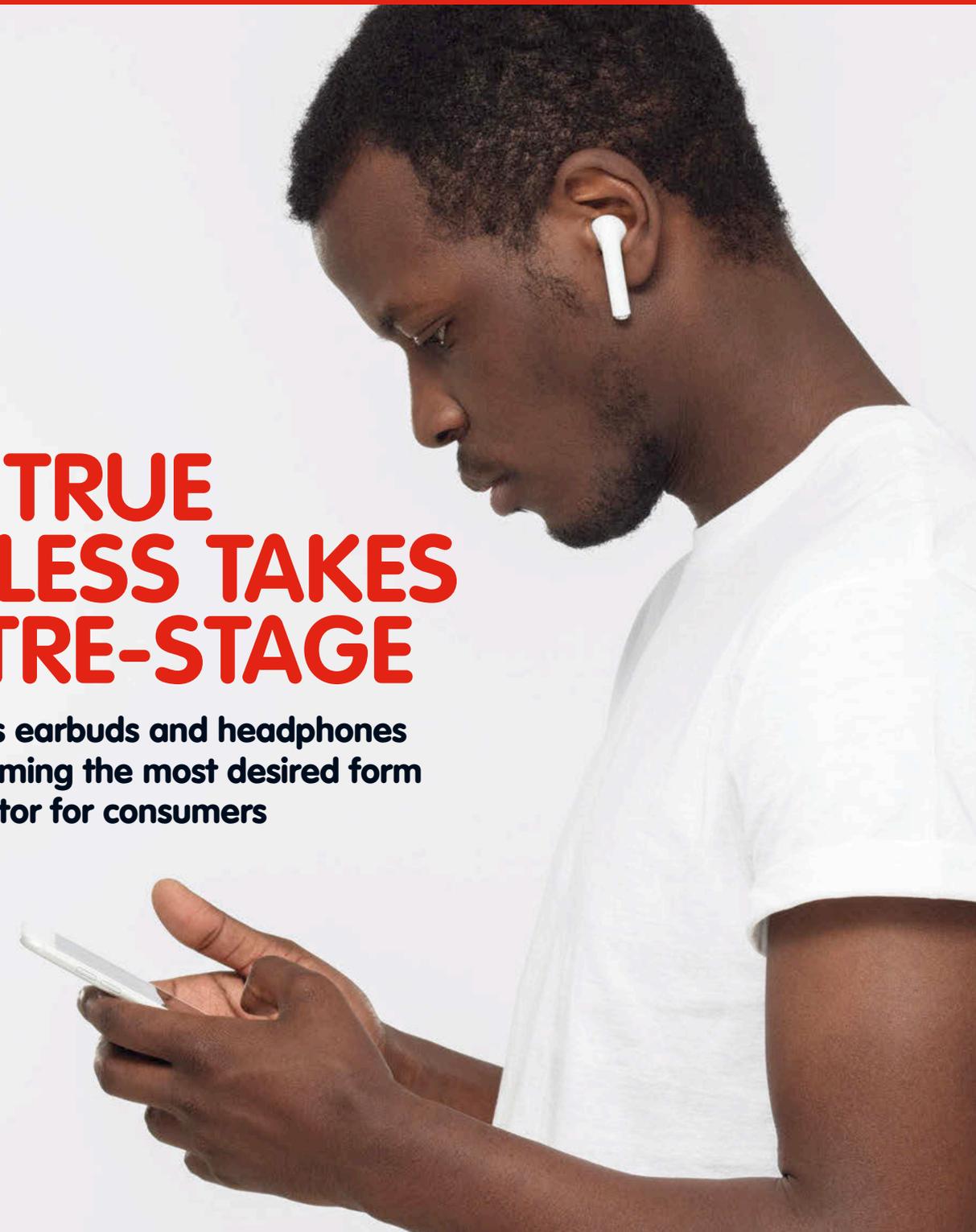


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True wireless earbuds and headphones  
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# A hideous Venusian invasion

BORIS JOHNSON'S CALL FOR A GREEN ENERGY REVOLUTION STILL LEAVES AN AWFUL LOT TO BE DONE BEFORE THE UK CAN HIT NET ZERO CARBON EMISSIONS BY 2050



**T**he Prime Minister's pledge that every home in the country will be powered by offshore wind within 10 years, committing his Government to a green industrial revolution that will create hundreds of thousands of jobs, is certainly a bold vision.

Johnson has called for offshore wind to power every home in the UK by 2030 which would see the UK's offshore wind power capacity increase by four times what it is today, to reach 40GW. It will require a huge investment, around £50bn, and need at least one turbine to be installed every week over the next ten years.

It's certainly interesting to see Johnson make this call when over the past twenty years he has ridiculed wind power, describing wind farms as a "disease" blighting Britain's countryside and looking like "a hideous Venusian invasion, marching over the moors and destroying the dales".

In fact, over the past ten years the UK's wind energy industry has proved to be a major success, with offshore turbine capacity growing from 1GW to almost 10GW at the beginning of 2020.

Johnson's scheme, however, faces a number of hurdles.

There's the need to speed up the granting of seabed licences and project contracts and in a bid to attract private investment a major contract auction is planned for early 2021, which could secure more than £20bn of investment and create thousands of jobs, according to RenewableUK.

Another challenge is that while these new turbines will power UK homes, they only account for around a third of the UK's total carbon emissions – the rest comes from businesses and offices.

As Lady Brown of Cambridge, deputy chair of the Parliamentary Committee on Climate Change, said: "If we're to reach net zero UK emissions by 2050, we'll need to see similarly bold commitments to cut emissions from our buildings, industry, transport and land."

And while at least 60% of the "content" of offshore wind farms will be made in the UK, a functional UK supply chain capable of creating thousands of new jobs is still lacking.

The Government is looking to address that and has announced a £160m investment in upgrading UK ports so that they can manage the new generation of mega-turbines. That could certainly help to create supply chain hubs and grow domestic supply chains.

And finally, fluctuating renewable energy sources such as wind power will require large amounts of energy storage capacity, which will be a critical component to support any growth in offshore wind power.

The UK certainly has the talent and capability to deliver on this Government initiative, but as is often the case with this Government the problem is not so much the rhetoric but the delivery on the ground.

Neil Tyler, Editor ([neil.tyler@markallengroup.com](mailto:neil.tyler@markallengroup.com))

**"If we're to reach net zero UK emissions by 2050, we'll need to see similarly bold commitments to cut emissions from our buildings, industry, transport and land."**

**Lady Brown  
of Cambridge**

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# AI development kit

XMOS ANNOUNCES ALL-NEW SOFTWARE DEVELOPMENT KIT FOR THE ARTIFICIAL INTELLIGENCE OF THINGS. **NEIL TYLER** REPORTS

XMOS has unveiled a software development kit (SDK) for the artificial intelligence of things (AIoT). Incorporating TensorFlowLite for microcontroller development tools, the SDK is designed to harness xcore.ai's versatility and make it easier for engineers to develop connected products that can sense, think, decide and act.

The kit includes: AIoT tools: scripts, tools and libraries to convert TensorFlowLite for microcontroller models into a format that targets accelerated operations on the xcore.ai platform; FreeRTOS: libraries to support FreeRTOS operation on xcore.ai; examples showing a variety of operations based on bare-metal and FreeRTOS operation, including smart microphone sensing and documentation, including 'getting started' guides, example builds and execution walkthroughs, as well as access to XMOS' open-source libraries of interfaces & signal processing algorithms.

These tools will enable developers to deploy custom or off-the-shelf AI models using a standard framework alongside all of the control, communications, signal and I/O processing required for a complete and secure application solution.

"Our AIoT SDK enables developers to create intelligent endpoint-AI solutions for a huge variety of applications," said Mark Lippett, CEO of XMOS. "The flexibility of the xcore.ai architecture enables customers to create truly differentiated solutions using standard embedded software techniques in a fraction of the time required using traditional hardware approaches."

## Alliance to accelerate AR eyewear app development

The LaSAR Alliance (Laser Scanning for Augmented Reality) is a new ecosystem of developers, suppliers and manufacturers collaborating to develop and accelerate Augmented Reality (AR) smart-glass solutions. Founding members include Applied Materials, Dispelix, Mega1, Osram and STMicroelectronics.

The Alliance will focus on addressing the technical challenges associated with all-day wearable smart glasses - balancing a small, light-weight form factor and extremely low-power operation with good FoV (Field-of-View) and a large eyebox. It contains all the foundational elements - a MEMS micro-mirror platform and BCD expertise from ST, compact illumination sources from Osram, advanced waveguide elements from Applied Materials and Dispelix, and the overall integration of these devices into a small optical light engine from Mega1.

The Alliance's aim is to facilitate the development and support of all the key technology elements for AR-enabled smart-glasses.



## LDRA to support Arm-based safety critical chips

LDRA is extending object-code verification to deliver advanced software testing for Arm-based chips used in safety-critical aerospace, defence and automotive applications, where safety-critical verification is essential. LDRA's support enables software developers to leverage the LDRA tool suite to verify code coverage at both the assembly and source code levels. Arm-based devices are found in many ISO 26262-compliant automotive applications, while avionics engineers are also turning to general-purpose Arm processors.

By extending object-code verification to Arm-based chips, LDRA enables compliance to Level A - the highest safety requirements - of DO-178C, the safety-critical standard for aerospace, and provides an opportunity for automotive developers to provide a similar level of assurance for the most demanding of applications in their domain.

"Designers will now be able to take advantage of the rich Arm ecosystem in their designs," said Ian Hennell, Operations Director at LDRA.

# New 'Center of Excellence'

NOKIA AND FINLAND'S TAMPERE UNIVERSITY JOIN FORCES TO DEVELOP 5G CHIPSETS. **NEIL TYLER REPORTS**

Nokia has joined forces with Tampere University to establish a 'Center of Excellence' to drive the development of System-on-Chip (SoC) custom processors for its ReefShark chipset portfolio.

The partnership, which will be based at the University campus, aims to accelerate the introduction of the technology into Nokia's ReefShark chipset portfolio and enhance Nokia's silicon capabilities and development of proprietary SoCs. The Center of Excellence is expected to open in November this year.

The partnership is intended to accelerate the development of proprietary SoC chipsets, including their design and manufacture, to improve time-to-market and to build a long-term SoC development competence and a foundation for technology leadership.

Nokia said that it will also explore areas such as machine learning, artificial intelligence and security hardware development as well as open source hardware based SoCs.

According to Ari Kynaslahti, Head of Product Management at Nokia, "This collaboration highlights our continued commitment to developing our ReefShark chipset portfolio and ensures that Nokia 5G solutions deliver a best-in-class performance to our customers."

## Cerfe Labs spins out from Arm

Arm has announced the spin-out of Cerfe Labs to develop and license new types of non-volatile memories based on correlated electron materials (CeRAM) and ferroelectric transistors (FeFETs).

Arm CeRAM researchers will join Cerfe Labs and assume ownership of the Arm joint development project with Symetrix.

As part of the spin-out, Arm will transfer its full CeRAM IP portfolio of more than 150 patent families to Cerfe Labs providing the foundation for a roadmap of related CeRAM technologies.

Cerfe Labs said that its initial focus will

be on producing meaningful prototypes which will be licensed to partners with a goal of accelerating timing of enabling these novel non-volatile materials for systems.

The new company is headquartered in Austin, Texas and is led by Eric Hennenhoefler and Greg Yeric two long-time leaders from the Arm Research organisation. Hennenhoefler will serve as CEO of Cerfe Labs and Yeric will step into the CTO role.

"CeRAM is the industry's most promising non-volatile memory with characteristics not found in any other memory technology today," said Hennenhoefler.

## Addressing 5G memory requirements

X-FAB Silicon Foundries, together with Attopsemi, the innovator behind I-fuse one-time programmable (OTP) IP solutions, have entered into a collaboration to address the memory requirements of 5G technology.

The companies have successfully qualified Attopsemi's I-fuse OTP memory in relation to X-FAB's XR013 open-platform foundry 130nm RF-SOI technology allowing customers to benefit from the incorporation of a compact (<0.2mm<sup>2</sup> surface area) and robust OTP block into the core XR013 technology module, but without the need for additional or custom processing. Read operation is possible at both 2.5V and 1.8V for MIPI compatibility.

X-FAB's XR013 is a feature rich, open-platform, 130nm technology that is optimised for RF applications.

The cooperation between Attopsemi and X-FAB presents greater scope for designers to integrate digital content with analogue trimming or data storage into next generation deployments, such as 5G New Radio (NR).

A key benefit is the flexibility with which RF products can address different regional market requirements via a single chip design.

"Close collaboration with Attopsemi has created a cost-effective OTP memory solution for our customers using XR013," said Dr. Greg U'Ren, Director of RF Technology at X-FAB. "This will be pivotal in enabling our customers to increase their on-chip functionality."



## Automotive Industry Approval for Mercury

Mercury has become an approved supplier to the Automotive industry, gaining approval to IATF16949. This further reinforces Mercury's commitment to longevity and ruggedness as well as design innovation in the taxing automotive component environment.

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# Genome data analysis in hours

IMEC UNVEILS LATEST SOFTWARE PLATFORM FOR GENOME DATA ANALYSIS. NEIL TYLER REPORTS

Imec has unveiled the latest version of its software platform for DNA analysis which is able to analyse samples eight to 16 times faster than the genome analysis toolkit (GATK) - the widely-accepted standard reference.

The elPrep5 platform encompasses the full analysis pipeline from data preparation to variant calling on a similar hardware infrastructure, opening up new opportunities and efficiency gains for hospitals and medical practitioners.

“This is the breakthrough we have been anticipating for years. Finally, we can run the entire DNA analysis pipeline with a single software platform solution, and faster than ever,” said imec researcher Dr. Charlotte Herzeel.

“Because variant calling is the most complex step, gathering results up to 16 times faster than the previous method has resulted in a four- to nine-fold reduction in time, all while retaining GATK identical results.

“For the medical sector, this allows massive efficiency gains because the time between sampling and diagnosis dramatically decreases and doctors can run analyses overnight. Moreover, since many hospitals run their analyses via rented cloud solutions, the reduced throughput times can immediately result in a cost reduction per analysis.”

After a DNA sample is sequenced, there are hundreds of gigabytes

of data representing the genetic information of the original sample, which, in the sequencing process, was cut into a multitude of smaller fragments.

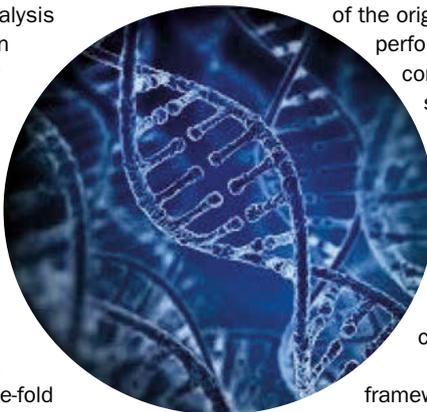
These fragments have to be reconstructed to a representation of the original DNA sample. Afterwards, an analysis is then performed to detect genetic variants, for example, in comparison to a known reference model. elPrep 5 is specifically designed to optimise this variant calling analysis.

Performing this analysis is a computational-heavy challenge and despite substantial cost reductions for DNA analysis over the past decade, runtimes can still last up to two to three days for a whole genome. imec’s elPrep5 can perform a whole genome analysis within a few hours without compromising the quality of the output.

By taking advantage of its parallel execution framework, elPrep5 performs the complete analysis after a single pass through the data. This architecture avoids the intensive read and write processes of fragments of data in and out of the memory.

elPrep5 is written in Go, an open-source programming language developed by Google, and can be run on standard servers that most hospitals have locally or in the cloud.

Several industrial partners have already expressed interest to integrate elPrep5 into their daily operations.



## The Internet of Trees for rapid wildfire detection

Environmental IoT startup Dryad Networks has secured funding of €1.8million to develop a large-scale IoT network for the ultra-early detection of wildfires.

The company’s digital forest solution has been designed to help public and private forest owners monitor, analyse and protect the world’s largest, most remote forests and tackle the devastating impact of wildfires on the environment, wildlife and communities.

Dryad’s large-scale IoT solution uses a network of sensors for ultra-early detection of wildfires in under 60 minutes even in remote areas, prompting a faster response than existing solutions.

By contrast, camera and satellite-based solutions can take several hours or even days to identify a fire because they rely on the smoke plume developing enough to be detected from a long distance, while emerging solutions based on the NarrowBand-Internet of Things (NB-IoT) standard are not practical

for large-scale and remote forests where the cost of building a LTE/4G network is prohibitive.

Forest fires account for around 20% of the annual global emissions from the burning of fossil fuel and account for the displacement of tens of thousands of people, approximately \$5bn of direct fire-fighting costs and over \$100bn of economic damage globally every year.

The solution comprises of solar-powered sensors that use AI to detect gases emitted in the smouldering stage of a wildfire as well as temperature, humidity and air pressure; gateways featuring Dryad’s patent-pending distributed mesh architecture - an extension to the LoRaWAN open standard for long-range radio IoT networks and a cloud-based dashboard to analyse and monitor a wide range of indicators and alert forest managers.

Dryad’s gateways interconnect in a multi-hop mesh network, making it

possible to cover very large forests, rather than the real-world 12km range supported by other LoRaWAN gateways and makes it economically viable to build a communications network for large forests where there is no mobile network coverage.

Dryad border gateways at the edge of the network connect to wireless (LTE/NB-IoT), satellite or wired internet to access the Dryad cloud platform.

Carsten Brinkschulte, CEO and co-founder of Dryad Networks, said: “The notion of the intelligent forest is now coming of age. Our vision is to deliver an effective communications architecture for even the most remote forests and make sub one-hour wildfire detection the new reality. Using a solar-powered, distributed mesh IoT network capable of covering vast expanses of forest where mobile network coverage is lacking will radically transform the way forests can be monitored and managed.”

The COVID-19 pandemic has changed the world as we know it - with nationwide lockdowns and social distancing measures upending the lives of people everywhere and driving economies into the ground. The virus has not discriminated, and no corner of society has been immune to its effects.

In the midst of crisis, many businesses have frozen spending plans and pulled funding as they have attempted to cope with the effects that the outbreak has had on their operations and revenues. However, that said, the pandemic has been a strong facilitator of creativity and innovation. And while it is true that the virus is likely to have a significant impact for years to come, there is at least some cause for optimism when it comes to the future of UK businesses.

Working practices have rapidly adapted, with many employees now working from home. There has been a push for companies to digitise their processes, and for customer-facing businesses to develop online offerings to ensure sales did not plummet.

This has pushed businesses across all sectors into uncharted waters, but these changes have not been without long-term merit. The intense period of innovation ignited by the global pandemic has proved that although we are living in unprecedented times, organisations can deliver on successful digital transformation even against all odds.

## Research

To explore this phenomenon further, Studio Graphene recently polled over 500 UK business leaders to uncover the impact that COVID-19 has had on innovation and creativity. The research found that almost half (47%) of the businesses surveyed had successfully migrated their offering from in-person to online since March 2020, with similar numbers (50%) stating that the virus had prompted them to adopt a new digital solution that they had previously been hesitant to embrace.

As history has shown, when faced with seemingly insurmountable challenges, business leaders and entrepreneurs are often at their most creative. To avoid the prospect

# Embracing innovation

IN RESPONSE TO COVID-19 RESEARCH SUGGESTS THAT BUSINESSES IN THE UK HAVE TURNED TO INNOVATION TO SURVIVE. **RITAM GANDHI** TALKS NEW ELECTRONICS THROUGH THE RESEARCH FINDINGS

of having to close operations or see sales fall off a cliff, many companies have clearly made daring and necessary decisions in order to survive.

This poll suggests that the pandemic has prompted many organisations to think outside of the box when it comes to delivering digital transformation.

Strikingly, half of the respondents stated that they had taken on new digital solutions to enable them to continue delivering their

innovation in the past.

Even for businesses that have previously opted to embrace digital transformation, mitigating risk has remained a focus. With so much careful planning and consideration, large-scale digital transformation projects often become drawn out, taking months or even years to realise.

However, recent events have shown that this needn't be the case, and businesses have cut these timescales down substantially. Although the final products might be a little bit rough around the edges and still require some refining, organisations will undoubtedly have learned some important lessons from these fast-tracked initiatives. This ought to stand them in better stead for the challenging months ahead.

## Fast-tracked initiatives

With many success stories of organisations acclimatising to this new reality, the looming question now for business leaders is how to avoid the trap of reverting back to laborious and overly cautious processes once the pandemic has passed.

Companies would do well to consider their accomplishments throughout this trying period carefully and incorporate the lessons learned into future implementations.

Thankfully, the research is encouraging; the findings of Studio Graphene's poll suggest business leaders have already recognised the positive impact that digital channels and automated processes can have on their day-to-day. Over half (55%) of the business leaders surveyed said that fostering innovation has now become a keen focus within their organisation. The vast majority of respondents also stated that they are now more likely to invest heavily in technology for their internal operations going forward.

All in all, the coronavirus pandemic has posed many challenges for businesses and their operations. But in the same breath, these difficulties have also exposed the need for organisations to invest in pioneering solutions.

- Ritam Gandhi, is the Founder and Director of Studio Graphene



product or service. An additional 39% of businesses stated that they had done so by investing in a new area of technology that they have never used before, such as artificial intelligence or augmented reality.

And for many businesses, these investments have been a long time coming. Great leaps have been made in this domain in recent years, but it is often the case that organisations end up bogged down by internal hierarchies and red tape when trying to implement new tech.

Naturally, most leadership teams will run into some anxiety about the prospects of change; it is always easier to stick to the status quo rather than invest resources into new products, services or ways of doing things. Indeed, almost half (45%) of the businesses surveyed agreed that a risk-averse culture has hindered their efforts towards

**Q**ualcomm's annual 'State of Play' reports assess the views of consumers from across the US, UK, China, Germany, and Japan looking at consumer attitudes and behaviours and how they are changing and driving buying decisions when it comes to audio technology.

Its latest report, for 2020, has found that true wireless earbuds have now become the most desired form factor among consumers and that combined with video consumption and gaming content, together with noise cancellation, are today's must-have features.

True wireless devices are becoming more popular as they provide complete freedom for users who are able to enjoy content in a much wider range of environments.

The broader wireless speaker industry is also going through a period of rapid change, which has been fuelled by the adoption of cloud-based voice assistants and smart speaker adoption - trends which are accelerating.

Covid-19 has also impacted the market and economic uncertainty has made price a more important consideration, when compared to findings of previous reports.

Despite some movement in consumer buying habits, sound quality remains the single most important factor for audio users and is the top purchase criterion.

As seen in previous 'State of Play' reports, consumer demand for ever-longer battery life has been increasing sharply year-on-year, as audio enthusiasts seek to use their devices more often and for a wider range of applications – as a consequence truly wireless earbuds are now expected to deliver a minimum of nine hours of playback time before being returned to the charging case.

The survey also found that consumers want improved

# TRUE WIRELESS TAKES CENTRE-STAGE

True wireless earbuds and headphones are becoming the most desired form factor for consumers. So why so popular? By **Neil Tyler**

interoperability between their wireless earbuds (or headphones) and their smartphone, in fact Qualcomm's research showed that the issue of smartphone compatibility was now a purchase barrier for almost a third of users.

However, audio quality probably remains the most important barrier for truly wireless earbud purchases, with almost a quarter of those questioned by Qualcomm highlighting audio dropouts as a negative quality criterion.

### Technology trends

The issue of compatibility and improving the listening experience has seen the Swedish digital audio company Dirac, together with ASUS, a manufacturer of phones, computers and electronics, come up with the ASUS ROG Phone 3.

This phone has been designed for mobile gaming providing 'cutting-edge sound quality', according to both companies.

This has been achieved through the integration of Dirac's immersive audio and optimisation technologies for the smartphone's built-in speakers and connected headphones.

"Today's flagship smartphones allow users to do more than ever before, including online gaming – where high-quality audio is just as critical as visuals, processing power, and other notable features," explained Mats Oberg, Chief Sales Officer, Dirac.

The company's immersive audio solution for built-in speakers employs advanced MIMO (multiple-input and multiple-output) technology that enable a phone's primary speakers and receiver speaker – responsible for sound during phone calls – to work together to produce much improved audio.

By co-optimising the speakers' impulse and frequency response, Dirac's immersive audio solution can create a broader acoustical experience that sounds very much like a surround sound system.

Dirac's sound optimisation solution upgrades the sound quality of the headphones by measuring and correcting the connected impulse and frequency response – so that it can improve musical staging, clarity, voice intelligibility, and bass fidelity.

Another company working hard to improve the quality of audio is CEVA, a licensor of wireless connectivity and smart sensing technologies.

Working with VisiSonics, a developer of patented 3D spatial audio technologies, they have developed a 3D spatial audio solution for embedded devices, including true wireless audio (TWS) earbuds and other hearables.

In this collaboration VisiSonics' RealSpace 3D audio software has been optimised for CEVA's low power audio and sensor hub DSPs together with CEVA's MotionEngine head tracking algorithms running on its BNO080 9-axis System in Package (SiP).



The result - a high precision real-time 3D audio solution that significantly improves the hearing experience whether that's for VR, AR or the new generation of motion-aware earbuds where 3D audio enhances the overall user experience.

VisiSonics RealSpace 3D Embedded for Headphones solution incorporates a suite of algorithms that give the listener a feeling of being present in an actual three-dimensional acoustic scene. The technology allows a user to precisely place auditory objects in virtual auditory space including both ambisonics and object based input, as envisaged in the Dolby Atmos and MPEG-H standards.

Commenting Moshe Sheier, Vice President of Marketing at CEVA said, "The use of contextually-aware audio for mobile and wearables is set to grow exponentially in the coming years on the back of 5G, and together with

Ceva and VisiSonics have developed a 3D Spatial audio solution for TWS earbuds and other hearables

VisiSonics, we can help OEMs and ODMs leverage high precision 3D audio in their hearables to ride this wave."

### Changing consumer perceptions

According to Dave Rogers, President Lifestyle Division, Harman International, a subsidiary of Samsung, the Covid-19 pandemic has impacted the industry both in terms of demand – "it has brought sweeping changes to society as a whole, altering the way people live, work, and interact" – and supply.

"There had been little discussion about Covid-19 even at CES, earlier this year. Come February and then March the industry started to take notice because both China and South Korea were being impacted. Consequently, our focus turned to the issue of supply. Companies were looking at and having to diversify their manufacturing footprint.

"There were worries about where product was going to come from; come March and our concerns moved from supply to demand as Western Europe and the US went into lockdown," Rogers explained.

The big question for the industry going forward is how consumer attitudes may change and how that could impact demand.

As Qualcomm's 'State of Play' report makes clear price has certainly become more of a concern for consumers, but whether that will remain the case is hard to predict, said Rogers.

"People are going to be worried about what the future holds and that could see consumer attitudes changing significantly in a post-Covid world," he suggested.

Rogers points out that sales of consumer audio devices have held up remarkably well over the course of 2020.

"April was a tough month for the industry and at Harman we saw sales down year-on-year for the first time in a very long time. Going back to 2010

we've recorded double digit growth for over ten years, so this was a shock to the business.

"There was a strong recovery subsequently, with rapid growth throughout May, June and July when we surpassed sales for this time last year. While our consumer audio business has performed well, our professional audio division continues to struggle."

Buying habits in the age of Covid-19 have evolved significantly and eCommerce, in particular, has seen exponential growth and has replaced physical retail channels – generating the equivalent of the last decade's growth within just three months according to research compiled by McKinsey.

Digital media platforms have also benefitted from the crisis, with digital video, music, and gaming all seeing spikes in engagement.

According to FutureSource, the crisis has also caused sizeable growth in the gaming headset market.

This increase in demand is linked to growing numbers of consumers using gaming as an at-home entertainment option for social distancing, in addition to consumers purchasing gaming headsets for working and studying from home.

While for Harman the consumer audio market has seen the much heralded 'V' shaped recovery, Rogers remained cautious as to how things could develop over the coming months.

"When we talked about a 'V' shaped recovery we were thinking that life would snap back to normal, it hasn't! We are facing a second wave of the pandemic and while sales will recover – we're expecting sales over the year to be up around 15 percent – where the market goes in 2021 is anyone's guess.

"If we see another heavy infection cycle then I think people will look to retrench, especially if the macroeconomic conditions deteriorate."

When it comes to true wireless headphones, according to Qualcomm's research, demand has surged over the past 12 months.

"Last year FutureSource was suggesting that sales of true wireless headphones would be ahead by around 200 per cent this year. Despite the pandemic they're ahead well over 65 per cent," said Rogers. "True wireless is the most important current trend in the headphones market and is set to become the new form factor for headphones in the coming year.

"There's huge demand and a massive shift towards true wireless devices. Another big trend has been improvements in interoperability which has been a massive benefit for smartphone manufacturers," said Rogers. "Harman is introducing a range of new true wireless headphones that combine powerful sound and bold designs that will include Active Noise Cancelling and IPX7 sweat and waterproofing that will significantly improve the versatility and performance of the earbuds. We are also introducing our new Dual Connect + Sync technology which is capable of pairing your device when the case is opened, and each earbud connecting immediately."

Rogers makes the point that people have more time to read, to exercise, and to consumer different forms of content.

"For a company like Harman it's not about the content, rather it's about enhancing that content and the overall consumer experience."

### Conclusion

According to Qualcomm's research the shift towards wire-free, highly portable headphones and earbuds is having a big impact on what consumers are looking to buy.

In its 2020 survey, user experience and comfort joined sound quality and battery life at the very top of what consumers were looking for from their purchases of audio devices.

While sound quality still matters



**"True wireless is the most important current trend in the headphones market and is set to become the new form factor for headphones in the coming year"**

Dave Rogers

Below: Harman is introducing a new range of wireless headphones - the JBL TUNE 225TWS



most to consumers, the data does show that a broader spread of feature interests are emerging – such as high-resolution audio, or noise cancellation both of which have trended up significantly, putting immersive listening experiences on-the-go at the top of consumer wants.

Consumers are said to be turning to wireless earbuds in order to watch TV, movies, and other video content, making it the third most common use case for these devices. Video calls and mobile gaming are also rapidly growing in popularity as well.

Using wireless headphones and earbuds for voice calling is another use case that is on the rise, and means that preserving wireless voice call audio quality will remain important and could be used by manufacturers in order to create stronger differentiation between products.

While all types of wireless headphones are used in an increasingly diverse range of locations, and true wireless earbuds are fast becoming the form factor of choice, a majority of consumers who were surveyed by Qualcomm said that they were likely or extremely likely to purchase wireless headphones or earbuds that offered additional features, such as voice assistance, fitness biometrics, or hearing assistance capabilities.

In future, fitness or health tracking, live language translation, mobile gaming, and getting information or directions from the Internet are becoming more important wireless headphone capabilities, with around 20 percent of consumers surveyed saying they can see themselves adopting these use cases.

"There's a huge opportunity here which is being driven by consumer demand," concluded Rogers.

"I think true wireless is certainly the next frontier for the smartphone when it comes to delivering listening experiences that resonate powerfully and personally."



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# Taking technology to the next level

Dr. Sailesh Chittipeddi, Executive VP & GM of Renesas' IoT and Infrastructure Business Unit talks mega trends, market opportunities and product roadmaps with **Neil Tyler**

**A**ppointed Executive VP and General Manager of Renesas' IoT and Infrastructure Business Unit back in July 2019, Dr. Sailesh Chittipeddi has responsibility for the company's IoT, industrial and infrastructure business at a time when the industry is not only having to handle the impact of Covid-19, but having to adapt rapidly to address new opportunities - such as the increased need for telecommuting solutions, remote healthcare, greater environmental awareness and e-AI.

Then there are the mega trends that are driving growth, whether that's data centre disaggregation, the ramping up of 5G or the accelerating movement of intelligence to the edge.

"On top of all of that Renesas has changed significantly in the past few years," says Dr Chittipeddi. "I joined when Renesas acquired IDT back in 2018, two years after the acquisition of Intersil. In two short years the company has been restructured and we've been pretty successful in accelerating product development across the entire portfolio."

Acquisitions, particularly those by large Japanese companies, haven't always had a great track record but Renesas appears to have bucked that trend.

"We made the decision to split the business into automotive and non-auto, for which I have responsibility. In general the non-auto business moves a lot quicker and our customers' design cycles are certainly shorter. The new structure has provided a sound platform enabling us to react to market trends much more quickly," says Dr Chittipeddi.

"From a R&D and business perspective we've successfully repositioned our portfolio to address an increasingly data centric world. There are still issues that need to be addressed - the supply chain is still centralised and we're using internal factories for our MCU, MPU and analogue devices. We need to look at using external foundries as new technologies are developed and if we want to continue to drive design-in momentum."

The challenges associated with the clash between the US and China is another issue. Dr Chittipeddi makes the point that Renesas' R&D efforts are well distributed globally, although he concedes

that some divisions – power and analogue, for example – are more exposed than others.

"In the UK we have a big presence, in terms of R&D, in both analogue and power and are likely to increase investment there. But we have a strong presence globally and our focus has to be on serving our customers."

Dr Chittipeddi accepts that international politics and trade disputes are challenging. "I have to hope that this is a phase that we're going through and that things will become more settled in the years ahead.

"China is a very important market and has made significant advances in artificial intelligence – it would be a shame if the global market ended up fragmenting."

## Global technology trends

When it comes to technology trends, Dr Chittipeddi identifies three key ones.

"When it comes to data centres there's a growing realisation that it's not just CPU performance or memory that's the limiting factor, it's actually the interconnect that is becoming more important. The break up and the virtualisation of the network is accelerating and is now a firmly established trend. That's going to lead to memory pooling, as well as processor and storage clusters, so the role of the interconnect is becoming more important."

From the company's perspective that trend works to its advantage as Renesas is all about "timing and interconnect technologies."

"We are seeing the move from DDR4 to DDR5 and looking beyond that, to the CPU and GPU break-up. You are going to have to adjust data centre workloads in future - that will become more critical going forward. Chip architectures will also have to be quite different depending on the sector and the associated workloads.

"Another area of interest is memory and there's an emerging new class that now plays between DRAM and NAND Flash. People are looking for a compromise between these two and I believe that once the software support has been developed to a point when there will be enough momentum, then that is a trend that will gain more traction in terms of the data centre."



telecom providers as well as this new class of emerging Open RAN solution providers.”

According to Dr Chittipeddi the restrictions that have been placed on Huawei are actually encouraging a move towards more open architectures and, while software will remain a major challenge, there are a growing number of innovative start-ups working aggressively in this space.

**“Whether you are talking proprietary or open architectures Renesas is well placed. We have developed a board portfolio of solutions that are capable of addressing the needs of traditional telecom providers as well as this new class of emerging Open RAN solution providers.”**

“We are seeing solid growth opportunities across 5G markets,” he says.

The third key trend, according to the doctor, is intelligence moving to the edge and how we move inference algorithms to the edge will determine the success of the move from the core to the end point.

“To deliver more processing capability at the end point will mean that you need a measure of neural processing taking place there. Our dynamically reconfigurable technology (DRT) allows you to do processing at the end point.

“Voice and machine learning (ML), in terms of defect recognition where machines can provide greater levels of sensitivity, are big trends here.

“Replacing repetitive tasks is another important trend and where technology can do a better job than we can, we’ll see a move to processing at the end point. It’s certainly something we need to capitalise on. Even when it comes to motor control functions they can be handled locally or centrally.”

When it comes to exploiting these opportunities it’s not possible for a single company to do everything itself, concedes Dr Chittipeddi.

“We don’t have the system knowledge for all these areas, so from a partnership perspective we are working with design houses, start-ups, universities and the like and have developed a very strong and extensive ecosystem.

“That ecosystem is critical, especially when there is a convergence between different technologies such as sensors, MCUs and MPUs. Where we can scale up production acquisitions will make sense but we also invest in working with exciting new companies – like I said, no monolithic company can handle everything on its own.

“We are engaging with a lot of small businesses and start-ups who are taking technology to the next level – they are exceptionally creative and innovative.”

But there are limits, as Dr Chittipeddi explains. “There are plenty of markets that I’d like to go after, but you have to be realistic and resources are finite. However, all things being equal – there are three I’m very interested in developing.

“These include voice – especially in light of the impact of Covid-19, then I’d like to expand our e-AI portfolio and go after more verticals and, finally, target lighting which I believe is going to be a big area in the years to come.”



When it comes to 5G Dr Chittipeddi argues that there are two major developments taking place.

“Today, 5G has taken hold, but primarily in the sub 6Ghz space. Despite the hype mmWave is still a couple of years from gaining a major hold in the market, in my opinion. In the UK, we work with Blu Wireless technology and seen some deployments with a company called CCS in central London – these are base-band modems.

“There is also a competing 5G environment with Open RAN and we are starting to see deployments using that architecture – I think it will be a similar trend to what we’re seeing with data centres. Hardware and software are decoupled and you work with an open and interoperable architecture.

“Whether you are talking proprietary or open architectures Renesas is well placed. We have developed a board portfolio of solutions that are capable of addressing the needs of traditional



# Creating natural sound experiences

Today's most advanced hearing aids are able to deliver better, personalised sound without annoying artifacts, as **Lise Henningsen** explains

**N**atural sound: It's all around us. The voices of our loved ones; waves crashing and birds singing, symphonies playing, traffic passing by. But many people have a hard time enjoying natural sound - or any sound for that matter.

According to the National Institute of Health (NIH), one in eight people aged 12 years and older has hearing loss in both ears. Twenty-five per cent of adults aged 65 to 75 and half of adults aged 75 and older experience disabling hearing loss. All told, it's estimated that about 26 million adults in the US have suffered permanent hearing damage, with estimates that a further 28.8 million could benefit from using hearing aids.

But for many, there's a problem with wearing hearing aids in that they don't sound natural. In fact, sound quality and the "naturalness" of sound remain among the most-cited reasons people don't pursue hearing assistance, despite the great strides in hearing aid innovation made over the last decades.

Ironically, the unnaturalness of hearing aid sound is, to a great extent, the by-product of that innovation. When hearing aids went digital, drastic improvements in noise reduction and advanced signal processing came at a price.

In the beginning, hearing aids were built to compensate for hearing loss and make speech audible again. Of course, the reality was - and remains - that ambient noise and the consequences of hearing loss are variable and listener specific.

Today, high end hearing aids are intelligent. They can process and separate out unwanted noise, like background conversation in a coffee shop, while simultaneously enhancing nearby speech so the wearer can better hear their companion. Really good digital hearing aids can even automatically adapt to different listening environments so the wearer doesn't have to, and they eliminate feedback that might have been associated with analogue technology.

They do all this through advanced

digital signal processing, but therein lies the rub, and the reason for further innovation in creating a more natural sound experience for the millions of people seeking it.

## Unnatural sound

Taking an analogue sound wave, converting it to a digital signal, processing it, then re-converting it back into a sound wave that the ear can perceive, takes time - in most cases 4 to 8 milliseconds. A signal is passed through the input stage and converted to digital numbers, passed through a filter bank, which splits it into various channels for processing, for example to compensate for a person's unique hearing deficiencies in one frequency range but not another.

Finally, the digital signal again needs to be converted from numbers back to an analogue sound wave at the output stage of the hearing solution. Studies have shown that a processing delay within that 4-to-8-

millisecond span can adversely affect sound quality.

The challenge with a system delay of approximately 4 to 8 milliseconds is simple: if processed sound and unprocessed sound mix in the ear canal of a hearing aid user, the delay will have a degrading effect on the perceived sound quality, also called the comb filter effect.

It's become increasingly important to get this effect under



control, because more and more hearing aids are fit with discrete and open- or vented-fit ear sets, particularly for people with mild to moderate hearing loss.

As a result, more direct, unprocessed sound passes through the opening around the ear set and mixes with the processed sound from the hearing aid. When that happens, the perceived quality of the user's own voice becomes tinny and artificial; environmental sounds come out distorted and unusual; and overall, the resulting sound becomes strenuous to listen to over time.

For anyone embarking on a new hearing life with hearing aids, the expectation is a world of sound as it was - natural. And many end up disappointed in their first experience of amplified sound, because, despite great strides in hearing aid development, until now, a more natural sound has been elusive. Smarter, more efficient processing

holds the solution.

**Signal processing**

The challenge is to build a digital signal path with virtually no system delay, so that the mixing of signals in the ear canal would not be detrimental.

Engineers at Widex looked at the situation and realised they could dramatically speed up the digital signal processing in hearing aids. Building off a determined focus on high-fidelity signal processing design, Widex is already an industry leader with the lowest system delay.

The company's time domain filter bank, along with its 32kHz sampling rate and 16kHz digital bandwidth, results in very high-fidelity sound and the perfect backdrop for engineers to tackle the comb-filter effect.

The solution is an alternate, innovative, high-speed signal pathway through the hearing aid. Widex calls it the ZeroDelay pathway, and is intended for people with mild to moderate hearing loss.

The new accelerated pathway results in a processing delay of just .5 milliseconds, effectively eliminating the comb-filter effect and the tinny sound many hearing aid users notice when direct and processed sound come together and cause distortion.

In this pathway, all signal processing is adapted to the ZeroDelay design to deliver the best and purest sound quality. Several core functions, such as acoustics stability, adaptive gain control, and enhanced signal-to-noise ratio, still take priority, while others are modified to fit it to the new paradigm of natural sound design in the faster ZeroDelay pathway.

The two pathways - ZeroDelay and "Classic" - exist, side-by-side on the Widex platform. Depending on the needs of the wearer, a hearing care professional can program one or the other as the default mode. The fact is, in real life, hearing naturally



**Author details:**  
Lise Henningsen is Global Head of Audiology for Widex

and with focus depends on context and intent. The wearer of hearing aids with the two distinct pathways can switch between them based on where they are and what they want to hear, thereby enjoying far great sound quality and a more natural experience in most situations.

**Better hearing**

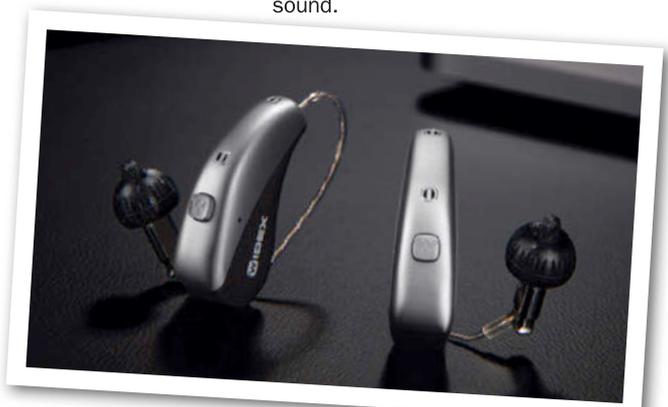
Why is this important? Why innovate to create a more natural-sounding hearing aid, beyond the fact that natural sound is what we all crave? One of the biggest reasons is so more of the people who would benefit from hearing aids will embrace the technology that's available today.

Most first-time hearing aid users are in their 60s and 70s, and although their hearing problems started years earlier, data shows it can take them, on average, seven years to give hearing technology a try. Having waited seven long years to try hearing aids, they shouldn't put on their first pair and hear tinny distortion.

What the development of a ZeroDelay pathway shows us is that there continues to be room for innovation in recreating natural sound. Could there be additional processing pathways, tailored further for prevalent hearing challenges? In what other ways can engineers shape sound frequencies and process digital signals based on a person's preference, lifestyle, or listening intent?

Having accomplished the delivery of natural sound, engineers are committed to further pushing the envelope on personalised, natural sound.

Widex's latest hearing aid range incorporates a number of improvements





# A NEW SAFETY STANDARD

IEC 62368-1 is the new hazard-based product safety standard coming into effect this December. What does this mean for design engineers? **Neil Tyler** reports

IEC 62368-1 comes into force worldwide from 20th December and it brings with it a totally new set of engineering principles and terminologies. Significantly, it's the first time that a hazard-based testing approach has been taken with these types of electronic equipment and comes in response to the growing convergence in, and the development of, new 'state of the art' technologies.

Multi-media and communications products, for example, had been falling increasingly under both the IEC 60065 (AV equipment) and IEC 60950-1 (IT equipment) standards, creating a degree of confusion among manufacturers.

In response the IEC Technical Committee (TC) 108 created the new 'hazard-based' standard - IEC 62368-1, which while it isn't a merger of existing standards does cover the older standards.

"This is the first time that a hazard-based, rather than test-based,

approach has been taken with product safety. To a large extent this makes IEC 62368-1 a technology independent safety standard, allowing for more design freedom," explained Richard Poate, senior manager at TUV SUD.

"Its introduction has caused some problems in terms of the compliance methodology, as it's the first time the hazard approach has been taken and people will need to be aware that it is not just a repackaging of the existing standards - although at first glance it's certainly possible to spot many familiar aspects to it," he conceded.

"But the hazard based approach that's been taken means it is not just a simple merger of the previous two standards. It is a fundamentally different approach to proving compliance and that your product is safe."

The two older standards followed a set of prescribed rules, while IEC 62368-1 now requires the identification of safety hazards in the

early product development phase.

"The standard takes a proactive risk-based approach by identifying hazards and then testing the effectiveness of the chosen safeguards," Poate said.

It also provides more performance options to demonstrate compliance.

With this new standard coming into force in a matter of weeks, what exactly are the benefits?

"While the previous standards were clear and addressed specific markets as is always the case with technology, new products and designs move very quickly while standards don't. So, as new products appeared, there was growing confusion as to which standards should be applied.

"Take the example of a Sky Box. It has a video recording capability but open it up and it's essentially a personal computer.

"As a result, different countries wanted products tested to one standard, others to another. The whole thing," according to Poate,

“was getting ‘messy’.”

As a result IEC 62368-1 was conceived as a replacement for these existing standards.

“The European version of IEC 62368 has been around for a number of years, but becomes mandatory in December,” Poate explained.

It comes at an interesting time for the UK with Brexit set to happen but Poate suggested that whatever is agreed by the UK and Europe, in their on-going trade talks, it would take a large team to re-write standards that have been developed over many years.

“No matter what deal is agreed, I think from next year the UK will look to operate with a harmonised set of European standards. There’s really no way we can re-write the thousands of different standards that are currently in operation.

“Going forward, however, I think there may be a push towards developing particular UK standards. However, I would argue that they would have to stay aligned to European standards, as manufacturers will not want to work with additional barriers to trade.”

While the biggest change with IEC 62368-1 is the adoption of a hazard rather than test-based approach, the testing requirement for batteries has also become more onerous.

“The requirements for batteries are more stringent and the standard has looked to become more ‘future proof’, with the aim of keeping up with developments in the technology. We are seeing more battery powered consumer products and a move away from mains-powered devices to lithium ion rechargeable batteries – the standard needed to reflect that.”

### A change of mindset

According to Poate IEC 62368-1 will require a significant change in mindset among engineers, when it comes to testing and compliance.

“With this approach an engineer is not designing a product to meet

a particular set of criteria in order to pass a specific test,” he explained.

“Rather they will have to identify possible hazards in their products, quantify them and then restrict access to those hazards.

“In the past, engineers would be confronted with a prescriptive set of requirements against which their design would need to be validated – a list drawn up by those who wrote the standard. It was very easy to follow, but how did you as an engineer know that all the hazards had been addressed? You were only working with those already identified, not new ones.

“IEC 62368-1 has turned that approach on its head and forced the design engineer to look at their product afresh, and requires them to identify potential hazards. That sounds easy, but can be quite challenging, especially for engineers who are used to working with a set of prescriptive tests,” suggested Poate.

Accordingly, while the new standard doesn’t throw away those types of tests, it does call for the identification of likely hazards to take place first and only then for the use of prescriptive tests to pass or fail that device.

“IEC 62368-1 is a hazard based safety engineering methodology which requires you to identify potential hazards, whether that concerns electrical, thermal or mechanical safety and so on, and mitigate against them.

“Take a fan that sits inside a laptop, for example. It has a moving element - rotating blades - so that would be identified as a low risk hazard – but whatever the level of hazard, the concept is the same.

“Taking this example, you will have identified the blades as a hazard, documented that and by doing so ensured that anyone would be able to see what was identified as a hazard and, perhaps, what was overlooked.”

According to Poate, once the hazards have been identified, then

the various safeguards required can be selected and the necessary prescriptive testing carried out.

“You are being asked to manage the risk associated with the hazardous part by employing safeguards. Only then do you fall back on the prescriptive testing that was at the heart of the previous standards, so you can test the integrity of those safeguards that have been selected.

“This is the heart of the new standard. You are identifying the risks first, then applying the safeguards and testing them.”

The biggest benefit from this new approach is that the engineer does not have to design to a specific standard, so there’s more flexibility as a result.

“To start with it will be a bit more restrictive – we are replacing a tried and trusted methodology with something very different. Engineers will not have used this approach before but, in time, I believe that once they get use to the new methodology it will give them much more freedom with their designs,” argued Poate.

The prescriptive test-based approach of the old standards left little room for subjectivity, as they required engineers to apply specific tests to prove compliance.

By contrast, IEC 62368-1 takes a more subjective approach which relies on engineering expertise to identify potential hazards.

“It’s not prescriptive and will allow designers to think outside the box, with the potential for radically new designs that could use new materials or be lighter, more cost effective, or come with better features.”

However, not every individual engineer may identify exactly the same hazards when considering a similar product.

“Only time will tell if this new, more flexible, less objective approach will ensure that products remain safe,” concluded Poate.



**“Only time will tell if this new, more flexible, less objective approach will ensure that products remain safe,”**

Richard Poate

There are four trends now shaping the automotive market and in a report published in 2016 by McKinsey & Company (“Automotive revolution – perspective towards 2030”) these were identified as autonomy, connectivity, electrification and diverse mobility.

In the year of publication, however, fully autonomous vehicles still seemed to be years away, and advanced driver-assistance system (ADAS) applications were much less common – in fact, the pace of disruptive change seemed glacial.

Fast forward to 2020 and things are very different. The rollout of 5G will have a significant influence, while the automotive-centric dedicated short-range communications (DSRC) standard is now in production vehicles. With momentum growing, the deployment for DSRC to support ADAS features is set to expand. In that respect, features such as adaptive cruise control, automatic emergency braking and lane departure warnings are becoming commonplace enabling Level 2 autonomy in mainstream vehicles.

There is plenty of investment in developing autonomous vehicles by carmakers, car-sharing companies and cash-rich internet companies on a worldwide basis.

One of the four trends, the evolution of electric vehicles, is fundamental to these developments. Sales are growing, in part due to the improvements made in battery technology, and we are approaching an inflection point where the battery cost is coming down to a competitive level and at \$100 per kWh, battery electric vehicles can be competitive with internal combustion engines.

Looking at these trends from the perspective of a semiconductor company, the complexity involved with developing ADAS and automated driving, as well as more established features such as infotainment, is now centred on a system-on-chip (SoC) approach.

# A clearer roadmap

Meeting the demands of new sensor modalities in ADAS.

By Thomas Wong



The close integration of functions, made possible by SoCs based on the latest 7nm and 16nm processes, provides the performance needed to deliver these advanced features. In turn, this is having a disruptive effect on the way automotive SoCs are designed, accelerating the move to finer semiconductor process geometries.

## Bringing technologies together

The main sensor most human drivers rely on is the eye. We can see in colour, perceive depth and distance, estimate speed and direction, and adjust to variable light conditions. If we apply these requirements to

Above: Autonomous vehicles will rely on situational awareness in order to function safely

Below: Comparing the three main sensing technologies currently used in autonomous vehicles

autonomous driving systems, it becomes clear just how big the task is. We are using image sensors, coupled to SoCs, to mimic the human experience. This involves synthesising information to make decisions, at the same speed and with the same accuracy as a human driver.

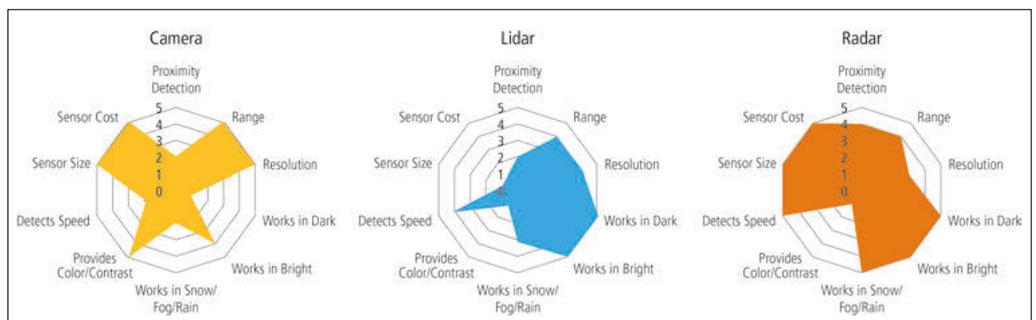
This will require more data than an image sensor can provide. Sensor fusion, based on multiple types of sensor technologies, distributed around the vehicle, will become the “eyes” of the autonomous driver. This sensor data will need to be processed, typically by a single SoC in order to reduce latency and avoid synchronicity issues.

The use of artificial intelligence (AI) to perform the data synthesis will also be essential, with the core intelligence also running on the SoC, rather than the cloud. These requirements are exerting extreme pressure on SoC designers.

Autonomous driving will require the vehicles to be capable of perceiving their environment. This means using sensors to monitor the road, other road users and the car itself.

This “situational awareness” is essential to allow the vehicle to navigate safely, plan its ideal route and adapt its plans based on the prevailing and changeable conditions.

There are three main computational modalities that any autonomous system must use to achieve situational awareness: sensing, through image and signal processing; perceiving, using data analysis; and decision making, through the use of AI. All of these can only be executed through semiconductor technology and



embedded software, namely the SoC.

**SoCs for ADAS**

Today Level 3 autonomy is available in factory models, and OEMs are working on the SoCs needed to deliver Level 4. It is not clear if the innovation will come from chips designed by the incumbent chip suppliers or from new entrants. As the sensor modality changes from cameras and radar (Level 2) to lidar, radar and ultrasonic sensors (Level 3 and Level 4), the sensor fusion element will become more complex.

Lidar has many benefits, but is relatively expensive and while radar technology is more mature and more cost effective for mainstream models, there is speculation around whether it has the scope to become good enough to avoid having to wait for lidar to mature and become commercially competitive.

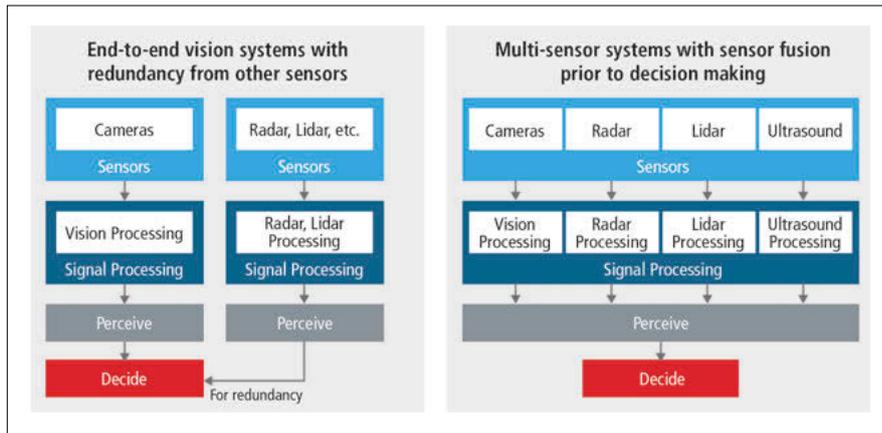
Together, these sensors can address the primary demands of autonomy: distance detection, traffic signal recognition, lane detection, segmentation and mapping.

No single sensor technology can provide all three, of course; only image sensors can “see” traffic signals, for example, while only radar is effective in rain or fog. With rapid advancements in radar technology, we may witness the deployment of next-generation imaging radar that can approach the capabilities of lidar at a fraction of the cost and reduce the amount of lidar needed in Level 3 and Level 4 autonomous vehicles.

There is some variation in the types of radar technologies currently being used today. Short-range radar works well for object detection when moving slowly in parking situations, medium-range for detecting other vehicles in adjacent lanes, and long-range for detecting vehicles and other objects moving at speed.

Employing multiple types of radar technologies puts greater emphasis on the need for sensor fusion, with the bulk of the data processing performed by a central processor. This means the SoC will need to process the data from the specific sensors when the sensing requirements change. The figure below shows some of the architectures now being implemented in SoCs for autonomous driving.

This move towards centralised sensor fusion means that an ADAS SoC will really be a network on a chip, following a heterogeneous SoC architecture based on a central communications highway that



connects functional blocks. These blocks will typically, but not exclusively, include image processing, radar, lidar, navigation and high-performance computing. Increasingly these will all be augmented using some form of AI.

The horsepower will be provided by a combination of DSPs - such as the Tensilica Vision, Fusion and ConnX processors - along with multicore CPUs and, more recently, dedicated neural network processors, such as the Tensilica DNA processor family for on-device AI. In order to feed these processing cores, high-speed interfaces will also be needed.

The SoCs being developed today use LPDDR4 at 4266Mbps speeds, but, to lower system power, designers are moving to LPDDR4X, which uses lower voltages but offers the same speed. Future designs will use

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LPDDR5 when the price is right, but DDR4/5 with GDDR6 will be used to meet the needs of AI acceleration.

MIPI is expected to remain the interface of choice for cameras, and there is some speculation about whether MIPI A-PHY will provide the interconnection for the many sensors needed.

To support the relatively long distances that the data must travel around a vehicle’s network, the use of GbE is expected to increase.

For storage needs, designers rely on standard flash interfaces, such as eMMC, SD and UFS. Of course, in order to be deployed in automotive applications, the underlying IP used needs to be compliant with AEC-Q100 and ISO 26262:2018.

**Conclusion**

As the electronic content of vehicles has increased, the semiconductor industry has responded, with integrated devices based on the most

Above: Examples of SoC architectures designed for autonomous driving applications

appropriate process.

Today, the demand for high-performance processing is influencing the industry to migrate from 28nm processes to achieve acceptable performance levels.

With the wider adoption of ADAS and the demands it brings, semiconductor manufacturers are now looking towards the very latest processes; 16nm, or even 7nm, processes are needed in order to enable the latest features.

There is now a clearer roadmap leading to Level 5 autonomy, even if that destination is still some way off. Using sensors to mimic a human driver comes with its challenges; AI is easing some of those challenges, but the underlying technology will still rely heavily on semiconductor technology that will need to work reliably for 10 or more years.

# Network testing in the 5G era

The stability and performance of networks involves vast amounts of data so operators are increasingly turning to AI for testing, as **Dr. Alexandros Andre Charaoui** explains

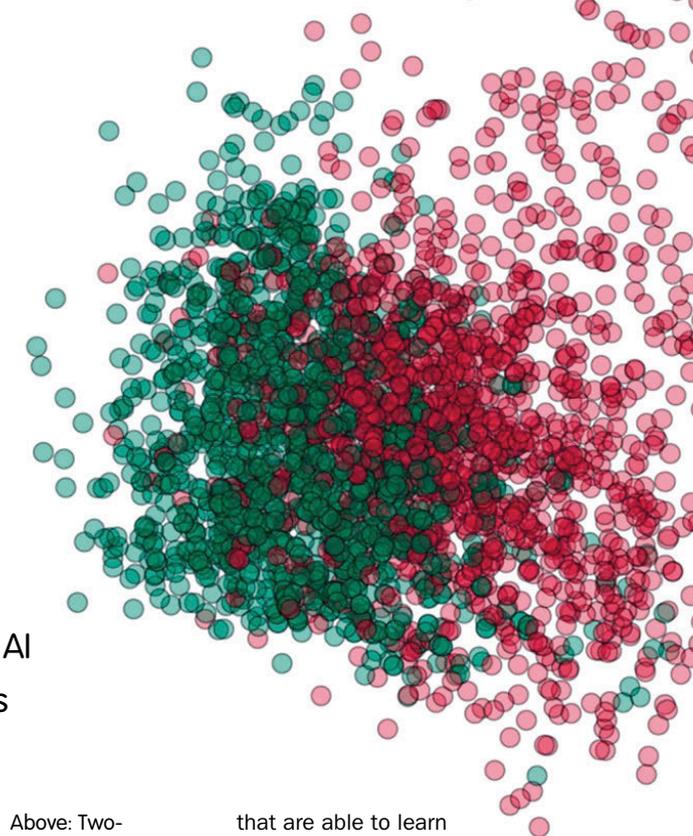
**M**obile network operators need to test the stability and performance of their networks in order to ensure good service, but because of the enormous amounts of data that's involved this is hardly possible with manual methods so, operators are turning to artificial intelligence to solve this challenge.

With the advent of the fifth generation of mobile communications, network testers are confronted with a novel situation. Many aspects of 5G – diverse frequency bands, network operators' different rollout programs, the breadth of applications such as IoT, conventional mobile communications, traffic networking, and so on – are leading to highly differentiated networks and test data.

Analysing this data in the usual aggregated form quickly leads to distorted results and incorrect interpretations. AI is able to offer a good solution to this dilemma. Algorithm based methods only reflect specific theories. These may not be ideal, but the data itself is reliable. AI methods, such as pattern recognition, are able to evaluate data sets without preconceptions and discover relationships that would remain hidden to human analysts.

## Big data needs AI

The term "artificial intelligence" has been bandied about a lot in recent years, often without a clear definition of what it means, and with no differentiation between systems



Above: Two-dimensional projection of multidimensional transmission conditions. Green dots represent successfully completed calls

that are able to learn (a characteristic of AI) and systems that are simply based on complex algorithms.

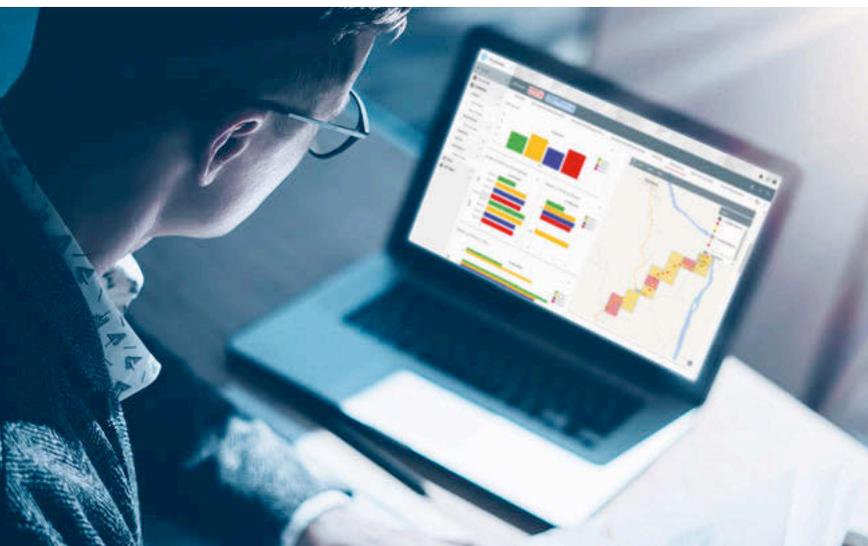
The term "machine learning" is a bit more specific. Here the goal is to automatically derive general rules from a large volume of data. After completion of the learning process, yes/no decisions can be made based on multidimensional dependencies or features.

The decision rules are learned by approximating between real data points rather than being formulated by human experts. This method requires very large data volumes and an intensive training phase. But in the application phase, it is able to correctly interpret new measurement data almost spontaneously.

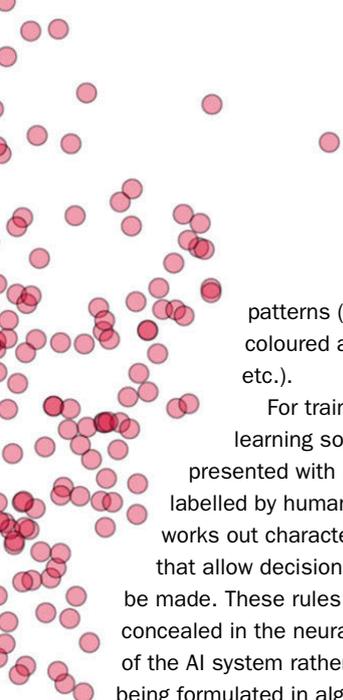
## Supervised and unsupervised learning

Machine learning can be roughly divided into two types: supervised and unsupervised.

The goal of supervised learning is to find statistical relationships between the data and events or predefined labels in order to generate estimations for unknown inputs. A widely used application is object recognition, in which the presence and position of a particular object in an image (e.g. "A cat is/is not present in the picture") is determined through multi-stage interpretation of



Left: R&S SmartAnalytics enables provider comparisons and network optimisations using AI-generated estimations



patterns (edges, coloured areas, etc.).

For training, the learning software is presented with images labelled by humans and works out characteristics that allow decisions to be made. These rules are concealed in the neural network of the AI system rather than being formulated in algorithms.

An example of non-visual pattern recognition is the determination of the call stability score (CSS) for network tests (described below).

Unsupervised learning works without labels. The algorithms have to independently recognise patterns or multidimensional data aggregates in order to derive usable conclusions from them, for example with the aim of measuring differences between new and known data points. A typical task for unsupervised learning is anomaly detection, which identifies unusual data without the support of experts.

**AI methods**

In response to the needs of network operators Rohde & Schwarz uses AI methods for applications such as simplifying the optimisation of mobile networks or improving the assessment of qualitative differences between providers.

The Data Intelligence Lab established in 2018 tackles these issues and supports Rohde & Schwarz R&D departments with data based analysis methods. These approaches are especially promising for testing mobile networks where particularly large amounts of data are generated, so that manual analysis and rule formulation are no longer practical. Machine learning makes it possible to use the information hidden in large data sets, for example to derive new assessment metrics. An example is the call stability score.

**Call stability score**

The call stability score is a new assessment metric for reliable communications. A suddenly dropped phone call is an annoying experience, so that is why mobile network operators have been testing voice quality and connection stability for many years.

The most popular statistic is the call drop rate (CDR). But since the number of dropped calls is very low in mature networks, it is necessary to make a large number of calls in order to obtain a statistically significant value. Consequently, drive test campaigns are long and expensive.

Therefore, Rohde & Schwarz uses a method to replace the binary call

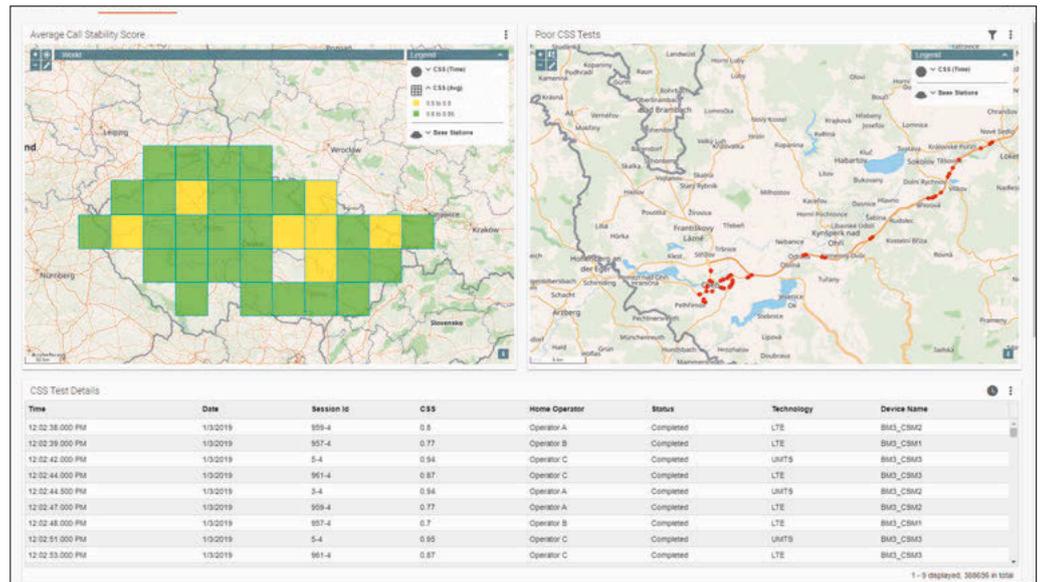
Below: Display of a network optimisation scenario using the R&S SmartAnalytics analysis software’s call stability score

In conventional CDR statistics, those unstable calls would be assessed positively as successful calls, distorting the network quality assessment.

The CSS value is based on information gathered from millions of test calls and incorporated in the model during the learning process. The assessment is conclusive right from the first call. The network call quality is registered more accurately and with less test effort.

In practice, every nine seconds of a call, measurement data is sent to the statistical model as a time series. The model assesses the data based on the learned rules and outputs a number between 0 and 1.

The higher the number is, so the



status (either successfully completed or dropped) by a finely graduated analogue value. This is done by creating a statistical AI-generated model that links the transmission conditions with the call status.

The CSS derived from the model allows the reliability of the mobile connection to be measured over the entire call duration and classified based on quality.

The diagnostic also includes unstable calls that were successfully completed but the data proves they were not far away from being dropped.

lower the likelihood of a drop occurring in that nine-second interval.

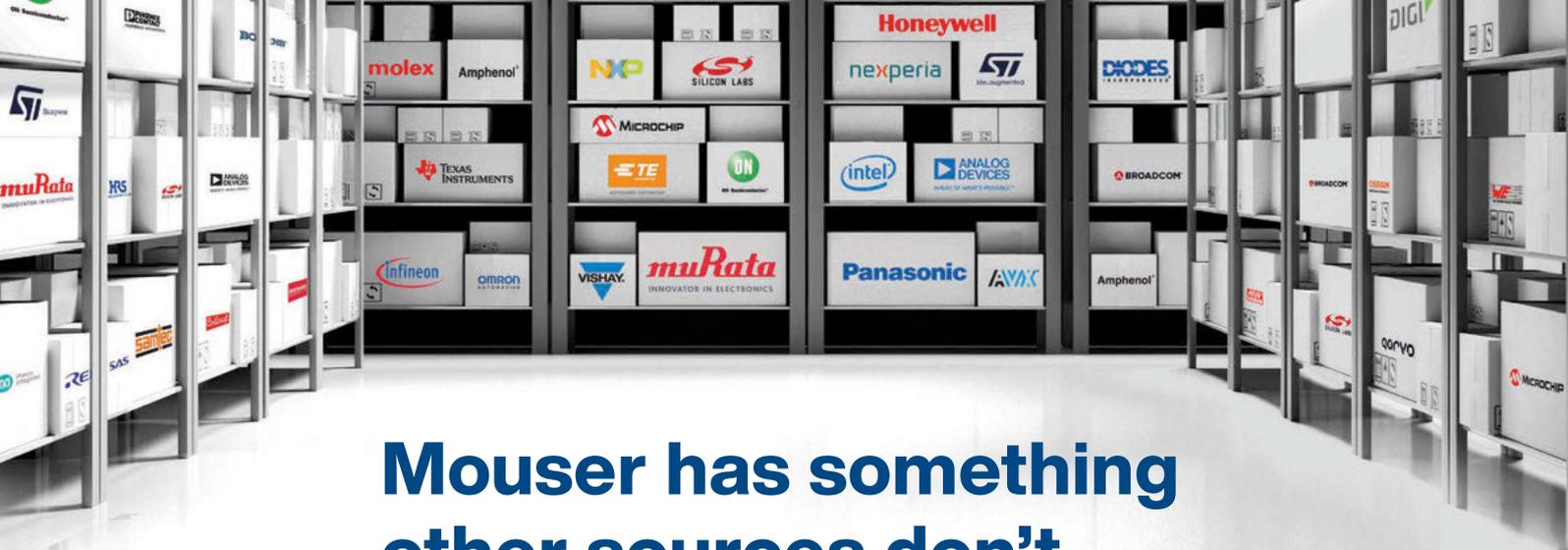
The CSS measurement is part of the R&S SmartAnalytics analysis platform.

Another AI-driven function in this software suite is anomaly detection using unsupervised learning. In both cases, the use of artificial intelligence leads to results that are not possible with conventional means.

AI methods will be used more and more in the future to maximize exploitation of the information content of measurement data.

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**D**C fans are called upon by engineers in many situations and applications to provide forced-air convection cooling. Thanks to their widespread use, they are relatively easy to understand and can be implemented in a variety of configurations.

Their operation is ultimately rooted in basic physics in which moving air is effective in cooling objects by absorbing heat and transferring that heat to be dissipated. How much energy is transferred is reliant on several factors: the mass of the moving air, the specific heat of the moving air, and the temperature change imparted to the moving air.

When it comes to selecting a fan with sufficient size and airflow specifications, an engineer must conduct basic thermal analysis to determine the minimum airflow required. This thermal analysis typically includes modelling of heat sources, temperature rise, and ambient conditions, while also ensuring an efficient airflow path for the forced air. CUI Devices has produced a blog, “Understanding Airflow Fundamentals for Proper DC Fan Selection”, which provides further details on thermal analysis and the selection process.

Once the thermal analysis is complete and the proper fan or fans are selected, an engineer could simply connect the fans to a power source and allow the fans to provide constant forced-air cooling.

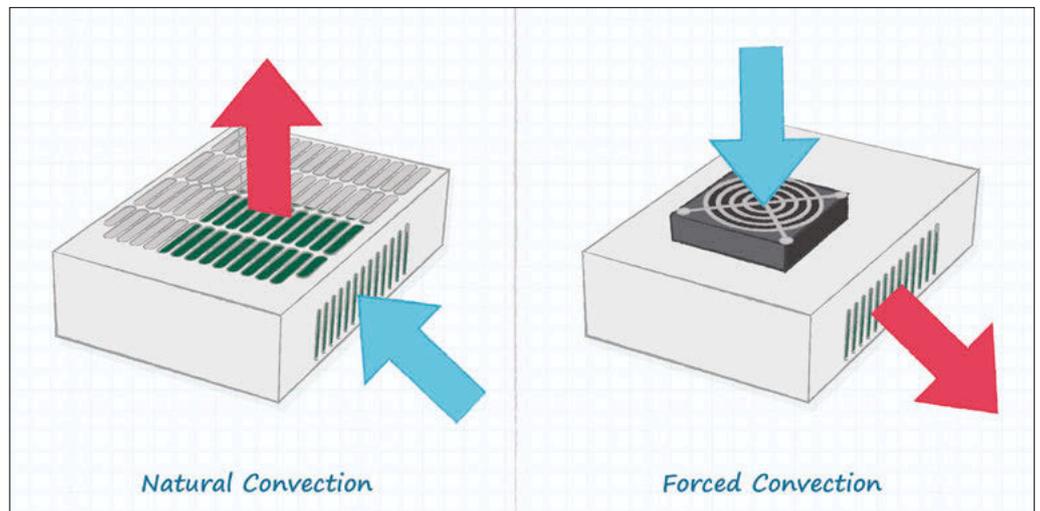
However, in most cases this approach is neither efficient nor effective long-term. Most fans today offer a range of options for better monitoring, control, and management. Understanding the options available can allow engineers to get the most out of their chosen fans and ensure better reliability of their overall system.

#### Basic On/Off fan control

As mentioned above, running a fan full time is a simple approach to thermal management that can

# COOLING SYSTEMS – MADE EASY!

**Jeff Smoot** looks at the monitoring, control and protection options available to engineers when it comes to DC fans



certainly provide the necessary forced-air cooling in an application. However, this simplistic approach is not energy efficient as a constantly running fan uses the greatest amount of power and causes audible noise not suitable for every scenario. Fans also contain various moving parts with long, but finite life cycles that will wear down quicker during continuous operation.

On/off fan control is one such approach that can extend fan life by cycling the fan on and off when a cooling threshold or temperature set-point is reached. Cycling the fan on and off saves power, can extend fan life, and reduces acoustic noise when the fan is not operating.

But on/off fan control is another method that is rather simplistic by nature and introduces its own set of limitations. From a thermal

Above: Natural convection vs forced-air convection

management standpoint, on/off fan control creates sequences of heating and cooling to the components being cooled. This thermal cycling can be a major factor in premature component failure because the differences in temperature-coefficients cause added stress on materials and joints. In fact, thermal cycling can be as detrimental, or worse for components than operation at constant high temperatures.

Thermal overshoot can also come into play during the time a fan begins operating and the time the forced air begins cooling. Unless the “fan on” set-point is set lower, overheating can occur while the cooling airflow catches up. Lastly, to limit on/off chattering around the set-point temperature hysteresis will need to be added.

The graph featured here was

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created to demonstrate thermal overshoot due to unavoidable thermal lag in on/off fan control applications. In the graph, the light blue line represents the desired set-point temperature and includes a step change, the green line is the on/off cycling of the fan, and the dark blue line is the actual temperature.

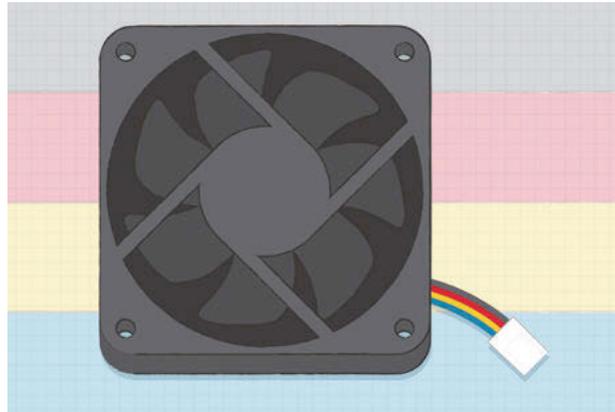
**Protections and controls**

Fans today are available with a range of controls and protections to help designers better optimise their thermal management systems. These controls can take the limitations of basic on/off control and improve upon performance, reliability, and efficiency. There are also protections available that detect fan problems early on, which can extend fan life and ensure systems are not put at risk.

To better understand some of the most common fan controls and protections as well as their implementations, see below:

**Pulse-Width Modulation (PWM)**

Pulse-width modulation (PWM) is used to control and change the fan speed based on varying thermal conditions. As the first step towards improved fan performance, PWM-based variable-speed control results



in better operating efficiency and can be implemented alongside advanced control algorithms. These advanced control algorithms can take into account usage patterns, energy costs, and more, while adapting to operational dynamics that match fan speed to thermal load.

This can be taken a step further by upgrading basic on/off fan control to the well-known proportional-integral-derivative (PI and PID) closed-loop control strategies. PI and PID controls help to avoid thermal undershoot or overshoot despite load changes by ensuring the airflow keeps conditions at the desired set-point temperature.

**Embedded Tachometer signal**

Sensing and reporting on a fan's

rotational speed via a pulsed signal, embedded tachometer is a control used for closed-loop feedback and more advanced fan control. Embedded tachometer also serves as a lock sensor if the fan seizes operation due to loss of power, obstructions, or any other reason. Having these detection capabilities is a major benefit to system operation, as the sooner negative conditions are detected, the quicker the system can be shut down or put in an inactive state to protect sensitive components.

**Auto-restart protection**

Auto-restart protection detects when the fan motor is prevented from rotating and automatically cuts the drive current. This protection serves to both protect fan-drive circuitry and indicate to the fan controller that there is a problem due to the drive current being cut-off.

**Rotation detection/lock sensor**

True to its name, rotation detection/lock sensor detects if a fan motor is operating or stopped in order to safeguard against problems at start-up or during operation.

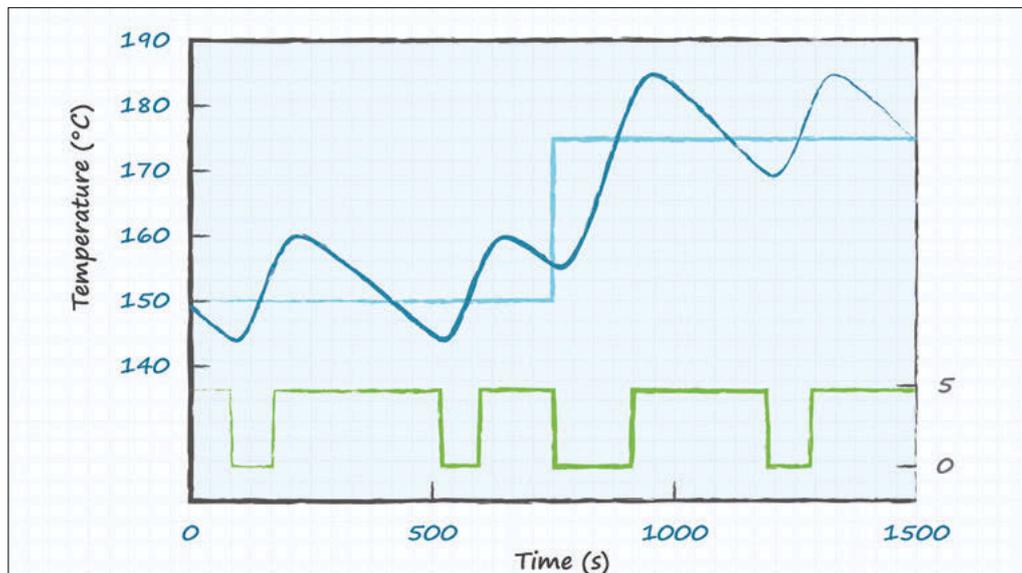
**Conclusion**

DC fans are a go-to solution in many thermal management systems, providing forced-air cooling to systems and keeping components within their operating limits.

However, simply selecting a fan and running it full time or using basic on/off control are short-sighted approaches to thermal management with fans.

With a host of fan controls and protections, engineers can better optimise their forced-air cooling solutions for greater efficiency and reliability and today the selection process of fans has been made easier with the availability of a broad range of DC axials fans and blowers with multiple sizes, airflow ratings and control options.

Below: Thermal overshoot and lag due to on/off fan



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