REALITY OR HYPE?
Blockchain has shown promise as a means of secure transactions in the crypto world. Can this technology translate to other use cases?
Quality You Can Count On

Original Manufacturer Components from 750+ Quality Name-Brand Manufacturers

FREE SHIPPING ON ORDERS OVER £50 OR $60 USD

0800 587 0991
DIGIKEY.CO.UK
COMMENT  5
Promising so much the smart home has yet to really take off. Perhaps, however, that’s about to change

NEWS
Research at the University of South Wales shows that integrated quantum chip operation is now possible  7

Microsoft suggests that organisations in the UK lack an AI strategy and are falling behind their competitors  8

World’s first TPM (Trusted Platform Module) for cybersecurity in the connected car  9

With the development of ADAS the automotive industry faces an array of complicated challenges, not least test  10

INTERVIEW  12
Piezoelectric haptics gets a boost
Boréas Technologies’ CEO, Simon Chaput talks to Neil Tyler about the company’s ultra-low-power haptic chip which delivers realistic feedback but without draining the battery

COVER  14
The blockchain buzz
Blockchain is the technology behind cryptocurrencies, but many are suggesting it offers a novel way to approach security. By Bethan Grylls

ANALOGUE DESIGN  18
Mixed signals for machine learning
Maybe AI-enabled systems are here to stay, but the cost of computation remains an issue. Could processing in the analogue domain provide a solution? Chris Edwards reports

BOARD TECHNOLOGY  20
Package deal
Why is system-on-package (SIP) becoming a more viable option for system design engineers? Chris Edwards talks to a number of leading suppliers working in this space

COMMUNICATIONS HARDWARE  22
Making 5G a reality
Much hype surrounds 5G and its impact, so how accurate are the claims that the commercialisation of 5G is imminent? Neil Tyler reports back from the 4G/5G Summit organised by Qualcomm

SECTOR FOCUS  24
The slow slog
While there’s plenty of excitement and money surrounding virtual and augmented reality, is the current cycle destined to crash and burn like so many others? By Bethan Grylls

EMBEDDED SOFTWARE  26
Coding standards
As the dependency on software within automotive development increases, so the importance of coding standards becomes more acute, as Richard Bellairs explains

MISSION STATEMENT
‘New Electronics keeps designers and managers abreast of the latest developments in the world’s fastest moving industry’
SAFE
RELIABLE
SECURE

TRUSTED SOFTWARE FOR EMBEDDED DEVICES

For more than 35 years the world’s leading companies have trusted Green Hills Software’s secure and reliable high performance software for safety and security critical applications.

From avionics and automotive, through telecoms and medical, to industrial and smart energy, Green Hills Software has been delivering proven and secure underpinning technology.

To find out how the world’s most secure and reliable operating systems and development software can take the risk out of your next project, call 01844 267 950 or visit www.ghs.com/s4e
The smart home space has promised to transform the way we live and is seen as a serious business opportunity for technology companies. But while there are a host of devices that are now available, from voice assistants to smart appliances, it’s still a market that is yet to really cross the starting line.

There are a number of reasons for this. Consumers are concerned with safety and security; they want devices that work flawlessly and that are interoperable – today interoperability tends to be limited to a device speaking to an app or to a hub device, such as the Amazon Echo; too many consumers don’t yet perceive the value of the connected home and, at the end of the day, too many devices on the market are just too expensive.

But things appear to be changing according to new research from IDC, which suggests that the global smart home market is set to grow by almost a third this year. It predicts that manufacturers will have sold over 640 million smart devices by the end of 2018.

As for the future it says that in four years, annual sales could reach as many as 1.3 billion devices with voice control driving that growth.

If those figures are accurate then that would mean that on average every sixth person, regardless of age, could own a smart home device.

Smart speakers such as the Amazon Echo or Google Home are the fastest-growing category and while the record of 100m devices was broken this year, forecasts indicate that as many as 230m smart speakers will be sold in four years.

Smart lighting, thermostats, door intercoms and security systems are also becoming increasingly popular.

The Amazon Echo, Google Assistant and ULE-based products are all seen as helping to drive growth and, perhaps, we are reaching a tipping point with manufacturers better navigating the challenges associated with the market. But challenges do remain.

Maybe we should stop talking about the smart home being simply about gadgets, and start talking about it as being something that’s embedded in a much wider, smarter community.

Neil Tyler, Editor (neil.tyler@markallengroup.com)
Looking for Display Solutions?

Established in 1996, Display Solutions provide the latest technical innovations in displays and embedded computing.

- Visit www.displaysolutions.co.uk
- Call +44 (0) 1480 411 600
- Email info@displaysolutions.co.uk

---

True Colour printing directly onto glass

AMT’s PhotoReal digital printing technology is a revolutionary breakthrough in touch panel technology. High-quality images can be printed directly on the front glass using low temperatures allowing glass panels less than 4mm.

Upload your drawings for an instant quote
Parts despatched in 24 hours
No tooling charges

Thermal Interface Materials (TIM’s)
Electrical Insulators
Tapes and Adhesives
Sealing Gaskets
Optical Diffusers/Reflectors
EMI Shielding

WWW.MATERIALSDIRECT247.COM

For more information on this and other displays go to:
www.review-displays.co.uk or call us on +44 (0)1959 563345
e: info@review-displays.co.uk
A quantum step

TESTS SHOW INTEGRATED QUANTUM CHIP OPERATIONS POSSIBLE. NEIL TYLER REPORTS

In order to develop quantum computers capable of solving complex problems like machine learning, millions of quantum bits or qubits – will be required, connected in an integrated way and designed to correct errors that inevitably occur in fragile quantum systems.

A research team, led by Scientia Professor Andrew Dzurak of the University of New South Wales in Sydney, has experimentally realised a crucial combination of these capabilities on a silicon chip, bringing the realisation of a universal quantum computer a step closer.

They have demonstrated an integrated silicon qubit platform that combines both single-spin addressability – the ability to ‘write’ information on a single spin qubit without disturbing its neighbours – and a qubit ‘read-out’ process that will be vital for quantum error correction.

The integrated design can be manufactured using well-established technology used in the existing computer industry.

Last year, the team published a design for a chip architecture that could allow quantum calculations to be performed using silicon CMOS (complementary metal-oxide-semiconductor) components.

In their new study, the team combine two quantum techniques for the first time, confirming the promise of their approach.

Previously, the team showed that an integrated silicon qubit platform can operate with single-spin addressability – the ability to rotate a single spin without disturbing its neighbours. They have now shown that they can combine this with a special type of quantum readout process known as Pauli spin blockade, a key requirement for quantum error correcting codes to be necessary for ensuring accuracy in large spin-based quantum computers. This new combination of qubit readout and control techniques is a central feature of their quantum chip design.

Addressing nanometer-scale verification challenges

Mentor, a Siemens business, is making available the Symphony Mixed-Signal Platform, which combines the Analog FastSPICE (AFS) circuit simulator with HDL simulators to provide fast and accurate verification of complex nanometer-scale mixed-signal integrated circuits (ICs).

Offering an intuitive use model and complete reusability of existing verification infrastructure, Symphony is able to deliver up to 5X productivity improvements in mixed-signal verification over traditional flows.

Systems on Chips (SoCs) have multiple high-performance, low-noise mixed-signal interfaces so require a versatile mixed-signal verification platform to verify connectivity, functionality and performance across mixed-signal circuitry on the chip. Mixed-signal simulation solutions must be fast, accurate, easy to use and seamlessly integrated into existing analogue and digital verification flows to meet time-to-market requirements.

According to Mentor, the Symphony Platform’s modular architecture leverages its AFS circuit simulator to provide exceptionally fast mixed-signal simulation performance with nanometer-scale SPICE accuracy and compatibility with all leading digital solvers, including Mentor’s Questa functional verification tool family.

Symphony allows users to remain in their existing use model and maximise the reuse of their existing verification infrastructure, including test benches, encrypted IP blocks, and digital/analog netlists.

“Customers require significant productivity improvements to their existing mixed-signal verification flows,” said Ravi Subramanian, general manager and VP of Mentor’s IC Verification Solutions. “With Symphony, they will have access to high-performance nanometer-scale, SPICE-accurate mixed-signal verification capabilities that will enable them to deliver better products quicker.”
Limited progress

In a conference call with analysts, Intel said that it was making some progress on improving 10nm yields, while reiterating its pledge to ship 10nm chips by the end of 2019.

Venkata (Murthy) Renduchintala, President of Intel’s Technology, Systems Architecture and Client Group, said that the yields were tracking roughly in line with what the company experienced at the 14nm node when it prepared to make that transition.

“We’re still very much reinforcing and reaffirming our previous guidance that we believe that we’ll have 10nm shipping by holiday of 2019,” said Renduchintala. “I feel more confident about that at this call than I did on the call a quarter ago. So we’re making good progress, and I think we’re making the quarter-on-quarter progress that’s consistent with prior generations having reset the progress curve.”

Intel has been struggling with yield issues at the 10-nm node, and in April announced that it was postponing the launch of any product until next year.

The announcement came as the company reported a very strong third quarter with sales of $19.2billion, up 19% on last year. The company reported a net income for the quarter of $6.4billion, up 42% from the third quarter of 2017.

While the company said that all segments were ahead this strong performance was driven by its data centre business segment which is growing at nearly twice the rate that Intel expected when the year began.

Its Data Center Group sales grew 26% for the quarter to top $6billion for the first time, reaching $6.1billion. Intel said that the strong sales were driven by demand from cloud and communications service providers.

UK organisations lack AI strategy

LACK OF AI STRATEGY, TRAINING AND EXPERIENCE HITTING UK ORGANISATIONS.

NEIL TYLER REPORTS

According to a report commissioned by Microsoft UK, organisations in the UK are at risk of falling behind overseas competition due to a lack of AI strategy.

The research reveals that in the face of significant disruption, 41 per cent of business leaders believe their current business model will cease to exist within the next 5 years. Despite big questions over the longevity of their business models, more than half of business leaders surveyed revealed they do not have an AI strategy in place to address these challenges.

The study, conducted in partnership with Goldsmiths, University of London and YouGov and based on a survey of more than 1,000 business leaders and 4,000 employees, found that companies that have started to use AI technologies are already outperforming organisations that have not by 5%, a substantial boost to the bottom line. These organisations were found to be more productive, have higher performance and experience better business outcomes.

The report ‘Maximising the AI opportunity’, highlights the country’s opportunity to lead the way in the development and use of AI, but only if organisations act now. It also urges business leaders to take a principled approach by establishing underlying values, ethics and commitments.

The research reveals that those organisations that have already adopted an ethical approach to the use of AI are outperforming those that aren’t by 9 per cent.

Contrary to popular belief, 59 per cent of UK employees surveyed are open to experimenting with AI to do new things at work. But a lack of strategy and direction from leaders is fuelling fear. Less than half trust their organisations to use AI responsibly and only 26 per cent say their organisation has a culture of transparency between leaders and employees. Meanwhile, 41 per cent believe AI will see older generations of workers get left behind over the next 5 years.

Contributing to this fear is the fact that organisations are not helping employees to prepare for the future. Less than half of UK leaders believe it is worth re-training their current workforce, and almost a third are unsure about how to start doing so. As a result, just 18 per cent of UK employees surveyed say they are actively learning new skills to help them keep up with future changes to their job as a result of AI.
A crucial step

WORLD’S FIRST TPM FOR CYBERSECURITY IN THE CONNECTED CAR. BETHAN GRYLLS REPORTS

Infineon Technologies says it is enabling a crucial step toward greater cybersecurity in the connected car, as the world’s first semiconductor manufacturer to put a Trusted Platform Module (TPM) specifically for automotive applications on the market.

The OPTIGA TPM 2.0 is designed to protect communication between the car manufacturer and the vehicle which increasingly turns into a computer on wheels.

Mobility of the future requires the exchange of huge volumes of data. Cars send real-time traffic information to the cloud or receive updates from the manufacturer “over the air”, for example to update software quickly and in a cost-effective manner. The senders and recipients of that data, whether car makers or individual components in the car, require cryptographic security keys to authenticate themselves.

By using TPM, Infineon says car manufacturers can incorporate sensitive security keys for assigning access rights, authentication and data encryption in the car in a protected way. The TPM can also be updated so that the level of security can be kept up to date throughout the vehicle’s service life. The critical keys are particularly protected against logical and physical attacks in the OPTIGA TPM as if they were in a safe.

Furthermore, incorporating the first or initial key into the vehicle is a particularly sensitive moment for car makers. When the TPM is used, this step can be carried out in Infineon’s certified production environment. After that, the keys are protected against unauthorised access; there is no need for further special security precautions throughout the various stages of the – often globally distributed – value chain.

The TPM likewise generates, stores and administers further security keys for communication within the vehicle. And it is also used to detect faulty or manipulated software and components in the vehicle and initiate troubleshooting by the manufacturer in such a case.

Encouraging autonomous car production

Almotive, a provider of full stack, vision-first self-driving technology, has released aiWare3, the company’s 3rd generation, scalable, low-power, hardware Neural Network (NN) acceleration core.

Designed to address the requirements of automotive embedded solutions, aiWare3’s patented IP core delivers both scalability and flexibility. By delivering new levels of performance in both central processing and sensor fusion units, aiWare3 enables automotive OEMs and Tier One suppliers to achieve L3 autonomy in production in much shorter timescales.

Scalable, the aiWare3 architecture facilitates low-power continuous operation for autonomous vehicles (AVs) with up to 12 or more high-resolution cameras, LiDARs and/or radar. aiWare3 delivers up to 50 TMACs (> 100 TOPS) per chip at more than 2 TMACs (4 TOPS) per W1.

This makes it optimal for real-time, embedded inference engines with strict power, thermal and real-time constraints and for processing-intensive NN tasks, such as low-latency, high frame rate segmentation, perception, and classification.

aiWare3’s highly configurable and scalable architecture enables OEMs to implement a variety of NN acceleration strategies in their hardware platforms. These can range from centralised NN resources shared among multiple workloads as part of a powerful central processing unit, to pre-processing integrated into each sensor or groups of sensors.

BBC micro:bit milestone

The Micro:bit Educational Foundation has announced the manufacture and distribution of the 2 millionth BBC micro:bit.

The Foundation has taken the BBC micro:bit global and the device is now available in over 50 countries - there are national projects in Canada, Croatia, Denmark, Hong Kong, Iceland, Uruguay and Singapore under way.

The BBC micro:bit is a pocket-sized codeable computer that has been developed to help young people get creative with technology, whatever their level of experience. Launched by BBC Learning in 2016 as part of the corporation’s, Make it Digital initiative, it is intended to help develop a new generation of digital developers and up to one million micro:bits have been delivered for free to every year 7 student in England and Wales, year 8 student in Northern Ireland and S1 student in Scotland.

The micro:bit was inspired by the BBC Micro and its impact on home and school computing in the early 1980’s of which only 1.5 million were produced. The BBC Micro was a UK-focused initiative but, through the Foundation, the BBC micro:bit is now available internationally with a range of projects helping youngsters get creative with technology.
Testing times

WITH THE ADVENT OF AUTONOMOUS VEHICLES THE TESTING ENVIRONMENT IS HAVING TO CHANGE. NEIL TYLER REPORTS

With autonomous driving expected to revolutionise the driving experience, Advanced Driver Assistance Systems (ADAS), and the convergence of sensors, processors, and software, means that the automotive industry faces an array of complicated challenges when it comes to the design and testing of vehicles.

Sensor fusion - the combining of measurement data from many sensors to drive outcomes - will be necessary, and will require synchronisation, high-power processing and the continued evolution of the sensors themselves.

Next year the Audi A8 will be the world’s first production car to offer Level 3 autonomy - equipped with six cameras, five radar devices, one lidar device, and 12 ultrasonic sensors.

Ultimately, the goal of processing sensor data is to create a fail-safe representation of the environment surrounding the car in a way that can be fed into decision-making algorithms and that can keep costs down.

ADAS processing capabilities are based on multiple isolated control units; however, sensor fusion is driving demand, among some manufacturers, for a singular centralised processor. But that can be costly and require vast amounts of processing, as a result, other manufacturers are looking at a more distributed architectural design.

Among the most significant challenges for manufacturers is choosing the right software, and testing it against an infinite number of real-world scenarios.

“All of which means a software-defined tester will be critical. Flexibility through software will be the key.

“Increasing the efficiency in software development will be integral to the autonomous driving revolution,” says Phillips.

“To be frank, a lot is changing in the testing environment. One of the biggest challenges with ADAS is that the actual test environment has got to be able to handle a much wider array of challenges. In the past we focused on a vehicle’s physical characteristics, today we need to consider electronic measurement and the role of the software in running ECUs.”

Software testing involves a very different testing methodology, according to Phillips. “When we talk about autonomous vehicles much of the software that will run on the ECU will have been written by neural networks or other non-human systems – so the tracking of changes back to source code is more difficult, as is validating the software as it’s always updating.

“Today, we talk more about predictive rather than deterministic testing. In the past, test was based on a simple ‘yes’ or ‘no’ response. ADAS is not deterministic and there’s not always going to be a clear answer, much of what we will have to do will be based on interpretation.

“As a result we’ll need more software engineers, but also full blown software architects.”

While some manufacturers favour consolidating ECU functionalities with the focus on sensor fusion, infotainment and those functions requiring less data – such as steering, air conditioning etc., others prefer a more distributed architecture.

“Consolidation of the ECU can be costly and will require immense processing capabilities. There’s also a greater risk that with fewer ECUs the vehicle could be more vulnerable to hacking and security breaches.

“There are also concerns that the distributed nature of production means that there is global accessibility to data, which could leave systems vulnerable.”

One of the big issues confronting the industry is a lack of standards.

“Car companies are going in different directions,” says Phillips. “With different sensors being used, decisions are likely to vary from device to device. But I believe that when it comes to probabilistic testing we are reaching an inflection point. There will need to be mandates and agreements at Government level.”

When it comes to test, car manufacturers are engaging with companies like National Instruments very differently.

“They no longer simply go out and buy a tester, they engage with us to design their own tester platforms that they can own and develop. That’s a massive change. They are making their own decisions and looking to the likes of NI to provide solutions.

“In truth, everybody knows the general direction, but most don’t now the address. Too many are still scrambling around and there remains a lot of unknowns for engineers to address.”
Arm Based Embedded Modules

Product families with expandable boards. Linux or Windows operating systems. Long term availability with excellent support for both hardware and software.

Product families:
- armStone: PicoTX SBC Cortex A5/A9, LVDS TFT, WLAN/BT
- Efus: System on Module Small form factor – 47 x 62mm Cortex A9, camera, PCIe, SATA, WLAN/BT
- PicoCOM: Small size SOM Cortex A5/M4, Single robust connector
- PicoCore – 35 x 40mm SOM Cortex A7, A53, MIV, WLAN/BT MIPI-DSI
- Starter kits for all modules for speedy development.

www.mansky.co.uk
Last month the Canadian company, Boréas Technologies, unveiled an ultra-low-power haptic technology that combined high-definition haptic feedback with low-power, making it suitable for wearables and other battery-powered consumer devices.

Simon Chaput, the company founder and CEO, set up the business after pursuing his Ph.D. at Harvard University where he invented a new technology to enable the use of piezoelectric actuators while using a very small amount of energy.

Chaput has not only managed to attract a very experienced team but has also successfully raised funding to commercialise the technology.

“The BOS1901 has been under evaluation with a group of customers and is now ready to meet the needs of a market in which consumers want realistic touch interfaces but in a way that doesn’t drain the device’s battery,” he explains.

“This is our first product and it has been under development for 18 months, since our first funding round back in March 2017. Over 1000 ICs have been distributed for evaluation and we have been working with a long list of customers.

“The key challenge for device designers is balancing the performance requirements with the hefty power demands associated with haptic technologies,” Chaput explains.

“The BOS1901 is capable of delivering 10X power savings over its nearest piezoelectric competitor,” according to Chaput, “as well as providing 4X to 20X power savings over other incumbent technologies.”

He does concede that those dramatic improvements are somewhat dependent on conditions, but they are considerable, nonetheless.

“These are certainly dramatic power savings and when combined with the BOS1901’s tiny footprint, we believe that it will help to open up HD haptic feedback to even the smallest battery-powered electronics.” Chaput continues, “If we’re going to see the use of HD haptic feedback spread across a much wider range of devices, we need to not only reduce the hardware footprint but also the power consumption as we look to increase both responsiveness and precision.”

According to Chaput, “The BOS1901 will be the lowest power piezoelectric driver IC for high definition (HD) haptic feedback currently on the market.”

Boréas Technologies’ solution is based on piezoelectric ceramic units but it is not the only solution to have emerged in this space. Other technologies include shape memory alloys that use carefully controlled, miniature nitinol wires; layered electroactive polymer films that can be integrated onto the surface of devices to provide completely localised haptic feedback and electromagnetic actuators, that are able to offer customised and varied sensations.

One of the key problems with actuators is that they need a high driving voltage – in the region of 50-200 volts – which can give rise to issues with efficiency or distortion. These problems can then lead to poor power consumption, noise and other challenges.

“Those issues have meant that actuators haven’t been able to penetrate the larger main-stream markets in haptics,” says Chaput. “Our device, however, has been designed to operate in the 3-5.5 V range, and that’s been achieved by building this device from the ground up. As a result, we’ve delivered efficiency and a piezoelectric actuator with very low distortion.”

Boreas’ CapDrive technology platform is a proprietary scalable piezoelectric driver architecture on which its haptic driver ICs are based. It not only provides greater energy efficiency, but both low heat dissipation and rapid response times.

“We’re addressing the needs of the haptics market which in the past few years has started to see real growth,” Chaput suggests. “It’s certainly a sizeable and growing market.

According to BCC Research, the global haptic actuator and driver IC market could be worth upwards of $26billion by 2022 and Boréas is looking to tap the fastest-growing segment for haptic interface technologies.

Its piezoelectric haptic components are expected to outpace legacy architectures, such as eccentric rotating mass (ERM) motors and linear resonant actuators (LRAs), which have tended to be limited by higher power consumption, large size, and slower response times.

Unlike ERM and LRAs, piezoelectric haptic components can be
used for both output (haptic) and input (e.g., button) in a system, helping to reduce the complexity, size and cost of interactive devices.

While the market for haptics has been somewhat ‘moribund’ over the past few years, there does seem to be growing interest in the technology and a growing number of new players have entered the market, from large OEMs to a host of new start-ups – Boreas being one of them.

While at Harvard University, Chaput worked closely with Gu-Yeon, a professor of electrical engineering and computer science, and his work with actuators, and the establishment of the company, came in response to research he’d been conducting in developing ultra-thin and efficient piezoelectric fans for cooling electronic devices.

“It was when we were looking to commercialise the product, that we then recognised the potential for disruption in the haptics space,” Chaput explains.

Having now gained validation from various partners, Boréas Technologies is now making available development kits for testing, so allowing a wider community to join their alpha test group in experimenting with this technology.

The opportunities for HD haptic feedback are “diverse”, according to Chaput.

He points to the use of the technology in consumer goods and in VR/AR gaming, where it will be able to add to audio and video, offering “realistic sensations, for users.”

The next step is likely to involve the development of virtual buttons or virtual keyboards. Used on a large display, in a vehicle for example, a driver would be able to feel their way over their screen.

“For Boreas Technologies, replacing mechanical buttons is the next logical step going forward,” Chaput concludes.
Since its introduction, blockchain technology has created a tremendous buzz, offering a secure exchange of value without any need for a central authority such as a bank, government or a financial institution. As such, some consider it as an essential tool for building trust online and expect it to serve as a stable foundation for a fair, secure, and inclusive digital economy.

Consequently, blockchain has captured the attention of many, with Governments, enterprises, academic institutions, and the ever-growing blockchain community in talks on what this innovative technology can offer to society.

In fact, Europe has taken active measures to support the innovation of platforms and applications in the form of number of initiatives, such as the European Union Blockchain Observatory and Forum.

According to market research published by ReportBuyer, the global blockchain business is anticipated to be worth $7 billion by 2022, and judging from the investments being made by tech giants such as IBM and Facebook, this could well be an accurate prediction.

But despite being a ‘hot topic’, blockchain is yet to be widely implemented in anything other than for the purpose of cryptocurrency.

**What is blockchain?**

Initially created for bitcoin – a type of cryptocurrency – blockchain acts as a trusted way to record transactions of a crypto asset. In other words, it acts like a traditional financial ledger, but instead stores information in digital blocks which are connected by a continuous chain.

Every transaction is a block, which is then added to this chain, explains Chakib Bouda, CTO, Rambus. The blocks store data on a public key and keeps track of who owns what, i.e. person ‘X’ has 0.1 bitcoin and person ‘Y’ has 2.5 bitcoin.

“Let’s say that I wanted to transfer 1 bitcoin to person X,” says Bouda. “When I request to put something on or take something off the blockchain, I’m given a private key, which I’ll need to use to sign the new block.”

The blockchain is decentralised and distributed across a large, public network of computers that act as nodes, with an ecosystem of ‘miners’ around it.

“A new block goes to all of the miners, who will ‘fight’ to validate it,” he explains, a process known as ‘proof-of-work’. This validation comes in the form of a mathematical equation, which increases in difficulty each time a bitcoin is ‘mined’.

“Whoever ‘wins’ gets rewarded with bitcoin,” continues Bouda, “and my block would then be added to the chain, with the information that my 1 bitcoin now belongs to person X. This updated ledger is then sent to everyone in the network.”

Bouda compares the mining process to an in-store transaction. The card machine sends information to the bank, which validates it. But, the bank is centralised, meaning there’s only one point of entry for those trying to access funds. In the blockchain environment, the
miners act as the bank, but there’s millions of them, based in scattered geographies.

This proof-of-work system means that each block can be trusted as ‘the digital truth’ because the ledger is immutable. For this reason, a lot of companies see blockchain as a potential tool for tracking the lifecycle of a product or for storing data such as housing ownership.

If someone did manage to tamper with the data, it would be obvious. “Each block contains a hash that matches it to the previous block,” says Damon Neale, Cloud storage expert. Created with an algorithm, the hash turns numbers and letters into an encrypted output. “If someone hacked a block, the hash would be altered and it would be obvious they’d tried to access it. This means a hacker would need to attack the entire chain, but that’s pretty much impossible because the system is decentralised, with every user having a copy of the chain. This means a hacked chain could be compared to a previous copy, and again, it would be obvious a breach had been attempted.

“The only way to truly hack the chain is to hack every machine – a number in the thousands – and because it’s a distributed system, a hacker wouldn’t know where all these machines were based. Moreover, in the time you’re hacking, new blocks can be added.

“It’s not impossible,” he admits, “but it’s very hard. Whereas with a bank, if a hacker got past the security, the assets are all in one central point.”

A different approach
Although many regard the proof-of-work as one of the defining features of the blockchain, interestingly, Doug Wick, VP, Products and Marketing at data security company, ALTR, believes this quality should be associated with the crypto world solely. “Blockchain is a particular way to structure and save data so as to give it high integrity and security.

“To me, the proof-of-work system is how a public blockchain works,” Wick suggests. He explains that ALTR has taken a different approach, creating individual businesses a private and permissioned blockchain instead. “In this case you don’t need to carry out a proof-of-work because you know that all of the nodes can be trusted, where they’re operated from, and who’s running them.”

Companies are, however, working on different ways to validate. The reason being is because the current proof-of-work method requires an extremely powerful computing system and it takes a long time for transactions to be added to the network. It has been argued that such a solution is not practical for other applications because it’s not scalable and when data is required, it’s needed in real time.

To create a secure data storage system, ALTR has made some significant changes from the traditional blockchain. This includes schema-less blocks, meaning that information such as documents, images, and videos can be stored. The company has also made the blockchain itself centralised, so there is no public access. “Hospitals wouldn’t want patient information shared publically,” Wick reasons. “What is decentralised is the data structure. Our technology is built in such a way that we can deploy nodes anywhere, but still privately. For example, a company might have some data stored in Amazon Web Services, some in Microsoft Azure, and some in its own data centre. It’s fragmented, so that no node contains the complete data, but each has a reference to the previous piece, meaning that ALTR can reassemble it when required.”

ALTR treats the blockchain like a RAID array, a technology that works with an array of separated hard drives that are controlled centrally. These work by replicating data across all of the hard drives, so if one goes down, the others still have access. RAID arrays also enable simultaneous writing to different harddrives, allowing for better performance. “We have built our technology around this concept,” says Wick, “giving the ability to read and write rapidly out of the blockchain.”

When an application wants data it ‘asks’ the smart database driver, a technology used in every database system. ALTR connects into existing computing networks through this driver, and has designed a technology that enables its blockchain to sit between this driver and the application. According to Wick, this means ALTR can monitor data activity. “Using the blockchain, we create an immutable data log that represents the digital truth. We can also govern access, so if a certain group requires access we can attribute rules to the block, such as viewing limitations. If someone tries to obtain an abnormally large amount of data, it would be flagged up and we can stop or slow that breach down in real time.”

Beyond cryptocurrency
Both Wick and Bouda agree that there are many applications that would
benefit from blockchain technology. One notable use case has recently emerged, with Infineon and XAIN agreeing to bring blockchain to the car.

According to the duo, feasible applications for this technology include automated payments, keyless access for car sharing schemes, on-demand services, tuning protection and automated driving functions. Essentially, it is all about the granting of access rights – to the car itself or to specific data in the vehicle. An example involving specific data is when insurance companies offer low rates for car owners with good driving habits.

All of Infineon’s 2nd generation AURIX microcontrollers (MCUs) can provide support for blockchain functionality in cars already. This support is based on an embedded hardware security module (HSM) that complies with the EVITA security standard. An HSM consists of special computing and storage units within the MCU. It performs the cryptographic operations and is protected by a dedicated firewall of its own. The 2nd generation AURIX MCUs thus have a secured memory for the digital key used for identification in the blockchain and are able to perform blockchain operations, such as hashing or digital signing, swiftly and securely.

However, the creation of new data blocks still represents a challenge for the conventional MCUs used in cars. Due to the amount of required computing power, the mining process has up till now been executed by high-performance processors. XAIN, however, is working on a new process that can also be performed on devices that need to be economical in their use of energy – such as MCUs in cars.

**What’s next?**

As for the future of blockchain, Bouda sees decentralisation as the way forward. “There is ‘talk’ of a decentralised Internet,” he says, pointing to data misuse from Internet based companies as a key driver for this development. "It sounds impossible, but I do see it as a potential. Not everything will be decentralised, but user content could certainly be – and this would place the power back with the people. Organisations earn millions selling data to ad companies, but with this a system like this, they’d have to start asking permission to access our data.

“Data centres won’t become redundant,” he ventures, “but instead of being central, they’ll be spread across points. Big players like Amazon and Google would become part of the network. I can’t imagine the idea is appealing to them, but there’s a mentality of ‘if you can’t beat them, join them’.”

“Everyone is very excited about blockchain, but no one has really adopted it,” adds Neale, “and that’s due to a lack of understanding of the benefits. When companies do deploy it, it’s being used as a less distributed, more centralised blockchain, which kind of defeats the point because there are fewer nodes to hack to compromise data. One could argue it’s just an overly complicated database. There’s a lot of potential, but for now, I’m not seeing it being used for anything but cryptocurrency.”

Bouda admits that blockchain isn’t as scalable as industry would like it to be, but compares it to the beginnings of the Internet. “That was slow – and this too, will take time.”

Wick believes that blockchain’s sluggish uptake may be due to the association of bitcoin. “This was a global phenomena and when companies look to utilise blockchain, they think really big. But this technology is still so new and extremely complex, so what we need companies to do is start solving the little problems and get people used to the technology.”

Wick says ALTR has taken this approach, solving a smaller problem: digital trust inside individual companies. From there, he believes trust can be built with the public in the blockchain. “Let’s say we have a group of banks using our technology, from there we can introduce a consortium-based blockchain where the banks can use a shared chain for transactions or to record activity with one another. Because they trusted it inside their own company, they have now developed trust to use it within the industry. Industry needs to build up and up, and then we’ll slowly start to see, for example, blockchains that are shared by nations or an entire supply chain.”

Above: Rambus has launched Vaultify Trade that enables secure storage and transfer of digital assets using proven, bank-grade, field-deployed tokenisation and encryption technology.
Mixed signals for machine learning

Maybe AI-enabled systems are here to stay, but the cost of computation remains an issue. Could processing in the analogue domain provide a solution? By Chris Edwards

Multiple technological winters have stymied the development of machine learning. But now that smart speakers have invaded the home and Amazon has decided the time is ripe for a $60 microwave that can take orders from Alexa, maybe AI-enabled systems are finally here to stay.

The problem that continues to face embedded applications of AI is the cost of computation. Much of the work has to be performed using high-speed digital processors, often in the cloud because the battery will not sustain local processing. Developers are looking to methods to cut the energy bill. Processing in the analogue domain is one possibility.

If you look at the gate count of a high-speed multiplier, a fundamental building block for most AI algorithms used today, it is easy to believe a simple analogue equivalent would be more energy efficient.

At the SysML conference earlier this year, nVidia chief scientist Bill Dally talked of running SPICE simulations to work out whether analogue is a viable approach when it comes to performing machine learning. But he quickly saw problems emerge. One is the issue of matching analogue devices to the required level of accuracy though this is not the primary concern.

One big difference between computation for machine learning and conventional signal processing is that systems such as neural networks are highly tolerant of errors. This has led companies pursuing embedded machine learning, such as IBM, to look at techniques such as approximate computing. This may involve letting arithmetic units make mistakes as long as they are not significant. This could let circuits operate very close to their voltage limits, which will help to save power. If an operation does not complete in time because it is voltage starved, it does not matter much to the overall answer.

Another approach is simply limited precision.

Limited precision

Low-precision is a problem for training neural networks. But researchers have been surprised by how low the precision can go during the inferencing phase when the network is comparing real-world data to the model on which it was trained. The precision came down quickly from full double-precision floating point to 16bit and then to 8bit. This makes neural networks fit well on SIMD pipelines. But some proposals have gone further to binary and ternary resolution with little adverse effect on performance in some applications.

Low-quality analogue should have little difficulty keeping up with those levels of accuracy and, in principle replace the high-speed multipliers with circuits that could be as simple as voltage-controlled amplifiers. But Dally noticed that a comparison of the energy each operation needs at the same level of precision, digital works out better because it is quicker.

“If you look at things like the fact that these circuits are leaking over the 10 microseconds it takes to do the computation it’s actually way higher energy to do it in analogue if you take the leakage into account,” he argues. “Digital CMOS logic is amazingly efficient especially at very low precision. If I’m doing 2 or 3 bit operations the arithmetic is actually almost in the noise and then it’s leakage that dominates.”

Digital processing has the advantage of being able to cut leakage by turning unused elements off. This is much harder with analogue techniques. But analogue machine learning is not dead.

Although digital processing makes it easier to control leakage, there are many situations in system design where leakage is inevitable. So, you might as well take advantage of it. Researchers such as Boris Murmann of Stanford University have been focusing their effort on hybrid systems that use analogue where it does turn out to be more efficient. One area is preprocessing.

Preprocessing

Security cameras and smart speakers are systems that need to maintain a low level of activity almost constantly simply to work out whether something important is happening nearby.
“It makes sense to have a wakeup algorithm. For it, you may sacrifice programmability for extreme energy efficiency. If I only want to wake up when I see a face I don’t necessarily need a very sophisticated deep learning-based algorithm,” Murmann explained at a workshop on machine learning at the VLSI Circuit Symposium in Honolulu. “I’m not trying to do a humungous calculation. I’m just trying to work out what is in the field of view and decide: should I wake up my big brother?”

Processing in the analogue domain makes it possible to work at comparatively low resolution because it can support a high dynamic range. “When analogue people hear ‘dynamic range’ they know what to do,” Murmann says.

High dynamic range makes it easier to deal with images that may contain strong shadows that might otherwise disrupt object-recognition models. “With optimal exposure, I can reliably detect objects even with 2bit resolution,” Murmann says.

Real-time threshold adjustments coupled with logarithmic processing in the analogue domain makes it possible to reduce the effects of shadows massively.

“These analogue circuits are a bit tricky and require a lot of analysis,” Murmann says, but the team has sent test silicon to the fab. The result of using the front-end is a 20-fold reduction in the data that passes into the next stage compared with conventional sensor interfaces.

The next step is to work out where to put analogue circuitry in the machine-learning cores. MIT associate professor Vivienne Sze points out that the energy consumption of most AI algorithms is dominated by the shifting of data to and from memory. She says there is a threefold increase in memory transactions for even a relatively simple deep-learning system such as AlexNet compared to what was needed for traditional image-recognition algorithms such as histogram of oriented gradients (HOG). To overcome the high cost of off-chip accesses to main memory, digital implementations try to cache as much data as possible. This works reasonably well for the convolutional layers in deep neural networks. Fully connected layers are more troublesome for caching strategies but convolutional layers tend to dominate the processing in these systems.

For front-end processing, the amount of data that needs to be held for neuron weights and for the preprocessed source image is relatively small: it should fit into local memory, which reduces the power overhead. But with analogue processing, it is possible to go further.

Professor Naresh Shanbhag of the University of Illinois says: “With conventional digital design, the memory read is highly curated. That hurts energy efficiency.”

The group’s approach is to avoid needlessly converting the charge levels stored in SRAM into digital ones and zeros and simply process them directly in the analogue domain. “The computation wraps its arm around the bitcell array. We don’t touch the bitcell itself: everything we do stays on the periphery. The computational signal-to-noise ratio drops but we can take advantage of the error tolerance of machine-learning algorithms,” Shanbhag explains.

The first test devices used SRAM but Shanbhag says the team is working with memory maker Micron Technology to develop a flash-compatible version, which would reduce leakage energy for always-on systems. The regular nature of the design lends itself to the compilation and synthesis techniques used by SoC designers to generate on-chip memory arrays, he adds.

Murmann’s group has taken a similar approach, developing an architecture that looks like a memory turned inside-out. Data from the image is passed through a network of demultiplexers and into XNOR gates that act as analogue multipliers. These low-resolution multipliers process each input against a set of weights with the results forwarded to an analogue summing bus. The final stage is through a second mux network to the output memory.

Although analogue computation is not going to revolutionise machine learning for embedded systems, work on hybrid architectures could provide a way to bring AI to always-on devices.
Package deal

Why is system-in-package (SIP) becoming a more viable option for system design engineers? By Chris Edwards

The system-on-chip (SoC) is arguably the biggest misnomer of today’s electronics industry. The core integrated circuit may well have onboard much of the logic circuitry needed to support the needs of the final system. But to get that SoC to function, the manufacturer of the final system needs to surround it with a host of support components, from power management to passives.

Gene Frantz, chief technology officer at Octavo Systems, says: “If you look at the world of integrated circuits and the impact that Moores law has had, it has had the significant positive of driving cost down and performance up.”

To a limited extent, semiconductor suppliers could integrate power management, analogue, processing and memory as long as the combined device could justify the various compromises required. And many devices exist that make those trade-offs.

Steve Drebohl, vice president of microcontrollers and technology development at Microchip, points to parts in the company’s range that are primarily analogue but with an embedded 8bit microcontroller to perform control functions. In those devices, the emphasis is on the analogue capability, not the processing power or density. “There can be less than 15 per cent digital content on an 8bit microcontroller now. It’s more about the peripherals.”

As the requirements on the various parts of the system become tougher to meet, monolithic integration quickly begins to break down. PCB integration has provided the route to bringing together disparate devices together and continues to meet many designers’ needs, whether through custom design or off-the-shelf single-board computers (SBCs). But size and performance issues are now making the PCB option more difficult to handle, even for those with the ability to turn around custom layouts.

Tyson Tuttle, CEO of Silicon Labs, points to the many competing requirements of IoT devices. They need low-energy operation, access to wireless networks, enough memory to support regular updates and the processing power to perform local signal processing.

“As you integrate more into the SIP, you can take advantage of the fact that you don’t have to have a layout expert or a power-management expert. It makes it a whole lot easier to do your thing.”

Gene Frantz

Below: An exploded view of a System-in-Package example

“...and the RAM doesn’t necessarily go with the flash memory. And you need energy management that is more than just an LDO [low dropout regulator]. It’s got to be able to power different sections up and down quickly and retain state when powered down.”

In higher-end systems, issues arise with the requirements of...
advanced processors. The number of signal, power and ground pins needed to feed a dense die become difficult to handle without specialised production methods. Frantz says: “You can get so small with an integrated circuit that it’s no longer useful to put it on a PCB: the ball pitch is too tight.”

Another issue with multicore processors made on advanced semiconductor technologies is one of power management. These devices now call for multiple power rails that can adjust the voltage dynamically to the pipeline’s workload. The activity is now so tightly coupled to the processor design that Apple wound up buying the operation that makes the power-management integrated circuits (PMICs) for its own SoCs from supplier Dialog Semiconductor. But, because it is extremely difficult to put the equivalent of efficient PMICs onto the processor, they have to remain separate.

**System-in-package**

This is where the system-in-package (SIP) is becoming an increasingly viable option for system designers: as a packaged device that sits between a monolithic integrated circuit and a module assembled on the fibreglass substrate of a PCB.

“As you integrate more into the SIP, you can take advantage of the fact that you don’t have to have a layout expert or a power-management expert. It makes it a whole lot easier to do your thing,” Frantz argues. He points to the SIPs Octavo has put together that bring together multicore processors, memory and I/O and which, if they were assembled on a regular PCB, would demand a relatively sophisticated stack-up.

“With the SIP, if you are clever with your board layout, do it with four instead of six layers and have no components on the back side.”

A number of suppliers are building SIPs into their portfolio of off-the-shelf modules, often sitting alongside regular PCB-based designs. Among others, Microchip and Silicon Labs have introduced SIP-based variants into their families of modules. “We are steadily offering more SIP products,” says Drebohl.

Tuttle adds: “Microcontroller plus wireless is where we see a lot of volume coming in. When you integrate the wireless into the microcontroller [package] you get not just a BOM saving but also benefits in terms of lower power if you do this well.”

In the near term, processor-based SIP suppliers aim to offer a variety of readymade parts. They can take advantage of the lower cost of customisation by mixing and matching parts inside the package. This is viable for runs of tens or hundreds of thousands compared to the millions often needed to justify producing variants of parts based on monolithic integration with advanced processes. In the long term, Frantz believes that it is possible to change working practices to get to the point where customers can order one-offs without it incurring a premium in terms of manufacturing cost.

**Unusual starting point**

Octavo is attempting to carve out a niche from an unusual starting point. It does not make its own silicon, although Frantz and others in the company are alumni of chipmaker Texas Instruments. Octavo’s work involves convincing the outsourced semiconductor assembly and test providers (OSATs) to work with devices from a variety of manufacturers rather than working with an existing chipmaker. It can be difficult for third parties to get the required test data needed to take bare chips and place them on the extremely finely tolerated substrates used for SIP.

One approach might be to work closely with a primary supplier but it’s almost impossible to find a single semiconductor vendor who can provide everything. “There are a couple of companies that come close and Texas Instruments happens to be one of them. But we’ve got to go to a separate vendor for memory,” Frantz says.

The answer does not lie in new technology, Frantz argues. “We have to work this a different way. Not change the process but change the management of those processes.”

Within a SIP, the individual chips are carefully aligned and bonded on a silicon or high-quality substrate using much smaller solder bumps than those needed for the bottom of the package. The electrical environment can be very tightly controlled, which reduces the need for the full testing that conventional packaged chips go through. Frantz says when Octavo started putting together SIPs the first wafer the company obtained did not have a map detailing the positions of good and bad die. Only post-packaged tests would reveal them. “But there were no failures,” Frantz claims.

“The tests run by a chip supplier need to cover operation over a wide range of voltage and frequencies that different customers will want to employ. With control over the PMIC and electrical environment, Octavo could operate all the devices well within their comfort zone. So, marginal devices that might fail because they could not guarantee operation across the full datasheet specification become usable in the more tightly constrained environment of the SIP.

Over time, Frantz expects suppliers like Octavo to gain more benefits from the techniques used by OSATs and the learning curve-driven nature of semiconductor processing. “Because of the high-volume nature of semiconductor lines, you can gain a lot of advantages in yield, testability and reliability for the final packaged device that you may not find on the lower-volume assembly lines. We believe we are going to get a lot of side benefits.”
Making 5G a reality

Much hype surrounds 5G, so how accurate are the claims that the commercialisation of 5G is imminent? By Neil Tyler

Last month saw over 2500 people from over 70 countries gather at a 4G/5G Summit organised in Hong Kong by Qualcomm. It was a chance for carriers, equipment providers, OEMs and software providers to come together to discuss how the industry was working to make 5G a reality and, despite accusations of hype, it appears that they are nearer to realising 5G than was previously the case – even just a few months ago.

Before the summer doubts had been expressed about the viability of rolling out 5G, but now the talk is of the commercial deployment of handsets next year.

So, is 2019 going to be the year when we’ll see the first 5G handsets? Some would argue that it’s a very aggressive time frame but for Qualcomm’s President, Christiano Amon, that’s certainly not the case.

He expects, “every Qualcomm Android partner with flagship Android phones to have 5G NR phones in 2019.”

Qualcomm’s business model is very much driven by delivering 5G so, perhaps, there is a need to be a little wary when it comes to their announcements, but there’s no denying that it is a key player when it comes to driving the roll-out of 5G.

Qualcomm partners with every leading Android handset manufacturer in the world, as well as working closely with leading carrier equipment manufacturers including: Ericsson, Huawei Technologies, Nokia and Samsung among many others.

Speaking at the Summit, Thomas Noren, VP, Head of 5G Commercialization at Ericsson said, “A year ago the situation regarding 5G was very different. Then people were asking whether they needed it, what it was and when it would be deployed. The acceleration we’ve seen over the past twelve months has been a fantastic achievement for the industry – the market is certainly gaining momentum.”

Critics suggest that there’s still much to do and 5G certainly isn’t a ‘done deal’, but there has certainly been a tremendous amount of work undertaken with regards to 5G and there are a growing number of trials taking place globally.

“5G is critical because without superior connectivity the promise of artificial intelligence of VR just won’t be realised,” Noren suggested.

While Release 15 is beginning to deploy, as with the other ‘G’s, there will have to be a lot of continuous work when it comes to the development of standards.

Beyond Release 15, Releases 16 and 17 will enable 5G NR for massive IoT, mission-critical services, and car to car communications (C-V2X) but while these standards evolve, companies will face further investment in time, people and resources.

5G development

Qualcomm has a critically important role in the development of 5G – looking around the 4G/5G Summit it was obvious how important a role it plays, and will play, in the development and deployment of 5G, as it hosted or organised hundreds of meetings.

But beyond that it has been responsible for a number of ‘firsts’. It has developed a mobile 5G NR commercial platform, including the first commercial modem, transceiver, and mobile reference design RF front
end for initial 5G launches. These “firsts” have enabled the eco-system that has built up around 5G to move more quickly.

The speed at which 5G and the technology being developed to support it is evolving, was demonstrated at the Summit where Qualcomm announced that it had extended its QTM052 mmWave antenna module family of fully-integrated 5G NR millimetre wave (mmWave) modules for smartphones and other mobile devices.

Compared with the first set of modules, which were only announced back in July, these new mmWave antenna modules are 25 percent smaller and engineered to enable mobile device manufacturers to address stringent mobile handset size requirements for 5G NR smartphones and mobile devices, which are expected to launch next year.

According to Qualcomm, the modules will provide OEMs with more options when it comes to the placement of antennas, offering more freedom and flexibility in their 5G mmWave designs.

Pairing the QTM052 mmWave antenna modules with Qualcomm’s Snapdragon X50 5G modem, they feature a phased antenna array design, integrating up to four modules in a smartphone form factor.

The modules are able to support advanced beam forming, beam steering, and beam tracking technologies, all of which help to improve the range and reliability of mmWave signals. The modules also include an integrated 5G NR radio transceiver, a power management IC, RF front-end components and a phased antenna array, and support up to 800 MHz of bandwidth in the 26.5-29.5 GHz (n257), 27.5-28.35 GHz (n261), and 37-40 GHz (n260) mmWave bands.

The amount of work involved in the development and roll-out of 5G was highlighted by the announcement that Qualcomm was working with Samsung to develop 5G small cells, which it’s hoped will open the door for massive 5G network speed, increased capacity, extended coverage and ultra-low latency.

Small cells are seen as a foundational building block for 5G and are intended to support delivery of uniform 5G experiences, especially indoors where most data tends to be consumed.

In order to address cost and form factor requirements for a wide range of 5G NR deployment scenarios, service providers, enterprises, factories and other stakeholders are expected to become increasingly dependent on 5G NR small cell solutions, and the suppliers that deliver them.

Mobile operators across the world including those in the United States, Japan and Korea are all expected to deploy small cells as a catalyst to support 5G-class experiences.

Small cells are expected to provide multi-gigabit throughputs and millisecond level latencies to improve the wireless experience, and support a variety of new and emerging applications, such as augmented and virtual reality.

In addition, 5G networks have the potential to create new opportunities, such as industrial automation and Automated Guided Vehicles (AGV), which rely on secure and high-speed wireless links.

By harnessing the 5G spectrum networks will be able to deliver multi-gigabit wireless speeds, making it ideal for fixed wireless access (FWA) applications, delivering “last-mile” broadband connectivity for homes, apartments and other venues in regions which have proved difficult to serve using traditional fibre or copper infrastructure.

Qualcomm’s FSM 100xx 10nm 5G Solution is said to be capable of enabling the Samsung 5G Small Cell solution to utilise both the sub-6GHz and mmWave spectrum, providing a next-generation wireless experience.

According to Qualcomm, the FSM100xx is expected to deliver MIMO baseband functionality that it claims will be unrivalled in the industry. Coupled with Samsung’s leading position in the development of 4G/5G infrastructure, Qualcomm said that it expected Samsung’s 5G small cell solution would provide mobile network operators with a much improved tool that would be capable of supporting both outdoor and indoor deployment scenarios.

As Amon said in his speech to the conference, “People may talk about the ‘hype’ that’s perceived to surround 5G but, as you can see from the ecosystem that it has thrown up, a lot of hard work is being undertaken to deliver 5G. By my reckoning over 560 companies are contributing to this technology and there have been over 100,000 technical contributions to the specifications that were completed at the end of 2017. “What we are seeing is the development of foundational technologies that will provide the scaling-up and flexibility that’s necessary to support use cases that will go way beyond mobile phones – there’s certainly a lot more to 5G than simply mobiles.”

According to Amon, “As new networks are deployed, so industries will be transformed. We’ve been through a number of significant milestones with this technology and the industry is moving very quickly towards 5G.

“A growing number of partners, working with Qualcomm, have announced deployments of 5G already and the commercial roll-out of 5G handsets is going to happen in 2019.”

So, if Amon is to be believed, it really is going to all happen next year. Reality or hype, the next twelve months could prove crucial to the future success of 5G.
Virtual reality (VR) and augmented reality (AR) are familiar terms, and can actually be dated back as early as the 1830s. Today, industry raves about their potential, so why is it that these technologies have still to deliver on the promises being made?

Over the last 30 years, we’ve seen 3 hype waves, promising that ‘this is the year for VR/AR’. But according to Bob Stone, Director, Human Interface Technologies Team at the University of Birmingham and Fellow of the Chartered Institute of Ergonomics and Human Factors: “Today’s market is just like the 1990s, littered with false promises. The difference? There’s just a bit more hope now.”

Talk of virtual shopping, education and gaming dominated the 90s, and significant investment into branches of VR were made as a result. “Unfortunately, the technology launched wasn’t fit for purpose,” Stone explained, “and a lot of money was squandered.”

The slow slog

Rebecca Gregory-Clarke, Head of Immersive at Digital Catapult, believes its slow evolution is owed to the previous limitations of the technology – noting it was “cumbersome and expensive”. As such, she explains it was restricted to academic research institutions and labs which could facilitate it both in terms of space and cost. But, with recent and significant progress made in displays and computing power, Gregory-Clarke believes new opportunities have arisen within this space.

Released earlier this year, standalone VR devices offer a virtual wireless experience, with all the components built into the headset. This is a step up from the tethered headsets and mobile VR previously introduced and, according to Gregory-Clarke, is one of the biggest leaps the technology has seen. “There’s a lot of research going into tracking – that is 6 degrees of freedom (6DoF) – and into new forms of gesture control, but there’s still much to be developed,” she admits.

Qualcomm is among those companies developing technology to accommodate for 6DoF – the ability to walk around in a virtual environment. With its Snapdragon platform, Hugo Swart, Head of extended reality (XR) at Qualcomm, said it has enabled 6DoF with simultaneous localisation and mapping (SLAM) – a technology that constructs and updates the digital map of an environment while also keeping a track of where the user is within the location.

To make this possible, the standalone device features a camera which allows high dynamic range video (HDR) capture. The system compares these HDR images at set periods of time and calculates movement based on that comparison. This means the system can determine whether the user took, for example, a step backwards, and create a realistic set of visuals that depict this movement.

The slow slog

So much has been said about, and money invested in, VR and AR, but is this just another hype cycle? By Bethan Grylls
Swart points to the advancements made in processors as one of the keys to unlocking the standalone device. “They need to be able to handle the workloads, rendering and visuals of a VR system,” he explained. Consequently, Qualcomm has developed ‘foveated rendering’ a technique based on the human eye. “When we look at something it’s in focus but our peripherals aren’t,” said Swart. “We apply the same concept so that what the user is focused on is in high resolution, but the rest is in a lower resolution. This saves GPU compute, but maintains great quality for the end-user.”

The Snapdragon chip contains a series of processing units including a GPU, CPU, an image processor, a DSP and a sensor hub. To minimise latency, the way in which these elements are connected was “re-architected”, explained Swart. And now, with the rise of 5G, Qualcomm is looking into how it can improve it further.

“We introduced the concept of boundless XR at our 4G/5G summit,” said Swart. “The rendering will be split between the headset and edge of the network, where the data will be compressed and sent back to the headset over 5G for final processing.”

The main challenge Swart sees in VR/AR is actually content. But, he notes this is a growing and improving area. “With any new ecosystem it’s a snowball effect. You start small and get a certain number of users who provide you with content. As more join, more content is created.” He compares it to the smartphone. “To begin with there weren’t a lot of features, but as they gained popularity, industry saw better devices and more apps.”

“Britain is going to have a big part to play in developing content because of its strong creative design and manufacturing industries,” Gregory-Clarke added.

But, despite a lack of content, a market report by Digi-Capital, the Silicon Valley-based AR/VR adviser, reflects a positive state-of-market, with it anticipating AR and VR to reach $120 billion by 2020.

However, Stone remains cautious. “We’re seeing a lot of optimistic expensive market survey reports which, to be honest, aren’t worth the paper they’re written on. There’s lots of technology, but it’s being brought to market at an immature status,” he contended. “People are buying them, believing what they read online and suddenly finding – like in the 90s – they’re not delivering.”

Stone points to misleading online videos as part of the problem. “There’s so many examples of so-called AR/VR being used in surgery, but it’s not. It’s just special effects on videos that’s convinced the public it’s real.

“Companies aren’t seeing growth or a lot of return – and they’re not likely to anytime soon,” he continued. “We have a lot of start-ups over ‘hyping’ what the technology can do in order to get cash flow through the door.”

He describes the market as experiencing ‘blips’, with the hype encouraging investment and optimistic attitudes, but does admit that the technology is moving in the right direction, becoming cheaper and more capable over the last decade.

“The number of applications and new UK companies emerging in this space is growing,” said Gregory-Clarke, “and the maturity of the products they’re producing is increasing, which is encouraging to see. We are also hearing a lot of success stories.

“But it’s not without its problems,” she countered. “On the consumer side uptake has been slower than some predictions. I think it’s important for industry to take a long-term view on this. The devices of today aren’t going to be the devices in 5 years’ time, but that doesn’t mean we shouldn’t be experimenting and learning new skills.”

“Looking back to 2016, I think the expectations may have been too optimistic,” agreed Swart. “But a lot of progress has been and is being made. I don’t think we should see it as a marathon. It’s a journey.”

Looking to the future, Swart envisions the smartphone becoming a pair of virtual glasses. “VR/AR will be the way people consume content. It will be our entertainment, the way we work and the way we socialise. But that isn’t a one-year transition, it will take time.”

While Stone holds out hope for a revolution in wearable equipment. “I hope to see something where you can explore, taste and smell in the virtual world, without being encumbered by these crazy wearables we currently have.” He points to healthcare as the main driver for the technology, with palliative and end of life care benefiting the most from virtual experiences – but for that to happen, he maintains that an extreme leap in content and hardware capability is needed.

What Swart, Gregory-Clarke and Stone do agree on is that VR/AR is here to stay – how long it will take is debatable.

“I want to see people become more critical of technology,” concluded Stone. And perhaps he’s right. Despite there being more hope for the technology than ever before, maybe we all need to take a step back, remain a bit more cautious and be a little more patient.
As the dependency on software within automotive development increases, so the importance of coding standards becomes more acute, as Richard Bellairs explains.

The ever-increasing dependency on software within automotive development, together with the growing complexity of that software, puts more pressure on software development processes than ever before. These days, it takes over 100 million lines of code to build a single passenger car. When we reach Level 5 of the Society of Automotive Engineers’ future vision – the point at which cars will be completely autonomous – the volume and complexity of code will reach even greater heights.

The advent of driverless and other next generation vehicles will increase reliance on software code, but even ‘standard’ vehicles now incorporate a variety of software systems, often connected to the IoT and requiring regular updates.

That is why open architectures have become so important in recent years, helping to standardise and future-proof software elements as much as possible to help manage growing complexity, enable software teams to collaborate better and ensure compliance, all without sacrificing time-to-market. Plus, coding standards and guidelines are needed to ensure that software components are reliable, secure, easy to maintain, and above all, safe.

**MISRA and AUTOSAR**

C and C++ are the dominant programming languages in the automotive world. MISRA C, MISRA C++ and the AUTOSAR C++ Coding Guidelines are the main coding standards. MISRA is a collaboration between vehicle manufacturers, component suppliers and engineering consultancies. Formed in the late 90s, it promotes best practice in the development of safety-related electronic systems for road vehicles. Its coding standards are also used in other industries where safety, quality and reliability are a priority, including rail, aerospace, telecom, medical devices and defence. Today, MISRA has been accepted worldwide for developing safety-critical software in C and C++.

MISRA may be the longer-established and most widely used of the two, but the increasing use of modern C++ is rapidly increasing adoption of the AUTOSAR guidelines. AUTOSAR is a partnership between over 180 companies involved in the automotive industry, with the aim to standardise open architectures for automotive software and embedded systems development. AUTOSAR is expected by many to be the de facto platform for future automotive design. AUTOSAR’s adaptive platform addresses the needs of connected vehicles and more autonomous driving. It is designed for technologies such as high-powered 32- and 64-bit microprocessors with external memory, parallel processing and high bandwidth communications. The AUTOSAR C++ Coding Guidelines have been created to support the development of adaptive platform components using modern C++.

The advent of next generation vehicles will increase the reliance on software code.
One of its core principles is to ensure that code is easily referred to as ‘clean code’, this is an excellent starting point. Often applying good code ‘housekeeping’ to play. Going back to basics and techniques has an important role expertise. Selecting the right tools requires considerable experience and areas of ambiguity or interpretation experienced developer: dealing with still be a challenge for even the most developers.

Complex systems, but it asks more of developers. C++ simplifies programming of dynamic memory). In other words, instance, around how to handle innovation, C++’s inherent flexibility means careful decision making (for instance, around how to handle dynamic memory). In other words, C++ simplifies programming of complex systems, but it asks more of developers.

Coding standards help, but it can still be a challenge for even the most experienced developer: dealing with areas of ambiguity or interpretation requires considerable experience and expertise. Selecting the right tools and techniques has an important role to play. Going back to basics and applying good code ‘housekeeping’ is an excellent starting point. Often referred to as ‘clean code’, this is about making sure that code is easily readable by everyone involved, so that it becomes easier to understand, errors easier to identify and decisions over changes easier to make. ‘Clean code’ can be as straightforward as just standardising and simplifying code naming conventions.

Continuous code inspection
Another good practice is to ensure that every line of code is thoroughly inspected throughout the development process, to ensure it is safe, secure and reliable. To avoid this being a manual process, developers increasingly use automated tools, such as static code analysers to verify code. As a result, any issues – such as deviation from a coding standard, excess complexity, or a hard-to-spot dataflow bug – can be detected early in the process. That approach also reduces the subsequent load on the testing processes that would traditionally take place later in the development process. It is representative towards the ‘shift left’ trend, where developers take on some of the work that would previously been carried out by testers or quality assurance engineers. Continuous testing and quality assurance thereby become part of the entire software lifecycle, rather than tasks that happen further down the line.

Establishing a transparent ‘single source of truth’ where every version of every digital asset associated with an automotive design project also supports better adherence to compliance requirements. This provides both a real-time and historic view of who did what, when, where and how. In the automotive world, this can include information relating to both software and hardware, such as documentation, code and other design artefacts, across both in-house and external contributors.

In automotive software development, there are typically many types of tool, file, platform and different teams contributing to a project, so it is essential that the single-source-of-truth supports this disparity. The need to provide an immutable change record, plus the ability to scale to accommodate large repositories.

Many automotive development teams are finding that they need a high-performance version control system that can scale to support the increasing size of their code base while also properly supporting other types of binary assets. They also need their static code analysis tool to integrate with this system so they can manage coding standard violations as their code evolves.

Finally, as the technology, tools and processes that underpin automotive development continue to mature, or new ones are introduced, it is important to keep reviewing the situation and to remain open to fresh ideas. In this fast-paced market, one thing of which we can be sure of is change.

Automotive design continues to be one of the most exciting, fast-paced and evolving markets of all, underpinned by software innovation. Understanding the role of software coding standards such as AUTOSAR and MISRA, then applying the right techniques and tools to ensure that they are adhered to, will help pave the way for a safer, more standardised future for the industry.
WIDEST BANDWIDTH, HIGHEST PERFORMANCE INTEGRATED RADIO SOLUTION.

The ADRV9009 RF transceiver is the only platform to support 2G/3G/4G/5G. For massive MIMO and phased array radar systems, it simplifies digital beamforming design and reduces complexity by handling local oscillator (LO) synchronization on-chip. The transceiver platform also features fast frequency hopping for efficiency in the design of portable test equipment.

REIMAGINE WIRELESS WITH THE ADRV9009 TRANSCEIVER.

DISCOVER THE FASTEST WAY TO 5G
analog.com/RADIOVERSE-ADRV9009