment.”

One of the areas Rapid is developing is in the field of EV charging. “Our partnership with installation specialist ICEE and manufacturer Schneider Electric has helped to create a seamless, one-point of contact supply chain for the customer looking to install an EV charging network,” says Bates.

Rapid has introduced several bespoke product modification services, made significant investments in staff and has doubled its Business Development Team, created a new Quotations team and made several senior management appointments. A new educational challenge, Airgineers, continues the company’s tradition of engaging in STEM initiatives. A fully responsive website will also go live soon.
Better tools, better process, better software

For more than 35 years, Green Hills Software has been developing the technologies which underpin the safety-critical systems of today.

Over the past 35 years, Green Hills Software has established a strong leadership position across a broad spectrum of embedded software developers, specifiers and partners. It remains dedicated to delivering success to customers and partners through a comprehensive offering of world-class software solutions and industry-leading, safety- and security-certification experts and services.

Founder and chief executive officer, Dan O’Dowd, continues to lead the company’s innovation and growth. Fiscal strength and self-sufficiency have always been part of the ethos, enabling Green Hills to continually invest in technology innovation. The company attributes over 35 years of stability and growth to forming strong long-term relationships with customers and partners, remaining focused on delivering leading technology innovation and the technical knowledge and longevity of its executive team and staff.

Historical product milestones
Green Hills Software’s culture of stretching the limits of technological feasibility has resulted in groundbreaking solutions that improve the efficiency and capability of software developers and their electronic products. Examples include the first embedded 32-bit compiler (Green Hills Compiler in 1983); the first embedded graphical Integrated Development Environment (MULTI in 1993); the first commercial, partitioning real-time operating system (INTEGRITY in 1997); the first backwards-in-time debugger (TimeMachine in 2003) and gigabyte-class trace probe (SuperTrace Probe in 2003).

Excellence in compilers and the MULTI debugger technology continue to be foundational components in Green Hills Software’s solutions. Their innovative design is focused on quickly resolving one or more difficult debugging problems that plague the users of other embedded software debuggers every day. Many days or even weeks can be lost trying to identify the bugs. This whole process can be dramatically reduced using the right tools. For example, the TimeMachine debugger enables developers to step and run forward and backwards through their code, more easily tracking down the root cause of bugs—even if they occurred long before the problem manifested itself. With TimeMachine, developers can more readily explore processor execution and, as a result, find and fix bugs faster.

Safe and secure real-time operating systems must be designed and not retrofitted. The only way to build a high-reliability operating system is to plan it from the start. The INTEGRITY RTOS was architected and developed to be used as a platform for systems

“Developing software that cannot be hacked and does not fail is not a dream – it’s a reality.” Dan O’Dowd, founder and CEO, Green Hills Software.

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that have to be independently validated against the highest levels of security and functional safety. INTEGRITY helps developers manage the growing software complexity execution within embedded systems.

Furthermore, Green Hills has built an experienced certification services team that not only achieves excellence in certifying its own products but also helps customers to certify their systems. Organisations have been relying on Green Hills to reduce certification time-to-market and costs for over fifteen years.

First certified in 2002 to RTCA/DO-178B Level A (avionics), the INTEGRITY-178 RTOS has made over 60+ compliant deliveries and in 2008 became the first and only operating system to be certified by NIAP (National Information Assurance Partnership comprised of NSA & NIST) to EAL 6+, High Robustness, the highest level of security ever achieved for any software product. In 2006, the INTEGRITY RTOS was certified to IEC 61508 (industrial) and more recently to EN 50128 (railway) and ISO 26262 (automotive). Also, the MULTI IDE meets the highest standards of functional safety, including IEC 61508:2010, EN 50128:2011 and ISO 26262:2011. MULTI satisfies both SIL 4 (Safety Integrity Level) and ASIL D (Automotive Safety Integrity Level) and is certified by TÜV NORD and exida.

The security of embedded products has been a specialisation for Green Hills Software for more than 25 years, long before the emergence of the IoT. In the last couple of years, the lack of security in embedded devices has made headline news. Cars, medical devices, industrial systems, infrastructure, personal devices and much more are part of the IoT. Each and every device should be architected secure, making it impenetrable to a hacker. This is an achievable goal.

Security is achieved through the selection of the right products, technical expertise and a rigorous development and quality process. The need for security in every product should be assessed, and the system designed to provide total protection from deliberate attempts to exploit it, as well as providing the separation architecture necessary to constrain software bugs within. For example, the INTEGRITY operating system provides multiple independent levels of security on a single or multicores processor.

To address the security market beyond the embedded device to manufacturing and operations, INTEGRITY Security Services (ISS), a wholly owned subsidiary, was formed to provide an end-to-end security product portfolio, from FIPS 140-2 certified cryptographic modules and secure boot solutions for the onboard protection of software, data, and network communications to large-scale public key management systems.

Looking into the future
Green Hills Software has the proven expertise to create the critical technology needed to produce reliable, bug-free, and high-performance software. Developers trust Green Hills to provide them with tools and methodology required to write and debug software used in our continually evolving world of technology.
Back in the 1960s, microwave technology was a very specialist niche, used mostly for military radar and communications applications. In the decades since then, it has become – if not entirely mainstream – the key enabling technology for successive generations of cellular communications as well as automotive radars and satellite TV.

A major change over the past 50 years has been the gradual replacement of vacuum tube devices such as the magnetron, klystron and travelling wave tube (TWT) with more efficient, reliable and compact solid-state equivalents. This began in the 1960s, when gallium arsenide (GaAs) transferred electron devices, commonly called Gunn diodes, were developed to provide a solid-state solution for the low-power generation of microwave energy. Although named after the British-American physicist J B Gunn, who observed the oscillations in 1962, the effect was actually predicted a year earlier by the British engineers Brian Ridley and Tom Watkins of Mullard Laboratories and Cyril Hilsum of the Services Electronics Research Laboratory (SERL) at Baldock, who wrote theoretical papers on the effect in 1961.

SERL later became part of the Royal Signals and Radar Establishment (RSRE) at Malvern, now QinetiQ, which was a major sponsor of Government-funded industrial research projects into solid-state microwave in the 60s, 70s and early 80s.

Gunn diode oscillators were used in a variety of military and civilian applications, including target-seeking radars in missiles like Sea Dart and Sea Wolf, airborne radars like the Foxhunter radar deployed on the Tornado, and - at the other end of the cost scale - direction-sensing Doppler radar modules for automatic door openers, temporary traffic light sensors, and police speed radars.

Indium phosphide (InP) was also used for Gunn diodes, and though capable of generating higher power levels there were concerns about reliability, and they were not widely adopted.

However, reflection amplifiers using InP Gunn diodes did go into service in a military radar application in the early 1980s.

**Monolithic ICs**
The dominance of compound semiconductors in microwave truly began with the development of the GaAs MESFET. The late Jim Turner, working at Plessey Research Caswell, published the world’s first experimental results in 1966, and followed this with a paper on the first commercial e-beam fabricated GaAs MESFETs in 1970. He went on to develop, along with his colleague Ray Pengelly, the world’s first GaAs monolithic microwave integrated circuit (MMIC), publishing the results in 1976.

While MMICs developed rapidly in both capability and complexity,
Bluetooth, the ‘short-link’ radio technology first appears in 1994.

The iPhone is released by Apple. It can go on the Internet, play videos and music in 2007.

IN 2008

Phased array radar
The MMIC’s compact nature, and its potential to lower unit costs, finally provided radar system designers with the opportunity to realise the first phased array radars in the early 1980s. These radars require a large matrix of transmit/receive modules, each with independent phase and gain control, that can move the main beam in two or three dimensions without physically moving the antenna.

The 996 radar was one of the first phased array radars to go into service with the Royal Navy, made possible by GaAs FET transmit/receive modules. Around the same time, a true 3D radar concept project was being developed. The Multifunction Electronically Scanned Adaptive Radar (MESAR) was an experimental phased array radar that used a solid state active array and a digital beamformer, together with programmable waveform generation and signal processing. The MESAR programme began in 1982, and was the forerunner of a new generation of intelligent radar systems, including the SAMPSON radar deployed on the Type 45 destroyer.

Circuit technologies
In the 1960s the predominant circuit technology was waveguide. Much of the design process, though based on electromagnetic theory, was empirical - a design manual of the time stated that “a good set of needle files is a prerequisite for a microwave design engineer”.

Microstrip technology gradually started to be adopted, initially on an alumina substrate as seen in the Texas Instruments 8-10GHz noise source from 1968, but later on flexible metal-clad PTFE substrates as well as the cheaper FR4 for lower frequencies. Today, laminate materials dominate the microwave PCB market.

Low-temperature co-fired ceramic (LTCC) technology was introduced in the late 1990s, and offered the...
advantage of combining the circuit and its packaging into one structure, being particularly suitable for multi-chip modules. Still in use, it nevertheless failed to fulfil its initial hype.

**Computerised design**

Computerised Optimisation of Microwave Passive and Active Circuits (COMPACT) was the first successful microwave design package, commercialised by Compact Software in 1973. COMPACT ran on a time-sharing basis on mainframe computers, and rapidly became an industry standard, particularly in the defence industry.

COMPACT was followed in 1981 by the company’s third-generation program SuperCOMPACT, which enjoyed a similar monopoly until the launch in 1983 of Touchstone by a new company – EEsotf. Touchstone was the first microwave EDA program that was able to run on a desktop computer, the newly-available IBM PC. Other companies followed up in quick succession. Hewlett-Packard launched its Microwave Design System (MDS), which eventually took over EEsotf and merged their products into the Advanced Design System (ADS) – still being marketed today by Keysight Technologies. Ansoft (now part of ANSYS) was founded in 1984, and specialised in 2D and 3D electromagnetic modelling, a field later joined by CST Computer Systems Technology. A later entrant to the EDA market, AWR, is now a division of National Instruments.

**Commodity GaAs**

Though defence remained the dominant microwave sector in the 1980s, interest was growing in commercial spin-offs. Early designs for direct broadcast satellite (DBS) systems began to emerge, and some prototype automotive radars were also trialled. DBS provided the first true high-volume application for GaAs HEMTs with the launch of the Astra 1A satellite in December 1988. Sky Broadcasting launched its commercial service on four channels on Astra, while rival British Satellite Broadcasting (BSB) transmitted over the Marcopolo satellite. The microwave low-noise blocks (LNB) that formed the first RF stage after the Sky dish or the novel BSB ‘squirial’ utilised four GaAs transistors, with a target price of £1.00 each for devices that had previously cost orders of magnitude more. Sky and BSB eventually merged, and the market expanded rapidly.

The age of commodity GaAs had arrived, coincidentally just in time to save the microwave industry from the inevitable slump in the defence market following the end of the Cold War.

**GSM to 5G**

Although early analogue (1G) cellular phones were available in the 1980s, the mobile phone revolution really took off when GSM was introduced in the early 1990s. Subscriber numbers grew exponentially, exceeding even the most ambitious forecasts. Demands on the RF front end components drove continuous technology improvements, with dual-band, tri-band and quad-band devices being required to cover different frequency designations around the world.

3G and 4G LTE increased the design challenges further, with stringent linearity requirements an high peak-to-average power ratios on the MMIC power amplifiers.

5G will push the requirements of microwave technology still further, but will offer a step change in data rates. It will make use of mmWave frequencies where wide operating bands can be made available.
Having started my own career in 1980 fabricating PCBs on the south coast, Wilson Process Systems was formally established a year later offering that exact same service alone with several other thousand companies throughout the UK in the 80s. Today only a few hundred companies remain offering prototype & small production batches. For many, the rise of imported PCBs from Europe followed by China through the 90s and into 2000s put many PCB fabricators out of business. For some, diversification was the only option which WPS took with both hands. The early 90s saw the opportunity to start populating PCBs as certain customers saw this as a natural progression. With the introduction of automated assembly early on, WPS soon established an ethos of automation which remains today. From initial photo-mech and plating processes manufacturing bare PCBs (when health & safety was at its infancy) through to today's offering of 200K placements an hour via its fleet of Universal surface mount equipment, WPS has seen numerous technical innovations covering PCB related production in its 37 years servicing the industry. Even with the wholesale migration out to the Far East, WPS has still managed to maintain its competitiveness within the volume industrial sector whilst still appealing to the small batch customers.

Today Wilson Process employs approximately 100 staff over 2 sites within the seaside town of Hastings. With over 30,000 sq ft of manufacturing space dedicated to automated through-hole, high capacity surface mount plus over 60 hand assembly operatives, WPS prides itself as a true supplier partner offering a competitive manufacturing resource focused on industrial, commercial and medical sectors within the contract electronics market.
RF power amplifiers are going wide and high to meet wider frequency ranges and the need for more bandwidth, as Keith Benson explains.

Many wireless electronic systems operate over wide frequency ranges and the need for more bandwidth continues. As a result, the systems engineer faces challenges trying to design electronics to cover the entire frequency range.

Given the possibility of having one signal chain cover the entire frequency range, most systems engineers would get excited at the prospect. However, the one signal chain approach is always related to the performance degradation that comes with a wideband solution vs. a narrow-band solution. At the heart of this challenge is the power amplifier, which commonly has superior performance when tuned over a narrow bandwidth.

Traveling wave tube (TWT) amplifiers have dominated higher power electronics as the output power amplifier stage in many of these systems. However, given the long-term reliability of semiconductor ICs, there has been a push toward these electronics, starting with GaAs. The emergence of GaN technology has created a move toward GaN amplifiers as the output stage of these systems. The driver amplifier in many of these systems is still commonly GaAs. So, how do you use circuit design to extract as much power, bandwidth, and efficiency out of these wideband power amplifiers?

Certainly GaN-based designs are capable of higher output powers than GaAs-based designs, and the design considerations are largely the same.

**Design considerations**
The most common type of monolithic amplifier design is a multistage, common-source, transistor-based design, also known as a cascade amplifier design. Here, the gain multiplies from each stage, leading to high gain and allows us to increase output transistor sizes in order to increase the RF power.

GaN offers benefits here because engineers are able to greatly simplify the output combiners, reducing loss, and improving efficiency, as well as shrinking the die size, making wider bandwidths and improved performance possible.

A less obvious benefit of going to GaN devices is to achieve a given RF power level, perhaps 4W - the transistor size will be less, resulting in a higher gain per stage. It will lead to fewer stages per design and ultimately, higher efficiency. The challenge with this cascade amplifier technique is that it is difficult to achieve bandwidths over an octave without significantly compromising the power and efficiency.

One approach to achieve wide bandwidth design is to implement a balanced design with Lange couplers on the RF input and output. The return loss is ultimately dependent on the coupler design, as it becomes easier to optimise the gain and power response over frequency without also needing to optimise the return loss.

Another topology to consider is the distributed power amplifier which incorporates the parasitic effects of the transistor into the matching networks between devices.

The input and output capacitances of the device can be combined with the gate and drain line inductance, respectively, to make the transmission lines virtually transparent, excluding transmission losses.
power is set by the voltage applied to
the amplifier such that if we want to
increase the output power, we need
to increase the voltage applied to
the amplifier.

\[ P_{OUT} = \frac{V_{DD}^2}{2 \times R_L} \]

This is where GaN becomes very
helpful, as we can quickly go from
5V supply voltage with GaAs to a
28V supply voltage in GaN, and the
achievable power goes from 0.25W
to almost 8W, simply by changing
the technology. There will be other
considerations to look at such as the
gate length of the process available
in GaN and if they can achieve the
gain you need at the high frequency
end of the band.

The fixed RL of 50Ω for distributed
amplifiers is different compared
to the cascaded amplifier where
we change the resistance value
presented to the transistor by
matching networks to optimise the
power from the amplifier. There is a
benefit in optimising the resistance
value presented to the transistor
with cascade amplifiers in that it can
improve the RF power. Theoretically,
it is possible to continue increasing
the transistor periphery size to
continue increasing the RF power, but
there are practical limitations to this,
such as complexity, die size, and
combining loss.

The matching networks also
tend to limit the bandwidth, as
they become difficult to provide
an optimum impedance over wide
frequencies. In the distributed power
amplifier, there are only transmission
lines whose purpose is to have the
signals constructively interfere along
the amplifier, rather than matching
networks.

There are additional techniques
to further improve the power in
distributed amplifiers, such as using
a cascade amplifier topology to
further increase the voltage supply to
the amplifier.

Each of these different topologies
and technologies have a place in the
semiconductor world, as they each
provide benefits, which is why they
have survived to this day.

The emergence of new
semiconductor materials like GaN
have opened the possibilities to
reach higher power levels covering
wide bandwidths.

Shorter, gate length GaAs devices
have extended frequency ranges from
20GHz to 40GHz and beyond. The
reliability of these devices is shown
to exceed 1million hours, making
them ubiquitous for modern day
electronic systems.

It’s to be expected that the trends
of higher frequencies and wider
bandwidth will continue into the
future.
The number of connected devices is increasing and with this comes the problem of an overcrowded network, threatening the user’s connectivity experience and device performance. The industry is hoping a new Wi-Fi Standard, known as 802.11ax, will provide an answer.

“This rise in connected devices will strain the network in terms of the number of devices that need to be supported simultaneously, the need for more capacity, and the need to provide coverage everywhere – near the Access Point (AP)/basestation, or cell edge,” comments Qualcomm’s Vice President, Connectivity Networking BU, Irvind Ghai.

Currently, most Wi-Fi solutions are based on 802.11ac – a wireless networking standard developed by the IEEE Standards Association. This provides wireless local area networks (WLANs) on two frequency bands – 2.4GHz and 5GHz.

The 2.4GHz band is used mostly by older devices and allows data rates to travel a farther distance than 5GHz, however, it’s an extremely crowded channel. By contrast, 5GHz offers faster speeds, but is restrained by range restrictions. This particular predicament gave rise to Dual-band, offering access to both channels.

Most APs are currently 4x4 802.11ac, supporting multiple input multiple output (MIMO) that allows transmission or reception of data on all four antennas at any given time and improves range and reliability.

With the second wave of 802.11ac, came the addition of multi-user (MU) MIMO, allowing multiple clients to be serviced simultaneously and a 2.5x capacity boost. A quality which helped with the Wi-Fi experience and performance, but hasn’t exploited their full potential.

According to Ghai, the problem lies in the fact that with 802.11ac, the radio has to use the entire spectrum available in a channel to transmit or receive data at any given time slot.

Now, the Wi-Fi standard is moving to 802.11ax – which has not yet been ratified, but is already being implemented by the likes of Qualcomm. With its focus on both the APs and client devices, Qualcomm’s 802.11ax portfolio includes the IPQ8074 System-on-Chip (SoC) for network infrastructure and WCN3998 11ax-ready client platform.

**Connected experiences**

The goal is that an 802.11ax system will improve connected experiences, delivering up to 4x greater capacity to make Wi-Fi traffic more efficient, improve coverage and offer longer battery life for Wi-Fi devices.

According to Ghai, it supports 12 streams (eight 5GHz and four 2.4GHz), 8x8 Mu-MIMO which offers advanced 8x8 sounding mechanism – the ability for multiple antennas to act concurrently – as well as 802.11ax 80MHz channel support.

“For a 1x1 client that is typically challenged on the uplink,” Ghai says, “an 8x8 can also provide 3dB better sensitivity over a 4x4 802.11ac AP due to twice as many antennas. In addition, improvements in radio design has further boosted receive sensitivity of the receiver, resulting in an overall 5-6dB improvement.”

Ghai describes 802.11ax as a technology that “builds upon the foundations ac has laid,” through the inclusion of uplink (UL) MU-MIMO, Orthogonal Frequency Division Multiple Access (OFDMA) and Hybrid Arbitrated Access (HAA).
Access (OFDMA) support and traffic scheduling. “OFDMA is the way in which the spectrum is being used and this is the first time a cellular-feature like this has been brought into the Wi-Fi standard,” he explains. “It means the channel can be ‘broken’ into smaller bits – allowing for up to 37 clients to be serviced at any given time, resulting in a more efficient use of spectrum.”

802.11ax also brings in a managed approach of resource allocation, optimising wake-up time and reduces Wi-Fi power consumption by two thirds, resulting in extended battery life without adverse effects on performance.

“Qualcomm is focused on making the 8x8 architecture that meets the customer’s system cost and power requirements,” Ghai says. He points to Power over Ethernet (PoE) as the key. But, this can be a challenge as 8x8 naturally consumes more power. “We can overcome this,” he continues, “by moving the silicon to a 14nm process and implementing power save nodes. So, for example, when a certain core is not in use, it can be shut down to save on power dissipation and improve the overall thermal characteristics.”

Qualcomm is working towards architectures on even more advanced process nodes. At The Small Cells World Summit earlier this year, it announced the “industry’s first” 5G NR solution targeted for small cells and remote radio head deployments (FSM100xx).

“The 5G small cell is 10nm and even further advanced,” Ghai contends.

“Shrinking the node means we can pack more functionality in a form factor and power envelope that can be used in carrier gateway or enterprise AP,” he says. “Particularly, many enterprise APs are PoE, and, as a result, have strict power budget requirements. Going to 14nm has allowed us to add quad core ARM processors, offload engine, 10G interface and 12 chains of 802.11ax - all in a single chip.

“The challenge lies in leading the industry transitions and making the required investment in innovation and R&D. Fortunately, Qualcomm has been a leader in going to new process nodes on modem and application processor for smartphones. We are able to leverage that R&D investment to provide the same benefit to connectivity and networking products.”

Building upon its original FSM for 3G and 4G small cells, this new technology aims to support 5G NR in both mmWave and sub-6GHz spectrum and is designed to allow OEMs to reuse software and hardware designs across these types two of products.

Cell densification

According to Qualcomm, small cell densification will be vital for 5G networks as a means of supporting outdoor and indoor deployments – the latter of which supports the majority of data consumption. The higher frequencies of 5G NR result in a solution needed to support delivery of uniform 5G experiences everywhere – both indoors and outdoors, and the FSM100xx has been designed to address these needs with MIMO implementation and multi-gigabit throughput, compact form factor and PoE support.

5G NR small cells allow the operators to provide capacity and coverage surgically at the location where it is needed. “This is more cost-effective and scalable way to provide capacity for ex: it is easier to deploy a 5G NR small at a ‘hotspot’ location where most of the data is consumed as opposed to rely on expensive macro solution that also require site acquisition delays,” Ghai adds.

Qualcomm isn’t alone. Marvell Semiconductors is also introducing a 11ax solution. Designed specifically for vehicles, it features 2x2 plus 2x2 concurrent dual Wi-Fi, dual-mode Bluetooth (BT) 5/BT Low Energy and 802.11p for connected vehicles. With 802.11ax expected to be rolled out in mobile phones as early as next year, Jeff James, Senior Director of Business Development at Marvell, says: “Delivering vehicles with the same capabilities is vital because customer expectations are increasing. They expect the same performance, security and reliability in all devices, including their cars. We’re building the car for the future.”

“The 802.11ax provides 40% higher throughput vs 802.11ac with 1024QAM, improves range by up to 50% through the use of dual carrier modulation and extended range, along with improving latency with OFDMA by ~6x,” adds Avinash Ghimikar, Director of Systems and SW, Marvell.

“To solve the over-crowded network, we must rely on advanced techniques such as 802.11ax or 5G-NR which can support multiple devices simultaneously,” Ghai contends. “Alternatively, we can use advance MU-MIMO techniques in 5G-NR or 11ax to improve experience of every users by providing multi-gigabit throughput.”

With the advent of technology like 802.11ax, industry is looking to resolve the problems associated with a crowded network. But, as advancements emerge, it’s inevitable other problems will evolve too, and as James alluded to, as advancements develop, customer expectations will only increase further.
Innovative device architectures containing novel materials require new solid-state analytical capabilities, as Paul van der Heide explains.

To keep up with Moore’s law, the semiconductor industry continues to push the envelope in developing new device architectures containing novel materials. However this, in turn, pushes the need for new solid-state analytical capabilities, whether for materials characterisation or inline metrology.

Aside from basic R&D, these capabilities are established at critical points of the semiconductor device manufacturing line, to measure, for example, the thickness and composition of a thin film, dopant profiles of transistor’s source/drain regions and the nature of defects on a wafer’s surface. This approach is used to reduce “time to data”, which essentially means that we cannot wait until the end of the manufacturing line to know if a device will function as intended, or not.

Every process step costs significant amounts of money and a fully functional device can take months to fabricate.

Analytical techniques
Recent advances in instrumentation and computational power have opened the door to many new, and exciting analytical possibilities.

One interesting example concerns the development of coherent sources. So far, coherent photon sources have been used for probing the atomic and electronic structure of materials, but only within large, dedicated synchrotron radiation facilities. Through recent developments however, table top coherent photon sources have been introduced that could soon see demand in the semiconductor lab/fab environment.

Importantly, the increased computational power, that’s now at our finger tips, is also allowing engineers to make the most of these and other sources through imaging techniques such as ptychography.

Ptychography allows for the complex patterns resulting from coherent electron or photon interaction with a sample to be processed into recognisable images to a resolution close to the sources’ wavelength without the requirement of lenses (lenses tend to introduce aberrations). Potential application areas extend from non-destructive imaging of surface and subsurface structures, to probing chemical reactions at sub femto-second timescales.

Detector developments are also benefiting many of the analytical techniques presently used. A good example of this is transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM) that can now image, with atomic resolution, heavy as well as light elements.

Combining this with increased computational power, allows for further development of imaging approaches such as tomography, holography, ptychography, differential...
phase contrast imaging, etc. All of which allow TEM/STEM to not only look at atoms in, for example, 2D materials such as MoS₂ in far greater detail, but also opens the possibility to map electric fields and magnetic domains to unprecedented resolution.

**Meaningful solutions**

The semiconductor industry is evolving at a very rapid pace. Since the beginning of the 21st century, the industry has seen numerous disruptive technologies emerge; technologies that need to serve in an increasingly fragmented applications space and, significantly, it’s no longer solely about ’the central processing unit (CPU)’.

Other applications, ranging from the Internet of Things to autonomous vehicles and wearable human-electronics interface are being pursued, each of which come with unique requirements and analytical needs.

In this rapidly changing semiconductor landscape, we, as an industry, are faced with the huge challenge of developing the right supportive infrastructure – with the right analysis facilities that have the right people at the right place, and where meaningful solutions are developed that have valuable impact. And while it’s true to say that we can analyse literally everything, the question that should always be asked is: ’what is of importance’.

Analysis is costly and many of the major high-volume manufacturing companies do not always have the time to fully explore all the potential areas of interest, and there are many. As a result, the industry is seeing far greater levels of collaboration especially with research institutions such as imec.

**Extending capabilities**

Looking ten to fifteen years ahead, we can expect to witness a different landscape. Although I’m sure that existing techniques such as TEM/STEM will still be heavily used – probably more so than we realise now (we are already seeing TEM/STEM being extended into the fab).

We will also see developments that will push the boundaries of what is possible.

This could range from the increased use of hybrid metrology (combining results from multiple different analytical techniques and process steps) to the development of new innovative approaches.

To illustrate the latter, take the example of secondary ion mass spectrometry (SIMS) - see the image opposite. With SIMS, an energetic ion beam is directed at the solid sample of interest, causing atoms in the near surface region to leave this surface. A small percentage of them are ionised, and pass through a mass spectrometer which separates the ions from one another according to their mass to charge ratio. When this is done in the dynamic-SIMS mode, a depth profile of the sample’s composition can be derived.

Today, with this technique, we can’t focus the incoming energetic ion beam into a confined volume, i.e. onto a spot that approaches the size of a transistor. At imec however, we were able to introduce novel concepts that resulted in what are called 1.5D SIMS and self-focusing SIMS (SF-SIMS). These approaches are based on the detection of constituents within repeatable array structures, giving averaged and statistically significant information. This way, the spatial resolution limit of SIMS was overcome.

There are also exciting developments occurring here at imec in other analytical fields such as atom probe tomography (APT), photoelectron spectroscopy (PES), Raman spectroscopy, Rutherford back scattering (RBS) and scanning probe microscopy (SPM).

One important milestone has been the development of Fast Fourier Transform-SSRM (FFT-SSRM) that allows users to measure carrier distributions in FinFETs to unparalleled sensitivity. This capability has also been translated into a commercial product which has been installed at several imec partner sites.

**New analytical approaches?**

Much like the rest of the electronics industry, probably, the biggest challenge materials characterisation and inline metrology will face over the next ten to fifteen years will be how to keep costs down.

This will force us to think of totally new approaches and methods. Today, we make use of highly specialised techniques developed on mutually exclusive and costly platforms. But why not make use of micro-electro-mechanical systems (MEMS) that could simultaneously perform analysis in a highly parallel fashion, and perhaps even in situ?

It is quite possible to imagine scenarios in which an army of such units could scan an entire wafer in the fraction of the time it takes now, or alternatively, the incorporation of such units into wafer test structure regions.

In addition, these could be reusable or disposable and if that was achieved, then that would be a true game changer.

It’s a huge challenge, but if it could be done, it would have a significant impact on the semiconductor industry.
Over the past decade the biggest investor in chip manufacturing has been Samsung Electronics. With a burgeoning flash memory market driven by solid-state drives and tablets, coupled with the push below 10nm for advanced microprocessors, the Korean manufacturer has ploughed money into high-end fab capacity so it can keep up. And, over the past couple of years, the semiconductor business has been on a tear.

With such high-volume markets to serve, you might expect chipmakers like Samsung to be lobbying for a shift to larger wafers. In the wake of the financial crisis, the company was, along with Intel, keen to convince its equipment suppliers to support an increase in wafer sizes from 300mm to 450mm so that it could cut productions. Although making equipment to support wafers as big as a family-sized pizza would be complex and expensive, the doubling in chips per wafer promised increased gross margins for manufacturers serving high-volume markets.

However, Samsung’s enthusiasm waned as it became clear that wafer size is not the path to lower costs that it used to be. Steps such as etching and vapour-phase deposition reap the benefits of larger wafers because they act on the entire surface at once. But lithography has become a much bigger source of cost and that remains fixed to the reticle size – something that has not increased in terms of area in decades. As a result, bigger wafers take longer to process. Consequently, chipmakers seem to be locked into 300mm for some time to come.

Not a wasted investment
“‘The [R&D] investment in 450mm hasn’t been wasted,’” says Malcolm Penn, president of market-analyst firm Future Horizons. “‘Spin-offs have gone into 300mm and made those 300mm factories much more efficient than they would have been under the natural roadmap.”

But the dominance of 300mm has come under unexpected pressure from its immediate predecessor, the 200mm wafer. First put into production 20 years ago, lines designed for 300mm wafers accounted for more than half of total installed fab capacity by the start of this decade.

As chipmakers shuttered their old 150mm and 200mm plants, partly driven by the long-term trend of transferring production to foundries, that share rose. It ticked up to just over two-thirds by the end of 2017. Although market analyst firm IC Insights expects continued capacity additions by the largest suppliers will push the share to more than 70% by the end of 2019, the old 200mm lines are fighting back in unexpected ways.
Since the early 2000s processes have been optimised for 300mm lines. As a result, the smallest geometry that was developed with 200mm wafers in mind was 180nm. But at the start of this decade, suppliers such as NXP and TSMC started to look at ways they could extend the life of their existing fabs and take the 200mm lines at SSMC in Singapore down to 110nm. Quietly, even Samsung has done the same, with its Line 6 fab in Giheung, Korea starting production of 65nm-geometry chips earlier this year.

Some of the resurgence in 200mm is based on the reuse of equipment from the twenty-odd fabs that have shut since 2009. According to Penn, supplies are soon snapped up. “You can buy secondhand pieces of kit for 200mm, that’s workable. But those are now rarer than hen’s teeth,” he says. At the same time, the equipment suppliers are seeing their sales of 200mm machinery tick up. Samsung has, for example, used extensive automation technology, which was part of the 300mm revolution, to cut costs at Line 6.

During the company’s second-quarter conference call held in mid-May, Applied Materials CFO, said: “Our 200mm systems revenue should be up over 20% this year. In fact, we are now building brand-new systems to keep with the demand for the billions of sensors and other low-cost devices needed in the Internet of Things, advanced automotive applications, and Industry 4.0.”

Applied Materials president and CEO Gary Dickerson said capacity expansion at ‘trailing edge’ nodes, which are now classed as geometries of 28nm and coarser, has been something the company has been seeing for about a decade. A decade ago, 10% of the company’s business was serving those nodes. The vast majority went into the leading-edge processes. “Over time, that’s evolved to 80/20, 60/40 and this year we see it evolving to 50/50.”

A lot of that supply is for 28nm on 300mm which has steadily increased and is demonstrating the interest among customers for SoCs that integrate sensors, memory and other circuitry that is expensive to provide on the finer-geometry finFET-based technologies. “Initially, we called peak capacity at 28nm [to be] 330,000 wafer starts a month. Then it was 400,000, then it was 450,000, and now it’s 500,000 wafer starts a month.”

Cost-volume trade off One of the reasons why manufacturers have opted for 200mm production rather than simply expand 300mm lines is one of cost-volume trade off. For devices that have small die sizes and do not ship in the millions, it is difficult to manage the smaller batches of wafers that would be needed for 300mm production.

In a number of cases, the push for 200mm is coming from novel technologies such as gallium arsenide on silicon. Suppliers such as EpiGaN and Kyma Technologies have claimed success in developing equipment and techniques to deposit the III-V semiconductor – useful for both power transistors and LEDs – reliably onto 200mm wafers.

Where chipmakers see high-volume markets, some are keen to push the cost advantage of bigger wafers even for speciality process technologies, such as those needed for mixed-signal and power devices.

Texas Instruments (TI) was among the first companies to manufacture mixed-chip chips on 300mm wafers with the conversion of its DMOS6 fab in its home state. The company has argued that manufacturing some of its devices on 300nm wafers gives it a 40% cost advantage before the cost of packaging is taken into account. According to IC Insights, in 2017 about half of TI’s mixed-signal revenue came from chip built on 300nm wafers.

Last month, Infineon Technologies said it would pump €1.6bn into a 300mm fab in Villach, Austria, that would focus on power devices. CEO Reinhard Ploss said the expected demand for power semiconductors “is underpinned by global megatrends such as climate change, demographic change and increasing digitisation”. He expects the devices to go into electric vehicles, renewable-power generators and data centres.

The widespread use of sensors based on microelectromechanical systems (MEMS), which are often made on wafers measuring just 150mm or smaller, has similarly convinced Bosch that it should move production to 300mm.

Penn says the margin improvements Bosch should see when its 300mm Dresden fab moves into production in the early 2020s will hurt competitors such as STMicroelectronics, which still uses 150mm wafers for some high-volume sensors.

But in an environment where factors other than size often contribute heavily to margins, the shift to 300mm is not necessarily the right answer.
ELECTRONICS DESIGN SHOW

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Engineers are fundamental to shaping the lives of every man, woman and child. International Women in Engineering Day celebrates this inclusivity and marks an opportunity to extend it.

By Debbie Ash

In the UK, we face a deficit of skilled engineers generally and struggle to attract women into careers within this industry. But, this acknowledgement is nothing new. 2018 is the Year of Engineering in the UK and it also marks 100 years since women were given the vote. The question we have to ask is ‘why aren’t we making an impact’? The lack of women in engineering is just one example of how companies and society still need to adopt a more flexible, inclusive and open-minded approach to employing the right people for the right job. The suffragette movement should have been consigned to the history books by now, so it seems tragic that in 2018 we’re still talking about gender gaps.

Oishi Deb, a software engineer at Rolls-Royce and STEM ambassador, who previously won the Sky Women in Tech Scholarship programme, says: “In India there is a stereotype that girls study medicine and boys study engineering, but this wasn’t something that put me off. At least 20% of the girls in my year went on to study some form of engineering at university. STEM subjects were actively encouraged and many of my teachers, including my English teacher, gave me guidance in terms of my future direction.

“We must speak to younger children about engineering because this is when it matters most,” Oishi contends. “I was recently at a primary school and it was heartening to hear as many questions about electronics, technology and engineering being asked by the girls as the boys. We need to harness this enthusiasm and curiosity from this...
young age and offer encouragement and support by providing female role models and demonstrating the breadth of opportunities in engineering.”

Orla Murphy agrees, suggesting that engineering isn’t just one career. “It’s hundreds of different jobs,” she says, “that can take you around the world, working for different companies and in a variety of fields.”

Gifted in maths, science and music at school in Ireland, Murphy’s degree in electronic engineering and music allowed her to study topics she loved, before spring-boarding her into a career at Jaguar Land Rover working on vehicle entertainment systems. “If you become a dentist then you’re going to be looking in mouths for the rest of your life,” she adds. “As an engineer, I could be designing a new audio system for a vehicle one day, and the next looking at how sensors can make a car safer. Engineers are problem solvers which is why I find my career so fulfilling.”

The media doesn’t help the stereotype either. A quick search on Google images shows you pictures of people in yellow hats on building sites – quite the opposite of how Rachel Wong, from Malaysia, both looks and feels.

As a tissue engineer at UCL Institute of Child Health, Wong uses stem cells to grow eyes and work in a lab in a lab coat. But I engineering is as fun as you make it.

“Being able to tinker with the world when it matters because that is what engineering is all about. Trying new things and often failing is what engineering is all about. “Being able to tinker with the world around me is thrilling! I could be part of the team that invents a device to diagnose cancer, or be instrumental in delivering malaria medicine to children who need it.”

Helping women engineers to remain in their roles
In 2014 researchers looked at interventions that would help women engineers to remain in their roles. Evidence suggested that 20% of those graduating with engineering degrees were women, but that 40% of those either leave their roles or never enter the profession. The academics came up with a list that could help women to stay in their roles, which included:

- Stretch assignments – being given tasks that were beyond their skills level – which when achieved brings a new level of confidence and assures that the person feels valued and supported.
- Constructive, personalised feedback – helping women to overcome the uncertainties when they started in their role, offering them explanations about strengths and weaknesses, and guidance for further improvement – which supported them in choosing which area of engineering to specialise in.
- An inclusive microenvironment – care and peer support received from line managers and role-models who demonstrate work/family balance.

However these should not be unique ways to manage women; they should be endemic in all companies who manage people.

Author profile
Debbie Ash is the VP Talent Management and Organisational Development at RS Components

Engineering is about innovation, it’s about design and it’s about leaving a positive impact on society.” Dr Weckman comes from a long line of women engineers and it was her family’s engineering background that gave her the impetus to enter into nanotechnology and biomedical engineering.

Maintaining interest
If encouraging women into this industry starts at primary school and with parents’ influence, how do we keep them in these roles throughout their careers?

“There isn’t one answer to encouraging more women to enter engineering,” observes Ruth. “But what is key is that it’s everybody’s job to make it happen. From the teaching staff who encourage curiosity in the world around us, to the toys we give our children to play with, through to the stock imagery we use to illustrate university prospectuses, and beyond to the support that we give all employees throughout their careers – especially to those in underrepresented groups.

“If everyone takes the time to think about how they talk, project and explain engineering, we’ll be far closer to seeing a truly universally accepted image of whom an engineer is – an engineer is anyone, so there’s an engineer in everyone.”

“We need to speak to younger children about engineering because that is when it matters most.”
Oishi Deb
Call James Creber on 01322 221144

Automotive MOSFETs down to 0.9 mΩ

Nexperia launches lowest RDS(on) automotive MOSFETs down to 0.9 mΩ

High efficiency saves space and system cost, ultra-reliable for safety-critical designs

Nexperia, the global leader in discrete, logic and MOSFET devices, today announced the release of the company’s lowest RDS(on) automotive-qualified MOSFETs. The AEC-Q201 Trench 31.40V automotive superjunction MOSFETs in the rugged, electrically- and thermally-efficient LFPAK5SE deliver a footprint reduction of up to 81% when compared to traditional solutions such as bare die modules, D2PAK or D2PAK-7 devices. The 0.9 mΩ, 220 A,0.5-rated BUKXJ90-40H MOSFET suits applications up to 1.2 kV and is also lower cost than larger D2PAK devices which were the previous best solution.

As well as reducing RDS(on) the new devices also feature an improved DC current rating of 220 A – a first for the automotive Power-SOS footprint. This enables higher power density on a small footprint, which is especially valuable for safety critical automotive applications that require dual redundant circuitry. The use of Superjunction technology delivers a higher Avalanche capability and Safe Operating Area for improved performance under fault conditions.

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Manhattan Skyline – E - Paper Displays

E – Paper Displays

Electronic paper and e-paper display devices that mimic the appearance of ordinary ink on paper. Unlike conventional backlit flat panel displays that emit light, electronic paper displays reflect light like paper. This may make them more comfortable to read, and provide a wider viewing angle than most light-emitting displays.

Available sizes are 2.9”, 5.65”, 6”, 9” 10.3” and 13.3” all with evaluation kits. Applications include electronic pricing labels in retail shops and digital signage, time tables at bus stations, electronic billboards, health and fitness displays, IoT devices.

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New military-grade laptop

New military-grade laptop PSU is 90% smaller and lighter, 80% lower cost

UK company, On-Systems, launches revolutionary disruptive technology, delivers new technology platform for harsh-environment PSUs

On-Systems, a young British company that specializes in innovative power supply design for harsh environments, today launched Pebble, a new COTS, rugged, 690W silent laptop power supply for defence, avionics and mobile applications that is a fraction of the size, weight and cost of current designs. Pebble is the first in a series of harsh-environment PSUs from the company which combine a new topology, custom-designed FET drivers and fast switching speed to deliver industry-changing benefits.

On-Systems’ new topology combines three stages into one, reducing IR losses and increasing efficiency. On-Systems has worked with a leading power semiconductor company to design new very fast FET drivers, allowing the Pebble to switch at up to 40 times typical switching frequencies.

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C&B’s 2017 Distributor of the Year Awards

TTE, Inc. scoops C&B’s 2017 Distributor of the Year Awards and recognised for Fastest Growth

Leading distributor enables designers in Europe and the USA to benefit from latest innovative switch solutions

TTE, Inc., a world-leader in specialist distributor of electronic components, has been named as C&B’s 2017 Distributor of the Year in both Europe and the United States. TTE Europe was also named the “Fastest Growing Distributor of the Year” for 2017. C&B is one of the world’s most trusted brands of high-quality electromechanical switches covering applications spaces including the industrial, defense, aerospace and consumer electronics industries. C&B’s switches and components are known for their durability and reliability, even when exposed to harsh operating conditions.

The awards recognize the both companies’ strong, joint global commitment to ensuring that new and existing customers have access to the reliable, high-quality and resilient switches and components they need to produce innovative new products.

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More Than 25 Top Awards for Excellence

Mouser Electronics Recognized with More Than 25 Top Awards for Excellence from Its Supplier Partners

Mouser Electronics, Inc., the global authorized distributor with the newest semiconductors and electronic components, today announced that it has received over 25 top business awards from its supplier partners for exemplary performance during 2017.

Suppliers cited many criteria for the honors, including double-digit growth, fastest new product introductions (NPIs), breadth of inventory, best-in-class global marketing campaigns, customer growth, global expansion and commitment to teamwork.

“It is very rewarding to be recognized by our supplier partners, who share our mission of delivering the newest technologies and providing best-in-class customer service,” said Jeff Niewo, Senior Vice President of Products at Mouser Electronics. “These awards honor the outstanding teamwork we share with these valued supplier partners.”

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Power Integrations’ SCALE-iDriver ICs

Power Integrations’ SCALE-iDriver ICs Now Available with AEC-0100 Certification for Automotive Use

Safe, reliable and reinforced isolation for applications up to 1200 V

Power Integrations (Nasdaq: POWI), the leader in gate-driver technology for medium- and high-voltage inverter applications, today announced that two members of its SCALE-driver® gate-driver IC family are now certified to AEC-Q100 Grade Level 1 for automotive use. The two parts, SID13360 and SID11820K, are suitable for driving 650 V, 750 V and 1200 V automotive IGBT and SiC-MOSFET modules, and are rated for peak currents of +/-2.5 A and +/-8 A respectively. The SID11820K has the highest output current of any isolated gate driver available and is capable of driving a 650 A /1200 V and 820 A /750 V switch.

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New FPGAs Solutions Open Doors for Rapid Deployment of Machine Learning Inferencing Across Broad Market IOT Applications Demanding Milliwatt Range Power Consumption

Lattice Semiconductor Corporation (NASDAQ: LSCC) today unveiled Lattice sensAI™ – a complete technology stack combining modular hardware kits, neural network IP cores, software tools, reference designs and custom design services – to accelerate integration of machine learning inferencing into broad market IoT applications.

With solutions optimized for ultra-low power consumption (under 1 mW – 1 W), small package size (3.5 mm2 – 100 mm2), interface flexibility (HIPPI, CSIO, USB, JTAG, etc.), and high-volume pricing ($15-$10 USD), Lattice sensAI stack fast tracks implementation of edge computing close to the source of data. “Lattice sensAI addresses the unmet need for flexible, low cost, ultra-low power AI silicon solutions suited for rapid deployment across a wide range of emerging, mass market IOT applications,” said Deepak Boppa, senior director, product and segment marketing at Lattice Semiconductor.

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