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COMMENT
As another report calls for engineering to be squeezed into the curriculum, will the Year of Engineering change the profession’s image?

NEWS
The industry must try harder as it looks to improve how engineering is perceived by school students

A ruthenium based compound could increase conductivity in organic semiconductors

Sodium based solid state battery is ‘safer, more reliable’, claim Swiss scientists

There’s still a way to go before R&D investment meets the Government’s target of 2.4% of GDP

COVER STORY
Measurement matters
The UK’s National Physical Laboratory, relaunched earlier this year, is looking to forge a stronger link between science and industry. We find out more from its chief executive

DISTRIBUTION
The changing face of engagement
In today’s digital world, distributors are having to adjust to not only how they meet the needs of design engineers, but also how they engage with them

ADVANCED PLATFORMS
AI’s power struggle
If artificial intelligence is to be used more broadly, it needs to be used locally and to consume less power – and that requires more power efficient algorithms

POWER
Protecting robust communications
Despite the robustness of RS-485 communications, transceivers used in the network still need protection against large over-voltages

RF & MICROWAVE
Primed for growth
In order to deliver 5G services, improvements will be needed in materials and processes. This means development kits will have a crucial role to play in stimulating the UK’s supply chain

DESIGN PLUS
The virtual interface
Birmingham University’s Human Interface Technologies Team has been pioneering the use of virtual reality, augmented reality, simulation and telerobotics since 2003

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Embedded in your success.
Another week, another report on engineering education – at least, that’s how it seems nowadays. The latest, from the Institution of Mechanical Engineers, concludes that engineering needs to be promoted more effectively at schools.

To a large extent, the report doesn’t tell us anything that hasn’t been explored by similar initiatives. Essentially, it says that lack of exposure to engineering means school students don’t get a sense of its value. This is exacerbated by a lack of knowledge amongst teachers and a lack of resources.

Nine recommendations are made in the document – and the lead recommendation shows just how hard it might be to get anything done. It says a working group should be set up to examine innovative ways in which engineering can be integrated into the curriculum. And Peter Finegold, the IMechE’s head of education and skills, seems to realise it’s all a bit futile. “We accept that Government is unlikely to change the curriculum fundamentally or introduce engineering as a standalone school subject.”

And there is the problem in a proverbial nutshell; all the time it retains its steely eyed focus on competing with Asian countries on maths performance, the Government isn’t going to be entertaining with any great enthusiasm the possibility of teaching children about engineering or bringing in problem based learning.

Yet the Government has designated 2018 the ‘Year of Engineering’. The year long campaign will support the engineering profession in recruiting the next generation of engineers. Events and initiatives across the UK will, if all goes well, give young people ‘an inspiring experience of modern engineering’.

Those somewhat longer in the tooth may be able to cast their minds back to 1997 and the Year of Engineering Success. That was a year long campaign ‘packed with events to persuade young people, parents and opinion formers of the importance of engineering’. It also hoped to recruit the ‘brightest and best talent’. Does that sound familiar?

In 1997, the industry was asked by Government to get together to provide a positive image and for engineers to ‘sell themselves’. Today, the industry is being asked to get together to agree a unified message about engineering.

The fact that we are going back around the loop again shows just how difficult it is to change things.

Graham Pitcher, Consulting Editor (graham.pitcher@markallengroup.com)
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Must try harder

ENGINEERING MUST BE PRESENTED MORE EFFECTIVELY IN SCHOOLS, SAYS REPORT.

GRAHAM PITCHER REPORTS.

As the Year of Engineering approaches, the Institution of Mechanical Engineers has called for engineering to be promoted more effectively in schools. Its report – *We think it’s important but don’t quite know what it is: The Culture of Engineering in Schools* – says low visibility of engineering amongst young people means they aren’t confident about considering it as a career.

Peter Finegold, head of the IMechE’s education and skills work, said: “The report’s findings show positive attitudes and appreciation of engineering among students, parents, teachers and school governors alike. However, few schools are integrating engineering into their teaching and the wider school culture. This is undoubtedly detrimental.”

The report is the third in a series in which the IMechE is looking at engineering in schools. It says Government needs to rethink how engineering is presented – particularly to girls.

It makes nine recommendations, including the creation of a working party to examine ways in which engineering can be integrated into the curriculum. Industry is also called on to create a ‘unified message’ about engineering and to provide young children with opportunities to take part in events that explore technology.

Finegold concluded: “As 2018 has been designated the ‘Year of Engineering’, with support across five Government departments, we believe it is time Government, as part of its future industrial strategy, ensures engineering is placed at the heart of our education system.”

Most accurate measurement of Planck’s Constant

Working in an underground laboratory with 1m thick concrete walls, scientists from the National Research Council of Canada (NRC) have measured Planck’s Constant with a precision of 9.1 parts per billion.

The team achieved its result using a Kibble Balance purchased from the UK’s National Physical Laboratory in 2008. The Kibble Balance allows an object to be weighed by balancing it against an electromagnetic force, rather than against an artefact such as the standard kilogram.

The work has brought the international system of units (SI) to the point where, within a year, all basic units will be calculated mathematically.

Barry Wood, an NRC Fellow, said: “While some aspects of every scientific breakthrough can be attributed to luck, our achievement stems from continually improving each and every component through perseverance.”

TechWorks awards winners announced

Shape memory alloy pioneer Cambridge Mechatronics has been named Company of the Year at the TechWorks Awards. Amongst the applications for the company’s technology are autofocus and optical image stabilisation, precision control for accurate dosing and metering, and the manipulation of surgical instruments. Unmanned Life took the Disruptive Innovation of the Year award for its artificial intelligence software platform, while large-area CMOS image sensor specialist vivaMOS was named Emerging Company of the Year.

Meanwhile, Visteon’s Alan Banks was presented with a lifetime contribution to industry award for his work in making the UK a world-class hub for automotive electronics design. Banks, who chairs the Automotive Electronic Systems Innovation Network, said: “I am delighted and honoured to be receiving this award. I passionately believe in the power of collaboration as an instrument to success, particularly in the changing and challenging world of automotive electronics.”

Other winners included WMG/Warwick University’s Siddartha Khastgir, who won the Young Engineer of the Year Award; Xilinx, Product of the Year and the University of Bristol’s Centre for Device Thermography and Reliability, which won the University Research Group of the Year category.
6G work underway

According to the Fraunhofer Institute, it is becoming apparent that the data rates expected from 5G communications systems will not meet the needs of users and industry for very long. Looking to solve the issue, Fraunhofer researchers are working on 6G as part of the EU sponsored TERRANOVA project.

The project, which runs until the end of 2019, will be working on ways of embedding terahertz wireless technology into fibre optic networks and exploiting new frequency bands. The goal is to create a terahertz frequency network that can transmit data wirelessly at up to 400Gbit/s.

Two Fraunhofer Institutes are working on core tasks. Fraunhofer IAF is focusing primarily on wireless transmission and the integration of wireless modules at chip level, including how to integrate a baseband interface with the fibre optic network and transmit the signals to the chip. Fraunhofer HHI, meanwhile, is developing algorithms to make the process as efficient as possible.

Strong demand for semis, says IDEA

The International Distribution of Electronics Association (IDEA) says demand for semiconductors from European companies continues to grow strongly, with the UK and Ireland making a significant contribution.

Orders for semiconductors in the UK and Ireland reached £167 million in the third quarter of 2017, an increase of 30% compared to the same quarter of 2016. Orders for passives also showed a 30% increase over the same period, reaching £36m.

Aggregating all sales of electronic devices, IDEA says UK and Ireland companies ordered components worth £295m in the quarter; 26% more than in Q3 2016.

For Europe as a whole, sales of electronic devices were said to be €2.01 billion. While this is a 16% improvement over sales in Q3 2016, sales have declined slightly in all categories since the beginning of 2017.

Dopant developments

A RUTHENIUM BASED COMPOUND COULD INCREASE CONDUCTIVITY IN ORGANIC SEMICONDUCTORS SIGNIFICANTLY. NEIL TYLER REPORTS.

Work by researchers from Princeton University, the Georgia Institute of Technology and Humboldt University in Berlin is pointing the way to more widespread use of organic electronics. In the short term, the work could help with the creation of organic LEDs that operate at high energy to emit colours such as green and blue.

“Organic semiconductors are ideal for the fabrication of mechanically flexible devices with energy-saving low temperature processes,” said Princeton researcher Xin Lin. “One of their major disadvantages has been relatively poor electrical conductivity, which leads to inefficient devices with a shorter operating lifetime than required for commercial applications.”

The researchers have developed an approach that increases the conductivity of organic semiconductors. The approach uses a ruthenium based dopant, which as a reducing agent, adds electrons to the organic semiconductor. In studies conducted at Princeton, the dopant was found to increased semiconductor conductivity up to 1 million times.

Seth Marder and Steve Barlow from Georgia Tech, said the ruthenium compound is a ‘hyper-reducing dopant’, adding that it is not only unusual in its combination of electron donation strength and air stability, but also in its ability to work with organic semiconductors that have previously been difficult to dope.

Nanoscale magnetic circuit

Researchers at the University of Cambridge, working with a team from TU Eindhoven, have used 3D nanoprinting to create a nanoscale magnetic circuit which is said to be capable of moving information in three dimensions. The team claims this could lead to magnetic devices that can store and process information in new ways.

“We have demonstrated a new way to fabricate and use a magnetic device which, in a nanometric scale, can controllably move information along the three dimensions of space,” said Amalio Fernández-Pacheco from the Cavendish Laboratory in Cambridge.

“Not only have we demonstrated a big leap in nanofabrication capacities, but, importantly, we have also developed a system which allows us to look at these tiny devices in a relatively simple way,” noted lead researcher Dédalo Sanz-Hernández. “The information within the device can be read using a single laser in dark-field configuration.”

Nanocomposite electrolyte

Imec and Panasonic have developed a solid nanocomposite electrolyte for next-generation batteries and say it has a Li-ion conductivity several times greater than that of its liquid equivalent.

 Ionic conductivity is said to be ‘several’ mSiemens/cm at room temperature and the partners have set a goal of achieving 100 mSiemens/cm in the next few years. If this target is met, it would make the electrolyte suitable for use in fast-charging high-energy cells.

“One of the benefits of imec is that we can leverage our semiconductor knowledge to solve challenges in other research domains, such as smart energy,” said imec programme manager Philippe Vereecken. “This is what we have done to develop a novel solid nanocomposite electrolyte.”
‘Safe’ solid state battery claimed by Swiss team

SODIUM BASED SOLID STATE BATTERY IS ‘SAFER, MORE RELIABLE’.

GRAHAM PITCHER REPORTS.

Researchers from Swiss materials science laboratory Empa and the University of Geneva (UNIGE) have developed a prototype ‘all solid state’ battery. The sodium based device is said to store more energy while maintaining high safety and reliability levels.

Because the battery uses a solid electrolyte, it allows a metal anode to be used. “But we still had to find a suitable solid ionic conductor that, as well as being non-toxic, was chemically and thermally stable and would allow the sodium to move easily between the anode and the cathode,” explained UNIGE Professor Hans Hagemann. The researchers discovered that closo-borane, an inorganic conductor, not only enabled sodium ions to circulate freely, but also removed the risk of the battery catching fire during charging.

Empa researcher Leo Duchene said the difficulty was establishing close contact between the battery’s three layers—a metallic sodium the node; a mixed sodium chromium oxide cathode; and the closo-borane electrolyte. The solution was to dissolve part of the battery electrolyte in a solvent before adding sodium chromium oxide powder. Once the solvent evaporated, the cathode powder composite was stacked with the electrolyte and anode, with the various layers compressed to form the battery.

Said to withstand 3V, the battery was tested for more than 250 charge and discharge cycles, after which it retained 85% of its original energy capacity.

All in a spin over heat

Physicists at Bielefeld University have found a way to create spin currents using the heat generated by electronic devices. According to team, it could be possible in the future to use spin currents to reduce power consumption.

In the study, conducted with the University of Greifswald, Gießen University and the Leibniz Institute for Solid State and Materials Research, researchers examined those magnetic nanostructures which generated spin current most effectively from heat.

The teams, led by Dr Alexander Böhnke and Dr Torsten Hübner, have tested different combinations of ultra-thin films. “Depending on which material we used,” said Dr Böhnke, “the strength of the spin current varied markedly because of the electronic structure of the materials we used.”

According to the researchers, magnetic nanostructures made from cobalt, iron, silicon and aluminium were particularly productive.

Marvell buys Cavium for $6billion

Marvell is buying Cavium for $6billion in a move intended to expand its wireless connectivity business.

“This is an exciting combination of two very complementary companies that together equal more than the sum of their parts,” said Marvell’s president and CEO Matt Murphy.

“This combination expands and diversifies our revenue base and end markets and enables us to deliver a broader set of differentiated solutions to our customers.”

The deal will see Marvell’s storage controllers, networking solutions and wireless connectivity products blended with Cavium’s multicore processing, networking, storage connectivity and security products.

Cyber security research institute launched

The Centre for Secure Information Technologies (CSIT) at Queen’s University Belfast has launched a new research institute whose goal is to improve hardware security and reduce vulnerability to cyber threats.

According to CSIT, the Research Institute in Secure Hardware and Embedded Systems (RISE) will be a global hub for research and innovation in hardware security over the next five years.

Professor Maire O’Neill, pictured centre, a cryptography expert at Queen’s University, has been named director of RISE. She said: “RISE is in an excellent position to become the ‘go-to’ place for high quality hardware security research. A key aim is to bring together the hardware security community in the UK and build a strong network of national and international research partnerships.”

Funded by EPSRC and the National Cyber Security Centre (NCSC), RISE represents a £5million investment. It will address cyber threats through four initial component projects, involving Queen’s University, the University of Cambridge, University of Bristol and University of Birmingham.

Flexible microfibre sensor

A research team at the National University of Singapore (NUS) has developed a soft, flexible and stretchable microfibre sensor for real-time healthcare monitoring and diagnosis.

The sensor comprises a liquid metallic alloy, which serves as the sensing element, encapsulated within a soft silicone microtube. The sensor measures an individual’s pulse waveform in real-time and the information can be used to determine heart rate, blood pressure and stiffness in blood vessels.

“Our sensor is versatile and could potentially be used for a range of applications, including healthcare monitoring, smart medical prosthetic devices and artificial skins. Designed to be durable and washable, it is highly attractive for promising applications in wearable electronics,” said lead researcher Professor Lim Chwee Teck.
Figures released by the UK’s Office for National Statistics (ONS) show the R&D expenditure in 2016 was £22.2 billion; an increase of 5.6% compared to the previous year. This increase was accompanied by growth in the number of full time equivalent R&D employees, rising by 2% to 210,000, of which 52% are considered to be scientists and engineers.

According to ONS, businesses themselves were the major source of funding, increasing their spend by 9% to £16.2bn, equivalent to 73% of total business R&D expenditure. Overseas funding is said to have declined to 16% in 2016 from a figure of 24% in 2010, whilst government investment in R&D was £1.7bn, slightly less than in 2015.

The figures were welcomed by the CBI, whose innovation director Tom Thackray said: “Even against an uncertain backdrop, British businesses have increased their R&D spend to record levels. Firms know that innovation can have a fundamental role in helping them grow and become more productive in challenging times. However, the total level of spending is still far too low by international standards.”

Thackray’s observation reflects a view held over the years that UK companies don’t take investing in the future seriously enough. A decade ago, the UK R&D Scoreboard – published by the then Department of Innovation, Universities and Skills, but discontinued by the Government in 2010 – found that leading UK firms invested almost £21bn in 2006; 9% more than in 2005 and similar to the amount spent in 2016. Confirmation comes from statistics published by the Organisation for Economic Cooperation and Development, which found the UK’s investment in R&D as a percentage of GDP has remained almost flat since 2000 at 1.7%. This compares with the average spend of OECD countries of 2.38% – up from 2.1% in 2000. The OECD said that Israel and Korea invest the most at 4.2% of GDP.

Regionally, most UK R&D investment is made by companies in the South East and East, accounting for 41% of all spending. However, while R&D spend in the East rose by 4.6%, the South East saw investment decline by 1.5%. The North East, Wales and Northern Ireland had the fewest R&D staff and levels of expenditure.

Looking at industries, pharmaceuticals continued to invest most in R&D, but the largest growth was seen in motor vehicles and parts, where £3.4bn was spent in 2016; 20% more than in the previous year. According to ONS, the manufacture of computer, electronic and optical products saw an R&D spend of £1.1bn.

The ONS figures came a day before Chancellor Philip Hammond presented his latest budget. In his speech, the Chancellor said: “We are allocating a further £2.3bn for investment in R&D and we’ll increase the main R&D tax credit to 12%. This will take the first strides towards the ambition of our industrial strategy to drive up R&D investment across the economy to 2.4% of GDP.” According to the Chancellor, the latest move will take total direct R&D spending to £12.5bn a year by 2021-22. Other initiatives include providing ‘more than £500 million’ for areas such as AI, 5G and full fibre broadband. Already, some interested parties have said it’s not enough, with some saying it’s too late.

“The Government has understood the scale of this challenge and its decision to increase funding until 2021/22 represents a hefty down payment on its commitment to raise UK R&D spend to 2.4% of GDP,” Thackray concluded. “Businesses await the details of this investment in the Budget and the Industrial Strategy. If it is spent in the right areas, it will help businesses to invest more of their own money, more successfully.”
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The National Physical Laboratory (NPL) was established in 1900 with the aim of bringing ‘scientific knowledge to bear practically upon our everyday industrial and commercial life’. Over the past 117 years, it has established itself as a world class centre of excellence in measurement science. Not only that, it has maintained the nation’s primary standards of measurement while developing and contributing to a host of innovations and technologies, ranging from radar to atomic clocks.

Throughout its history, NPL has played host to some of the UK’s most distinguished scientists, including the likes of Alan Turing and Donald Davies, who invented packet switching.

The tests carried out at the laboratory have grown exponentially since it began. The testing of aeroplanes and airships started in 1908 and, by using tests devised to measure the magnitude and distribution of wind forces on bridges and structures, NPL helped accelerate the efficiency and safety of both.

By 1911, it had begun testing vehicles and, during the next 30 years, extended its capabilities to include wind tunnels, introduced materials testing, was instrumental in the development of radar and in 1946 began work on the world’s first automatic computing engine.

NPL’s science, engineering and technology provides the measurement capability that underpins the UK’s economy.

Based in Teddington, south-west London, NPL employs more than 500 scientists and is home to 388 of the world’s most extensive and sophisticated laboratories. It has also set up a number of regional bases across the UK, including sites at the University of Surrey, the University of Strathclyde, Cambridge University and the 3M Buckley Innovation Centre at the University of Huddersfield, offering a regional point of contact with organisations looking to better understand its work, but also to discuss their own measurement requirements.

The UK’s National Measurement System comprises a core of laboratories, one of which is NPL. Others include: the National Engineering Laboratory, The National Gear Metrology Laboratory and the National Institute for Biological Standards and Control.

The UK has played a leading role in measurement in Europe and has received extensive funding to support measurement research and the development of new capabilities, whether that continues post Brexit is, like so much else, still to be decided.

As a national laboratory, NPL is obliged to supply impartial and independent advice, which is to the benefit of consumers, investors, policymakers and entrepreneurs alike. Today, its work is diverse, covering the development of new antibiotics and more effective treatments for cancer. It is also using the latest techniques and facilities to deliver quantum communications and superfast 5G.

Good measurement is crucial and NPL plays a vital role in not only responding to new challenges, but also in supporting innovation, raising quality levels and boosting productivity. Reliable and traceable measurement gives confidence in
data, for example, and supports the take up of new ideas by industry and other organisations.

All technological advances need to be built on a foundation of reliable measurement to succeed. The UK and the wider world is having to confront some significant societal challenges, whether that’s environmental, issues around sustainability, security, health and energy and without good measurement none of these can be quantified or, more importantly, understood.

In September 2017, NPL was officially re-launched. According to CEO Dr Peter Thompson: “When we were first launched all those years ago, our grand vision was to translate scientific discoveries into economic growth and skilled employment and this re-launch has been about renewing that vision. Our aim is to cultivate growth across those areas that will benefit the UK’s economy; whether that’s advanced manufacturing, digital, energy and the environment or the life sciences and health.”

These four sectors – or pillars – have huge measurement challenges, according to Dr Thompson.

NPL has traditionally looked to support a broad spectrum of sectors, he explains. “Perhaps that’s not been the best way to deliver the greatest impact,” he concedes. “So, last year we started a consultative process with the aim of identifying the most important sectors to the UK going forward. Our aim was to engage with industry and from that engagement shape the research projects we’d look to undertake going forward, as well as shaping the services and products we’d look to supply.

“From the external research, we conducted, we also realised that we needed to be more market facing and to better communicate what we do. Our main message is that we are here to deliver a meaningful impact for the wider economy as well as for individual organisations.”

Forging a stronger link between the lab and the wider world was seen as crucial by Dr Thompson and the management team at NPL.

No longer a sleeping giant

“Our aim, since our inception, was to create the standards for measurement that will support new trade and commercial innovation,” he says.

Dr Thompson says NPL was essentially a silent partner to industry, helping to deliver now-ubiquitous innovations and advances. “Our aim over the next 100 years will be to see us continue in that role, but this time we will provide a narrative that highlights our contribution and work.”

Dr Thompson joined NPL in 2015, having spent more than 20 years at the Ministry of Defence.

“What has always motivated me is the impact that science can have. Personally, it’s never been about the science per se, but rather how research can be best applied to make a real difference.

“Engagement is crucial if you are to better understand an organisation’s needs and then use that to re-shape your work to better meet those needs.”

The Government’s National Measurement Strategy has resulted in a restructuring of the relationship between Government, the National Measurement Office and the laboratory infrastructure, of which the NPL is a part.

The NPL now reports directly to Government and the National Measurement Office has become the National Measurement and Regulation Office with the remit, as part of Regulatory Delivery, to simplify technical regulations for the benefit of businesses in the UK.

“When I joined, the debate around the future of measurement in the UK was well underway,” concedes Dr Thompson. “My role was to deliver that new relationship and engage with stakeholders and businesses to find out what was important to them and how they would define our success. That discussion resulted in the re-launch this year.

“There was certainly an issue around perception. Were we purely focused on the science or were we looking to apply that science? As the governance structure and the rhetoric around the restructured organisation changed, there was a feeling among some that the quality of the science at NPL would suffer.”

While Dr Thompson refutes that, he does argue that science needs to be impactful which, typically, means developing measurement products or services that will make a real difference.

“The journey that has taken us to where we are today has required us to establish new relationships with Government and to develop clear thinking around the impact that science can and should have, going forward.

“As a knowledge based organisation our mission and our values were really important and we took a long time to unpick that and ensure that what we were doing was relevant. We needed to be
bold, connected and to keep things simple.

“As I mentioned before, the issue centred around whether we should do brilliant science and give people what they think they want, or become better connected with industry and clients and give them what they needed.”

The past two years have been challenging and the decision to refocus the science portfolio away from some traditional areas in favour of new ones – the four pillars – was not without its critics within NPL.

“You’re dealing with an institution that deals with certainty, so making the changes we have would have been tough at the best of times,” Dr Thompson suggests.

A standalone company

Today, the NPL is a standalone company with the UK Department for Business, Energy and Industrial Strategy as its only shareholder.

“My job has been to make the new model work and to ensure its sustainable. Today our funding is derived from Government contracts, large collaborative research programmes and by selling products and services to individual companies,” Dr Thompson explains.

“World class measurement science and engineering is and will remain our primary focus and the bar has been set high in terms of delivery,” he suggests. “We’ve undergone tremendous change at NPL and the organisation has been transformed in the past few years.

“Today, we are more aligned with government priorities and the needs of industry. We are now actively marketing the laboratory and that follows on from surveying thousands of organisations from industry, SMEs, research and technology organisations, government partners and regulators and other users of measurement.

“It was interesting talking to them because many had not heard of NPL or knew anything about the work we carry out.”

“Measurement is critical for a large user base,” says Dr Thompson, “and new technologies pose new and very complex measurement challenges. For example, Big Data and the Internet of Things require a better understanding of data quality and certainty.”

Confidence in innovation is crucial and measurement helps to reduce risk. New technologies need validation if investors are to have the confidence to invest in the companies developing them.

Another area that is revolutionising computing, secure communications, imaging measurement and sensors is quantum technology. The delivery of this and its commercialisation is, for example, dependent on the development of an effective measurement infrastructure and NPL is currently investing heavily in new facilities and creating recognised international standards to that effect.

“Our quantum heritage is a strong one and we currently employ more than 100 scientists in this field. We work closely with innovation centres, InnovateUK, primes and SMEs so the UK can seize any commercial opportunities available to us in the global market.”

While NPL has a strong reputation in quantum technology, it also has a leading position in fields such as spectrometry, bio-metrology and medical physics.

While it remains early days, this more outward approach has started to pay dividends.

“We are seeing more businesses and universities coming to us with proposals and asking NPL to work with them, which wasn’t the case in the past. Our growing regional presence means that we are engaging with organisations at the local level and have a point of contact with SMEs, which traditionally has been a hard part of the market to engage with,” Dr Thompson notes.

Measurement skills aren’t available through conventional education, so NPL also provides training and learning from early interest to expert level.

“The Postgraduate Institute for Measurement Science at NPL brings together more than 150 postgraduate researchers and we work closely with some 30 UK universities to bolster students’ employability and skills.”

In terms of the changing perception of NPL, Dr Thompson believes that a growing number of national laboratories are looking to adopt its approach.

“We’re certainly perceived as leading the international community when it comes to re-shaping perceptions around measurement and delivering more impactful science.

“Our role has to be to lift the lid on science and communicate its impact to the beneficiaries of our work. We need to engage more and recruit more scientists and engineers.

Dr Thompson concludes: “We need to fill the void between brilliant science and industry picking up the technology and commercialising it.”
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The changing face of customer engagement

In today’s digital world, distributors have to adjust not only to how they meet the needs of design engineers but also how they engage with them. By Neil Tyler.

The trends that have been affecting the electronics industry over the past few years are on-going and continuing to impact on distributors, whether that’s technology drivers, mergers and acquisitions among OEMs or customers relying more heavily on distributors to pick up the slack, as they look to cut back on their own direct sales and marketing capabilities.

Across the electronics industry, procurement and technical support continue to evolve rapidly and design engineers are asking for more focused help with their designs and projects.

Many engineers acknowledge that distributors have extensive design expertise and knowledge and, as such, it’s not unreasonable that more of them are looking to exploit that resource.

Distributors have devoted considerable energy and money on developing technical teams that are well placed to answer questions on new designs or to address component requirements when it comes to designing a brand-new product.

At a time when OEMs are operating with significantly smaller in-house engineering teams, many distributors are a valuable source of technical expertise.

Although operating in an increasingly digital world, distributors are still supporting design engineers across a mix of different channels and the rise of the maker movement.
and megatrends such as the Internet of Things, are all combining so that distributors are continually reassessing how they engage with the engineering community.

Farnell element14, for example, has just started offering start-up companies specialist support and resources to take their products to market.

This support, dubbed ‘Maker to Market’ includes product design and manufacturing services.

Commenting at the service’s launch earlier this year, Peter Birks, business president, Farnell element14, said: “With our Maker to Market services, we are helping to meet the needs of both start-ups and professional makers who have great ideas and are passionate about the products or ideas they are developing – but who may not necessarily have the in-house skills or resources to be able to design, manufacture, distribute and promote their products.”

Another resource made available to start-ups is the company’s Hardware Studio Connection, a venture between Avnet, the parent company of the Premier Farnell group of businesses, and Avnet’s new Dragon Innovation division. This gives designers access to support from the companies’ engineers as well as discounts on components and services.

These types of programmes are intended to help start-ups through the tricky product development cycle and to help them navigate across the notorious ‘valley of death’ – the gap between bringing an idea from concept to the point of production.

All the main high service distributors would agree that there is certainly a greater focus on meeting the requirements of customers, with engineers being encouraged to share their technical problems and distributors becoming more focused on providing solutions.

It would be fair to say that the days when distributors were preoccupied with only supplying components are over.

What added value the distributor brings to the customer experience is now critical and for many it is about helping to bring new ideas to the market, not just selling more products.

The internet has totally changed customer expectations. Today, they now take for granted price comparison services, rapid response times to technical questions and fast delivery – 24-hour delivery is now taken for granted.

However, there does remain a requirement for the human touch and the quality of service still matters, especially when it comes to high service distribution.

Distributors are well placed to consolidate and gather data from a variety of sources – much of which will be of use to customers, as well as to the distributors themselves. How they use that data going forward is still open to question.

Those distributors who are able to offer a high level of service and support would appear to be well placed to be the market winners in the longer term, although challenges are obvious. Intensive levels of service will be both demanding and resource heavy and distributors will be required to invest significantly in tools and resources as well as in recruiting and retaining talented staff.

Successful distributors are often considered as being an extension of a customer’s business, whether that’s because they provide technical expertise, account management or hold stock for them.

Mouser Electronics, for example, offers its customers an internet-based Inventory management tool that can be accessed using a mobile app which can both manage and track their stock of electronic components and related supplies.

Managing inventory levels

Users can manage part numbers and inventory levels, generate inventory reports, and import current product inventory data from spreadsheets. The tool also provides check-in/ check-out functionality, which helps organisations track shared tools such as scopes or soldering equipment.

While distributors can be seen as an extension to a company it’s increasingly apparent that bigger trends are forcing them to develop a deeper and more sophisticated ecosystem to better serve customers.

Long discussed it is now considered critical if high service distributors are to differentiate themselves from their competitors, especially when engineers are turning to distributors for more than simply sourcing components.

In 2016, in an interview with New Electronics, Lindsley Ruth, CEO of Electrocomponents, said that, in future, the key differentiator between distributors would be how a broader ecosystem evolves. “One
which brings together distributors, manufacturers, universities and governments,” he suggested.

Mike Englund, CEO of RS Components, doesn’t resile from the importance Ruth has attached to the development of a broader ecosystem.

“For today’s distributors, it’s more about thought leadership and less about product marketing,” he suggests. “Our customers, quite rightly, expect better product knowledge – certainly more than they did 10 years ago – and there is certainly emphasis being placed on providing localised engineering expertise.”

“Engineers today have a much better and deeper understanding of what’s required across more areas,” says Graham Maggs, VP Marketing EMEA at Mouser Electronics, “and that has been one of the biggest changes of the past 10 years or so. Then, as a distributor, when you met a customer, you’d be seeing a design engineer and a components standards engineer, as well as manufacturing and quality engineers. Today, you meet engineers who have broader responsibilities and who have a better grasp of all these issues.”

As a distributor working in the UK, Englund suggests that design, production and manufacturing remain buoyant, despite the turbulence Brexit has generated.

“I’d go as far as to say that we’re experiencing exciting times in the UK. “We are well placed to take advantage of the talent here and despite some degree of trepidation downstream, there is certainly a lot of positivity out there and there’s real demand for those technical skills.”

According to Englund, the emergence of new technologies, energy sources and the development of the IoT are combining to help drive demand in the market.

“Many projects are specialising in new technologies and require input from us, in terms of our technical expertise.

“We are always happy to help customers and engage with them and we have been involved with a growing number of projects over the last six months,” Englund says.

“Due to the pace of change around technology, however, and the need to innovate faster I think it’s fair to say that distributors are increasingly seen as ‘go-to’ specialists because we are able to help customers with their design solutions.”

Englund also contends that the pace of change is helping to drive higher levels of innovation.

“The pull for products is being driven by designers looking to improve levels of connectivity, but while the Industrial Internet of Things (IIoT) and the broader Internet of Things (IoT) are driving this technology, we are finding that they also need advice. While businesses have recognised that they need to adopt this technology and design it in, they need help to do this successfully.

“Key trends that we’re seeing include automation around production, the automation of non-facing customer activities and the use of augmented reality. These are all ‘big focus’ areas for businesses at present.”

For engineers, distributors not only provide a necessary support to better understand what new products or components for specific applications are coming to market, but how to design them into applications and solutions more effectively.

**Back to the future**

A key role for distributors is to promote existing and new product accurately and in a timely fashion.

“With profit windows shrinking, designers continue to base their next projects on the most recently introduced semiconductors and components, so they can gain a competitive edge,” says Maggs. “At Mouser we have always been committed to stocking new, innovative parts as soon as the manufacturer makes them available so that we can truly be regarded as a leading NPI development fulfillment distributor. We also look to offer a wide choice of development tools which are a vital part of the design ecosystem today.”

Likewise, DesignSpark plays a crucial role for RS in disseminating information out into the marketplace.

“With more than 500,000
members, our suppliers are turning to and using DesignSpark to communicate directly with engineers, uploading new content which we can then use across a variety of social channels to reach a wider audience,” says Englund.

A successful distributor has to earn the trust of its customers.

“That’s what drives our media activity,” he explains. “It’s about getting that message out there and connecting with our customers in a way we haven’t before.”

Englund talks of the importance of having a more sophisticated engagement with its customers, but RS certainly hasn’t discarded more traditional ways of engaging with its customers.

**Traditional engagement**

“Our RS Local initiative is part and parcel of our multi-channel approach,” he says.

In a recent major investment in the UK, RS is transforming its existing branch network into what it describes as RS Local service centres.

“Our aim with this development is to provide customers at a local level with innovative solutions to help them build and maintain their solutions; we want to offer an ‘Apple Store’ experience,” Englund says. “It’s a chance for our customers to walk in and to talk to us directly. We want these centres to offer a destination in which engineers can not only come in and pick up products but engage with us directly.”

The first of these new centres was opened in Bermondsey, South East London in September, with a second set to open shortly in Heathrow.

The initial reaction has been positive, according to Englund.

“Customers really like the experience; they talk, feel and play with the digital tools available and it’s helping to transform the perception they have of the company.

“If we can’t help them in-store, they have direct access via a video web link to our main centre in Corby, where specialists are available to offer advice and support.”

According to Maggs: “Despite our commitment to the web, our local customer service support remains a crucial part of our success as a distributor.

“Of course most business is transacted online – and we like to think our site is one of the best around, as it acts as both an eCommerce platform and a knowledge centre – but we also employ personnel at nine different sites across the EMEA region, where their job is to be there so that customers can speak to someone in their own language who has a native understanding of the local business culture.”

For distributors change is unrelenting.

“As a distributor we are looking to invest more in automation, packaging, labelling and sorting. Beyond that, we are looking to address the changing needs of our evolving customer base, which will mean looking at software, tools and automation,” says Maggs. “We’ll need to become more agile and dynamic and make better use of the data that we generate, breaking down silos of data and making better use of artificial intelligence and cloud based data systems.”

“The pace of change is constant and we, as distributors, need to keep up to date not only with the new products coming to market and extending our portfolio but how we engage with our customers to provide them with the technical services and support that they need,” Englund says.

“Global disruptors move quickly, so we need to as well. We need to benchmark ourselves against the best, and that means looking beyond our competitors and outside of our space to the likes of Apple and Amazon when it comes to embracing best practice.

“We need to listen to our customers and act,” he concludes.
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If artificial intelligence is to be used more broadly, it needs to be used locally and to consume less power. By Chris Edwards.

It is easy to see artificial intelligence (AI) as a naturally power-hungry technology; it demands racks of servers stuffed with a combination of multicore CPUs, GPUs and, increasingly, FPGAs that crunch through terabytes of data to form the connections between millions of virtual neurons.

If it is to break into a broader range of real-time applications, such as self-driving cars and robots, AI needs to be able to work without calling for help from remote servers. Even if the connections were entirely reliable, latency is incurred by data crossing the network before it can be interpreted. AI needs to be more local, which means cutting the power demand of its algorithms.

One option is to move away from deep learning for these real-time systems, even though that has become practically synonymous with AI. Gradient descent links many of the techniques used in machine learning (ML) today. It extends from simple curve-fitting algorithms to highly complex loops and stacks of virtual neurons that underpin the video and audio recognition abilities of server-based deep-learning systems.

While the current focus is hardware optimisation for deep learning, the same techniques will often apply to other areas, such as support vector machines and Gaussian processes.

In neural networks, the transfer of data and neuron weights to and from memory dominates power consumption. Bringing data and processing power closer together makes a big difference. A further optimisation is to make the arrays smaller to limit their capacitance. At ISSCC 2017, University of Michigan researchers, led by Professors David Blaauw and Dennis Sylvester, showed a hierarchical way to bring memory and processing closer together for ML (see figs 1 and 2).

Small arrays for storing more frequently used data, such as input neurons, were custom designed for low-current operation and placed close to the processor. Synaptic weights, which are used less often in calculations, went into denser, more power-hungry SRAM cells that could sit further away. There, they could more afford to suffer the higher capacitance of a larger array and longer buses. The design avoided the use of caches altogether, relying on static scheduling to assign data to the right memory banks.

Some R&D teams have found it possible to reduce the arithmetic precision of a lot of neuron calculations, sometimes to as little as 4bit or 8bit for comparatively unimportant links. Some connections can be pruned completely because their contribution is relatively tiny.

A useful aspect of AI architecture, such as CNNs, is their error tolerance; the large number of individual calculations tends to average out. Whereas most digital designers work to remove the possibility of error from arithmetic circuits, those working on approximate computing accept them if savings can be made elsewhere. One option is to run circuitry much closer to its voltage threshold and accept that some neurons will not compute the right answer.

Approximate computing for ML need not be isolated to digital circuitry. On the basis that digital multiplications contribute a significant amount to overall energy consumption, Zhuo Wang and Naveen Verma of Princeton University recently developed a circuit design based on a ladder of comparators. Each comparator is twice the width of its lower neighbour: an arrangement...
similar to that found in a flash A/D converters. However, unlike an A/D converter, comparator gates can be switched to ground or the signal input, providing a way for the training algorithm to program thresholds dynamically. The comparator outputs are summed and produce a voltage that approximates a linear classifier. The machine-learning system they built is much simpler than a CNN, but could be trained to recognise numbers in 9x9 images, while consuming was 30 times less energy than a comparable design based on digital multipliers.

Enyi Yao and Arindam Bass of Nanyang Technological University opted to exploit the combination of randomness and analogue circuitry. They based their design, published early this year, on the extreme learning machine (ELM) design proposed by Nanyang’s Professor Guang-Bin Huang a decade ago. The ELM is based on the same multilayer architecture as used in traditional neural networks, but only the outer-layers weights are trained; neurons in hidden layers use random weights. The design simplifies training massively, yet still works for some types of problem.

Another option is for AI algorithms to use memory arrays for processing. For example, the Hopfield network is a type of neural network that operates like an associative memory. At the 2012 DATE conference, Professor Leon Chua argued the memristor – the fundamental device type he proposed in the 1970s – could be used to implement neuromorphic computing and claimed the Hodgkin-Huxley model of the synapse shows memristor-like behaviour. Other researchers, such as Professor Sayeef Salahuddin of the University of California at Berkeley, argue the thresholding behaviour often seen in biological brain activity is not just common to memristors. Devices such as spin-torque transistors, themselves derived from magnetic memories, exhibit similar effects.

Several years ago, University of Pittsburgh assistant professor Helen Li used memristors to build a neuromorphic AI. It could perform character recognition with a claimed hundred-fold greater energy efficiency compared to conventional digital processors.

Quantum computing offers an alternative path to that of trying to emulate biological brains and could demonstrate very good energy efficiency for some types of ML. Google and Microsoft have joined startup D-Wave Computing in pursuing quantum annealing as a stepping stone to full quantum computing. The inspiration for quantum annealing systems comes from a theory developed by Ernst Ising almost a century ago. He came up with the idea of a spin glass to represent a highly disordered, hot magnetic material. As it cools, the magnetic moments of the atoms in the glass align, with spins flipping up and down to try to find the lowest energy state.

A quantum-annealing machine uses qubits in place of atoms, but follows the same principle: excite a system into a disordered state and then let it settle to its lowest energy state. The hardware was designed originally for optimisation problems that are difficult to compute on digital hardware, such as the Travelling Salesman problem. The machine is pushed towards the solution by manipulating electromagnetic fields around the qubit elements.

The optimisation process also works for the curve-fitting problems used by many classical machine-learning algorithms. Researchers have used hardware such as D-Wave’s and systems based on nuclear magnetic resonance techniques to build simple machine-learning systems that can tell numbers apart.

Quantum and neuromorphic technologies could align with more complex quantum computers. Late last year, researchers from the universities of Oxford and Waterloo demonstrated a way of building quantum memristors using supercooled quantum dots that may translate to systems that operate at room temperature.

Although AI has suffered numerous false dawns, the rapid adoption of deep learning by the FANG group – Facebook, Amazon, Netflix and Google – has perhaps finally given it a permanent role in IT systems. As AI becomes more commonplace, it may be the driver behind what seem today quite exotic forms of computing. But with many avenues opening up from memory-based systems to quantum, it remains unclear which direction low-energy AI will finally pursue.
Despite the robustness of RS-485 communications, transceivers still need protection against large over-voltages. By Thomas Kugelstadt.

Robustness and reliability have made RS-485 an industrial workhorse. A minimum differential signal swing of 1.5V and reliable operation over common-mode voltages ranging from -7V to +12V have catapulted its deployment. Initially used as a communication network in laboratory instrumentation, RS-485 can be found in applications ranging from building automation to traffic monitoring systems.

As the use of RS-485 grew, demand increased for a higher output voltage swing, a wider common-mode range and increased tolerance to electrostatic discharges. There was also a need for greater stand-off capability or protection against persistent over-voltages beyond the maximum transceiver supply level specified in datasheets.

**OVP versus transient protection**

The 24V and 48V DC supplies in industrial and telecom systems are commonly distributed through the same conduits as the data lines of an RS-485 network (see Figure 1).

If a DC supply shares the same connector or screw terminal block with the data lines of an adjacent bus node circuit, wiring faults can occur that connect one or more supply conductors with the transceiver bus terminals.

Another cause of failures is the layout of the conduit. Sharp bends often violate the minimum cable radius specified for data and supply cables. Over time, the increased mechanical pressure on the cable will cause a break in the insulation, causing shorts between power and data lines. This can also happen when machinery or equipment is placed against a conduit, thus crunching the cable. Over-voltage events can last for minutes and even up to weeks until their causes are eliminated.

Much shorter over-voltage events, such as over-voltage transients, can occur due to load switching activity in the power distribution system and lightning strikes, which induce high surge currents and voltages into the data lines.

Engineers new to over-voltage protection often assume that protection against short- and long-term over-voltages can be provided by adding external transient voltage suppressors (TVS) to a non-fault protected, standard transceiver. This is not true because the maximum power which the TVS can absorb decreases with increasing transient duration. Figure 2 shows a 600W TVS rated at 1ms pulse width. Note that the time axis ranges from 1μs to 100ms, with power levels of 6kW and 200W respectively. From this characteristic, it should be clear that exposing a TVS to long-term over-voltages would fry the device.

Therefore fault protected transceivers are needed to protect bus nodes against a wide range of over-voltages. These transceivers can provide protection against DC over-voltages of up to ±60V and transient over-voltages of up to ±80V.

**Integrated versus discrete**

Occasionally, designers ask ‘why not use a non-fault protected, standard transceiver and a few discrete low-cost transistors with sufficient high voltage breakdown for over-voltage protection?’ The answer is simple: A discrete solution adds more cost.
and development time and consumes more space than a fault-protected transceiver.

Let’s assume the function of the fault-protected, half-duplex transceiver in shown in figure 3 is to be accomplished with a discrete design using a standard transceiver. First, the transmit path and the receive path must be separate to allow for the implementation of a boosted output stage with high standoff voltage. This requires the use of a full duplex transceiver. The output stage could be realised with four discrete transistors or an integrated H-bridge, whose control inputs require the conversion of RS-485 bus signals into TTL or CMOS logic levels. This would require a drive logic circuit between the transceiver and the discrete output stage.

In the receive path, a discrete voltage limiter, consisting of Zener diodes and series resistors, must be implemented to limit the bus voltage during an over-voltage event, otherwise it remains transparent.

Figure 3 shows that the discrete solution already becomes cumbersome by merely providing the basic functions for over-voltage protection, while still lacking a current limiter, which is a vital component for over-voltage protection.

Current limiting is a critical function during over-voltage events when the driver is actively driving the bus. Because the enabled driver presents a low-impedance connection to ground, bus currents flowing through the driver become huge, damaging the device if they are not limited.

**Current limiting**

Fault-protected transceivers with common-mode ranges wider than specified in the RS-485 standard require double fold-back current limiting within the driver stage. Figure 4 shows the current limiting function of the ISL3245x family of fault-protected transceivers that operate over the wide common-mode range of ±20V.

Here, the first fold-back current level of 63mA ensures that the driver never folds back when driving loads within the entire 40V common-mode voltages. The low second fold-back current setting of 13mA minimises power dissipation if the driver is enabled when a fault occurs. This current limiting scheme ensures that the output current never exceeds the RS-485 specification, even at the common mode and fault condition voltage range extremes.

In the event of a major short-circuit condition, the transceivers also provide a thermal shutdown function that disables the drivers whenever the die temperature becomes excessive. This eliminates any power dissipation and allows the die to cool. The drivers automatically re-enable after the die temperature drops by 15°C. If the fault condition persists, the thermal shutdown/re-enable cycle repeats until the fault is cleared. Receivers stay operational during thermal shutdown and fault-protection is active, regardless of whether the driver is enabled, disabled or the IC is powered down.

The energy of over-voltage transients caused by lightning can easily exceed the transceiver’s fault protection and must be absorbed by external TVS diodes. Two conditions need to be satisfied when adding external TVS devices to a fault-protected transceiver:

- The TVS breakdown voltage must be 1V higher than the highest common-mode voltage of the application or the maximum DC-supply.
- The peak clamping voltage of the TVS must be less than the transceiver’s maximum fault-protection levels.

Fault-protected transceivers with a wide supply voltage range enable designers to use the same device in 3.3 and 5V systems, which reduces logistics and can lead to an attractive price break for higher volumes.

**Conclusion**

System designers are no longer required to choose between robust fault tolerance and high performance in RS-485 and RS-422 transceivers; devices such as the ISL32458E and ISL32459E from Intersil offer both. These transceivers feature ±60V over-voltage and ±15kV ESD tolerance, while including operation from supply voltages ranging from 3V to 5.5V. They also operate with data rates of up to 20Mbit/s and provide a ±20V common-mode voltage range. In addition the ISL32459E provides a cable-invert function.
The relentless growth in demand for data means that – even with additional bandwidth being added through carrier aggregation and higher order modulation – 4G networks will not be able to keep up with future demands.

A whole range of new use cases is also on the horizon, such as augmented reality (AR) and virtual reality (VR), autonomous vehicles, and remote surgery, for which ultra-low latency will be required. At the other extreme, while massive machine-type communications (MTC) for the Internet of Things (IoT) will not require wide bandwidth or low latency, the sheer volume of connected devices is likely to be too much for conventional cellular networks to cope with.

Fixed wireless access, where 5G would provide high-speed Internet connectivity to regions where fibre is uneconomic, is already proving to be a popular proposition as an early application. The conflicting needs of the different use cases could be met by ‘network slicing’, where different parts of the virtualised network are optimised for each application.

According to Cisco, global mobile data traffic grew by an estimated 63% in 2016 and is predicted to grow at an average rate of 47% over the succeeding five years to reach 49 exabytes (10^18) per month by 2021, see Figure 1. Even existing applications, such as the use of smart devices, are accelerating rapidly, with a 300% increase in mobile payments, 40% of cars forecast to be ‘connected’ by 2020 and 560million wearable devices in use by 2021. HD video streaming, which is already challenging 4G networks, will evolve to 4K and then 8K, massively increasing the demand for bandwidth. 5G is also intended to provide the foundation on which to build smart cities, pushing mobile network performance and capability requirements to the limit.

In order to meet these demands, the International Telecommunications Union (ITU) has set ambitious target specifications for 5G network performance (see the table opposite). The networks are being designed to provide 100billion connections worldwide.

This level of performance presents some serious economic and engineering challenges, as well as excellent opportunities for UK companies to take a lead. The UK is home to two important 5G testbeds: the 5G Innovation Centre (5GIC) based at the University of Surrey; and the University of Bristol 5G Testbeds and Trials Programme. It has been estimated that this research could enable an additional £173bn to the UK economy by 2030.

In order to deliver 5G services, some radical new technologies are needed. For the first time, frequency bands in the millimetre-wave (mmWave) spectrum beyond 24GHz will be used for cellular access. These frequencies have been used for some time for wireless backhaul to connect base stations to the backbone network, but not in handsets or base stations. Because of the propagation characteristics of mmWave signals, it will be necessary to deploy ultra-dense cellular networks with base stations around 250m apart. So, in an urban environment, many lampposts will probably carry a mmWave base station.

Despite the complexity of working in this frequency range, the sheer number of base stations will necessitate a reduction in unit cost, improved bandwidth, power and efficiency compared with today’s macro base stations. A corresponding increase in the number of backhaul radio links will also be seen.

In addition to the densification of conventional base stations, other types of delivery platform are being considered, which may include low earth-orbit (LEO) satellites, high-altitude platforms (HAPs) or even drones – all of which will need RF technology.

Gallium nitride (GaN) is already rapidly emerging as the semiconductor material of choice for use in 4G base station solid state power amplifiers (SSPA), due to its high electron mobility, coupled with typical transition frequencies (fT) of 200GHz. This, along with its high breakdown voltage and high thermal conductivity, enable it to deliver power levels in tens of watts under linear operating conditions. Already, some 40% of 4G base stations use GaN power amplifiers, according to US manufacturer...
Wolfspeed. The more demanding bandwidth, power efficiency and linearity requirements of 5G will mean that GaN will dominate those base station SSPA slots, initially in the sub-6GHz bands, but later at mmWave frequencies.

Although GaN devices are currently more expensive to fabricate than those using other substrates, such as gallium arsenide (GaAs) and silicon, increasing volumes and wafer sizes could reduce costs.

The EPSRC Hub for future manufacturing of compound semiconductors, hosted at Cardiff University, is researching ways to fabricate compound semiconductors on silicon substrates with a view to driving down the manufacturing costs. It is hoped that this research will yield advances in heterogeneous integration, in which GaN and silicon devices could be integrated onto the same chip to make the best use of both materials.

In order to fully exploit the properties of GaN, improvements are required in the materials and processes used to make the chips themselves and to build the SSPAs and systems that use them.

Many of the challenges relate to providing adequate heatsinking and thermal management for the devices, which are able to run at much higher channel temperatures – typically up to 400°C – than either silicon or GaAs. Other challenges include developing new low-loss printed circuit materials and manufacturing techniques for the high-volume production of subsystems using GaN devices, including the potential of 3D printing microwave circuits and nano-scale metamaterials.

Many universities and technology companies in the UK have skills and research interests in these areas, and Innovate UK is keen to stimulate and encourage the advancement of this indigenous capability.

In many branches of electronics, development kits are often used to evaluate the performance of new chips, as a means of reducing the time to market. Development tools and evaluation boards have traditionally offered an easy way to explore the applications of a product without the need to manufacture a custom circuit. This approach is equally applicable to new GaN devices.

A development kit strategy

Development kits form a key strategy of the recently-announced Compound Semiconductor Applications Catapult. This Catapult plans to launch a series of development kits in the areas of power electronics and photonics as well as RF and microwave.

The development kits will be produced with support from UK companies, and, where possible, will feature chips from UK foundries. Companies will be able to use these development kits to explore new applications, and to launch products that will drive sales for companies across the UK supply chain.

As a result of a number of workshops where the Catapult has consulted with relevant companies, several categories for prospective compound semiconductor (GaAs and GaN) development kits have emerged:

- mmWave SSPA modules and transceivers and antennas for automotive, 5G and satellite communications applications
- 100W, 6 to 30GHz compact SSPAs for space and defence
- Low power (up to 100mW), high efficiency power amplifiers at 0.8 to 5GHz for IoT applications
- Sub-6GHz SSPAs for 4G LTE and 5G base stations, integrating software defined filters, active antennas, and switches
- THz power amplifiers for security and medical applications
- Direct RF to digital and digital to RF conversion: 10GHz D/A and A/D converters, eliminating IF stages and providing digital reconfiguration

The consultative process is continuing and the Catapult welcomes further suggestions from UK companies for development kits that would help to stimulate the already outstanding capabilities of the RF supply chain and to equip them for the future.

A particular challenge for the Catapult is to reverse the decline in RF compound semiconductor chip production in the UK: whilst the UK’s indigenous chip design and prototyping expertise is world class, most of these devices are currently fabricated at foundries overseas.

Working with the UK’s fabless chip designers, the Catapult has ambitions to commission new RF chips from UK foundries for inclusion on development kits.

Author profile:
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INNOVATION
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Established in 2003 by Professor Bob Stone, Birmingham University’s Human Interface Technologies (HIT) Team, based within the university’s School of Electronic, Electrical and Systems Engineering (EESE), has been a pioneer in the development of interactive media and telerobotic technologies in the UK, building on Prof Stone’s long experience in virtual reality (VR), augmented reality (AR), mixed reality, simulation and telerobotics.

Crucially, the team – which has been developing and evaluating demonstrators for a variety of end users, such as the military, healthcare and heritage – emphasises the importance of understanding human factors when developing interactive technologies, whether wearable devices, headsets or games controllers incorporating the need for realistic visuals, sounds and haptics.

Prof Stone was one of the first Europeans to experience NASA’s VIEW Virtual Reality system in the 1980s and established the UK’s industrial VR team at the National Advanced Robotics Centre. He was also accredited by Russia’s Gagarin Cosmonaut Training Centre with introducing VR into the Russian space programme.

“The HITT was set up in Birmingham to build on those experiences and to help corporates to better understand VR and manage the hype that then existed, and which still does today, around the concept,” Prof Stone explains.

Working with technical experts from the ESEE, the team has taken VR scenarios and developed bespoke interfaces incorporating platforms ranging from drones to submersible devices.

Today, VR is more accessible and affordable and, from an industrial perspective, it’s much easier to turn projects around quickly, according to Prof Stone. “Today, using a £700 laptop and free software, we can do work that would have cost hundreds of thousands of pounds just 10 years ago.”

He warns that the VR environment remains one in which hype and false promises are still prevalent.

“There are too many start-ups that are here today and gone tomorrow businesses, making the same mistakes we’ve seen in previous cycles, from naïve business models to overly optimistic sales projections. We are in the middle of another hype cycle,” he contends.

There are a variety of definitions floating around covering this space but Prof Stone contends that: “VR is a totally computer-generated world, AR sees virtual models interacting with the real world and, while mixed reality is similar it uses real world objects to make the virtual more real.”

All will have a role to play going forward, says Prof Stone, but while VR is a mature technology, he believes the industry is lacking believable real case studies. “I think that is where the industry is being held back. We need to see more case studies and ignore industry speakers selling the same old messages. I’d like to see more industrial conferences where claims can be presented directly to end users and examined in detail.”

Collaborative initiatives

HITT worked closely with the UK’s Human Factors Integration Defence Technology Centre (HFI DTC) between 2003 and 2012. More recently, it has been involved with collaborative initiatives in maritime defence and unmanned systems.

“This work has provided us with opportunities to work closely with stakeholders and end users in the development of methodologies focusing on human centred design,” says Prof Stone. “Our research looks to avoid the technology push failures that were so evident in the 1980s, 1990s and early 2000s by developing and evaluating demonstrators that emphasise the importance of the human context.”

HITT has a long-standing working relationship with the military in the UK.

“We helped to develop VR-based part-task trainers and a variety of innovative human interface concepts for simulation and tele-robotic systems,” explains Prof Stone.

Some of the projects delivered include a desktop Minigun simulator, an Interactive Trauma Trainer for
Virtual Reality

The simulator enabled trainees to develop the skills into the real environment. It was designed to allow trainees to appreciate the capabilities and limitations of the vehicles they were to operate.

The simulator enabled trainees to better adapt to controlling the vehicles and manipulators remotely, and to understand the limits of the vehicle.

As well as a highly realistic virtual urban street scene and house interior, a replica (physical) CUTLASS console was constructed containing accurate representations and locations of the key components, including the manipulator mode selection areas on a touch screen,” Prof Stone explains.

“Users’ needs come first

When it comes to developing simulators, the technology should come second to the users’ needs, according to Prof Stone. “You need to understand the end user, experience what they do and look out for gaps and mistakes – all of which will help to create a more realistic training experience and one that transfers those learned skills into the real environment. The human factor is critical here. Too many companies believe that by placing sensors into a glove or a headset, their training problems will be solved: the user is simply an after-thought.”

When developed using strong human-centred design principles, VR and AR interfaces can be used to present a range of information sources to end users, using appropriate methods of presentation, from gesture selectable windows featuring readable or audio-presented text (manuals, for example), static images and videos of instructional or previous incident records, to complete 3D reconstructions with a range of interactive elements.

The use of ‘intelligent avatars’ can also help to guide the attention of the end user to critical elements of the scene, or direct their attention to other relevant features.

One system developed by HITT was used to evaluate advanced human interaction techniques in a command and control context for BAE Systems. The end user’s motions and gestural input commands were tracked using a motion capture system and the outputs from the captured data displayed, in real time, a range of different tactical information types. These included a citiescape that appeared to exist in 3D on an otherwise empty ‘command table’, the locations of multiple unmanned air vehicles (UAVs), ‘floating’ menu screens, which enabled the user to tailor the amount and quality of the data being presented and simulated aerial 3D ‘keyhole’/laser sensor scans of suspect terrorist assets. An avatar provided additional spoken information and interface configuration support. “In 30 years of working in this field, I’ve never been more excited that I am today,” says Prof Stone. “Today, we can put technology in the back of a van, fly drones with a range of sensors in an afternoon and create imaging using that data in the evening. It is so much more exciting and immediate than just a few years ago.”
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The mainstream aspect ratio of the TFT LCD panel in the market is 4:3 or 16:9. But for some applications, bar type shapes of display panel would be much better to display the required information. Bar type TFT-LCD displays are perfect for industrial equipment, automotive application, server systems, POS system, dynamic information displays and advertising displays.

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Hylec-APL launches new DEDSS Series

Hylec-APL launches new DEDSS Series lockable IP66 IK10 Stainless Steel enclosures for challenging environments

Time-saving "everything supplied" kit; suits corrosive and hygienic environments; six sizes available

Wellingborough, UK: Hylec-APL, the specialist supplier and manufacturer of electrical and electronic components and enclosures, today announces its new DEDSS Stainless Steel Series of lockable, solid door enclosures specially designed to provide high-quality, secure, cost-effective protection for specialist and demanding electronic and electrical installations. The DEDSS Enclosure Series is IP66 rated and protects contents against water and dust, as well as being able to withstand impact to IK10 specifications and extremes of temperature ranging between –25degC and +55degC. Suitable applications for DEDSS enclosures include corrosive environments, such as the chemical and petrochemical industries, and environments where strict hygiene is required, for example, the agro food sector.

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Mouser Electronics Signs Deal

Mouser Electronics Signs Global Distribution Deal with Sfera Labs

Boards and Modules Enhance Raspberry Pi 3 Applications

Mouser Electronics, Inc., the New Product Introduction (NPI) leader that empowers innovation, has signed a global distribution agreement with Sfera Labs, developers of innovative hardware and software that bridges the best of the maker world with the professional automation market. Through the agreement, Mouser will stock Strato Pi and Iono Pi boards and servers, which address the fundamental requirements of professional applications based on the Raspberry Pi 3 single-board computer. The Sfera Labs’ product line available from Mouser Electronics includes fully assembled Strato Pi and Iono Pi boards as well as corresponding CE-certified and FCC-compliant servers, which are assembled units that house the board and a Raspberry Pi 3 Model B single-board computer packaged in a compact DIN standard case with omega-rail mounts.

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New Keyed SMA fibre optic system

New Keyed SMA fibre optic system from OMC ensures consistent mated performance

Combines best features of multiple connector styles; eliminates rotational variation

OMC, the pioneer in optic electronic design & manufacture, has launched a new keyed SMA (KSM) connector and diode receptacle system for its wide range of fibre optic transmitters and receivers which offers the rotational consistency of a keyed connector along with the security and reliability for which the SMA connector is renowned.

The KSM fibre optic connector system combines a new connector and diode housing design, which OMC describe as delivering the best of all worlds. Unlike the standard SMA connector, which can be inserted at any rotation about the ferrule axis, OMC’s KSM system incorporates a mechanical keyway mechanism, thus eliminating rotational variance when a cable is mated to the transmitter or receiver.

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Power Integrations Enables No-Neutral Wireless Wall Switches for Smart-Home Lighting

Reference design for two-wire smart wall switch is compatible with retrofit wiring and LED lights

Power Integrations [NASDAQ: POWI], the leader in high-efficiency, high-reliability LED drivers for PCs, today announced a new reference design, E622, describing a smart wall switch compatible with wiring conditions most commonly found in residential retrofit installations.

Typically, smart wall switches with wireless connectivity, occupancy/vacancy sensing and/or voice control require a neutral return wire to power the unit, which is not always available in retrofit situations. No-neutral products are available for legacy incandescent bulbs because the small AC input current that is allowed to leak through the load when the smart-switch is in standby mode is insufficient to heat the filament.

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Flexible PROVERTHA Custom Specific M12 T

Flexible PROVERTHA Custom Specific M12 T and Y-Distributors offer multiple options - now available at Aerco

Modular system ensures fast, compact and secure connections

PROVERTHA Custom Specific M12 T and Y Distributors are now available from Aerco, the distributor and stockist of electrical and electronic components serving the oil and gas markets. In addition to its comprehensive standard product portfolio of M12 and Y distributors, PROVERTHA offers custom-specific variants for the ProLineus and CANbus. This offering, based on a modular concept of T and Y distributors, enables compact and secure solutions for fast connections to be realised quickly.

With the custom specific variants, PROVERTHA provides a lot of options. The distributors can be delivered with or without grounding clips, and if a protection degree of IP 67 is required, options include moulded distributors in robust and solid metal housings.

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Lattice’s New Low-Power MachX03

Lattice’s New Low-Power MachX03 Control PLD Options Improve Embedded I/O Expansion and Board Management

New Devices and Feature-Rich Evaluation Board Expedite Development of Control Applications in Server, Communications, and Industrial Markets

New MachX03-9402 devices extend the key benefits of the MachX03 family including internal configuration memory and flexible programmable I/O to more complex applications needing more logic and embedded memory. Latest package options offer a 50% reduction in power consumption and expand resources for motor control and board management applications. New evaluation board offers the most flexibility for designing MachX03 control PLDs into a variety of system architecture.

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Nexperia boosts protection portfolio

Nexperia boosts protection portfolio with three new miniature, high-performance TVS diode families

Targets interfaces with high surge protection requirements including USB Power Delivery in portable devices

Nexperia, the former Standard Products division of NXP, today announced three miniature TVS diode families that are available in space-saving packages for applications in portable devices, including USB – Power Delivery (USB-PD) protection. All the new parts feature high surge ratings and high peak pulse power. Taking up just 1 x 0.6 mm [SMD0606-2/SMD808 package] of PCB space and with a height of 0.5 mm, the new PTVS4501BL TVS diode delivers very good clamping characteristics and a typical surge robustness of 38.3 A (650 µA pulse), which is industry benchmark for a device of this size and specification. Applications include battery line and audio port protection.

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