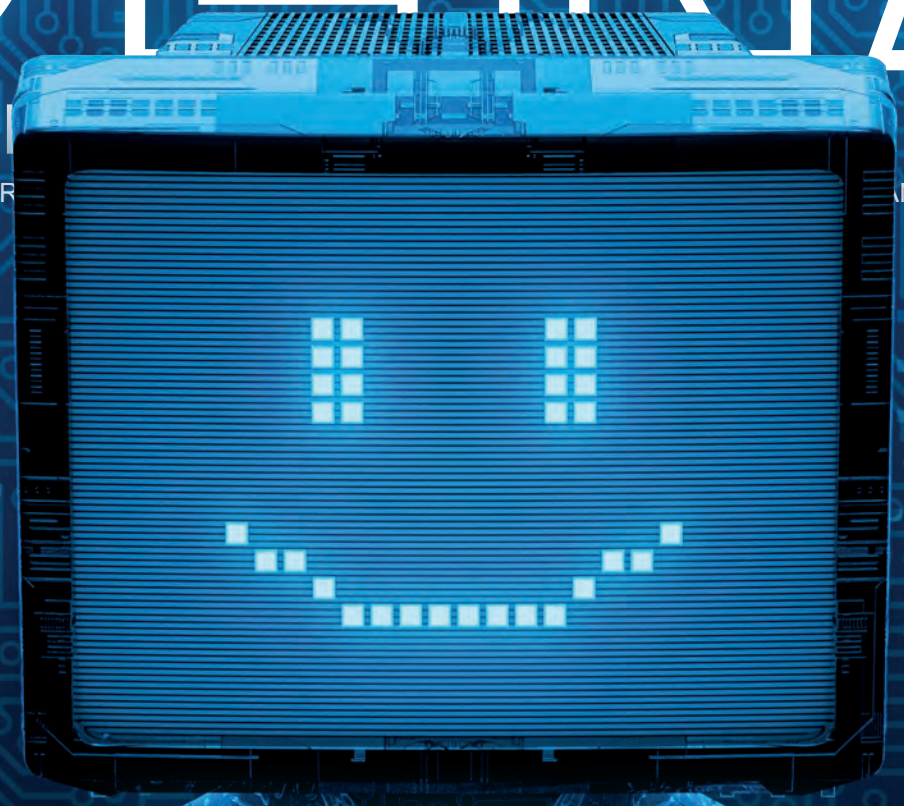
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EDITORS WORD



Happy Holidays!

When I was a kid (think Charlie Brown), it seemed like adults enjoyed very few topics of conversation, one of the main topics being how time seemed to pass faster the older one became. I remember thinking, "Good grief! Can't you think of anything else to talk about." But it turns out they were right.

In those days of yore, the week leading up to Christmas Day seemed to last for an eternity. Now, by comparison, when Christmas is still a couple of weeks in the future, all I have to do is blink and… I find the holiday is already over and it's time to go back to work (sad face).

Toys were different also. The height of technology when I was a kid was the Magic Robot Quiz Game (https://bit.ly/3UWx9xl). First, you placed the little robot in the center of a circular pattern of questions and rotated it so the pointer it was holding pointed to a particular question. Next, you placed in in the center of a circle of answers and it rotated to point to the correct answer to the question. Magic!

Now, in addition to the most amazing electronic marvels, there are some amazing educational toys like the Turing Tumble marble-based computer (https://bit.ly/3UWBikN) and the Spintronics mechanical electronics (https://bit.ly/3UXLSIg).

And, of course, we present a curated collection of grown-up toys in this magazine. You may think of these pages—which are replete with components, tools, and technologies—as our gift to you. Happy Holidays from all of us here at DENA.

Max Maxfield

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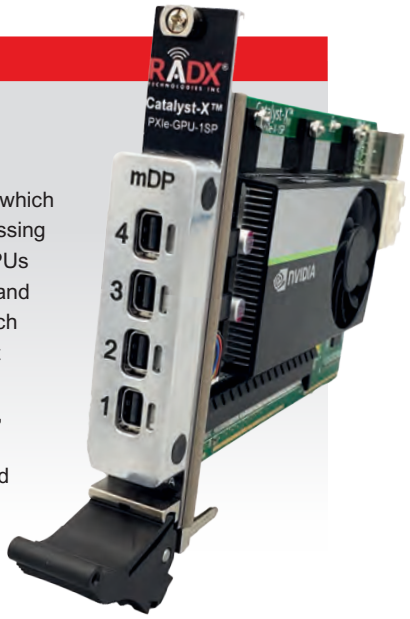
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TOP STORY

RADX announces Catalyst-GPU family of COTS PXIe/CPCIe modules



RADX Technologies has announced its Catalyst-GPU Family of COTS, low-cost, PXIe/CPCIe GPU Modules. Catalyst-GPUs are the first COTS products that bring the cost-effective, easy-to-program, high-performance compute acceleration and advanced graphics capabilities of NVIDIA Quadro T600 and T1000 GPUs to the PXIe/CPCIe platform—the fastest growing platform for Modular Test & Measurement (T&M) and Electronic Warfare (EW) applications.

With comprehensive support for MATLAB, Python, and C/C++, combined with support for virtually all popular computing frameworks, Catalyst-GPUs are easy-to-program for both Windows and Linux operating environments. Catalyst-GPUs feature multi-teraflop (TFLOP) level performance, which is ideal for accelerating signal processing applications. In addition, Catalyst-GPUs are ideal for machine learning (ML) and deep learning (DL) applications, which are becoming increasingly important for artificial intelligence (AI)-based signal classification and geolocation, semiconductor and PCB testing, failure prediction, failure analysis, and other important missions.

www.radxtech.com

METCASE announces eight new 'no extra cost' custom colors



Metal electronic enclosures manufacturer METCASE has extended its range of 'no extra cost' custom paint colors and finishes. Adding eight new shades to its range of always-in-stock paints brings the total to 38 colors plus anodizing, passivate, pre-treatment, and anti-corrosion finishes.

The new paint colors are violet blue (RAL 5000), cobalt blue (RAL 5013), pigeon blue (RAL 5014), yellow (Pantone 1235C), medium dark orange (Pantone 159C), salmon orange (Pantone 2027C), teal (Pantone 2238C) and anthracite (Pantone 432C).

METCASE can supply its 19" enclosures and desktop/portable instrument enclosures in any specified RAL or Pantone color. However, there is no extra charge if the customer chooses a color from the always-in-stock range.

Finishes include tough powder polyester painting, chip-resistant wet painting, nickel-loaded RFI/EMI shielding lacquers for plastic parts, blemish-free linishing, anodizing, Iridite NCP (conductive/anti-corrosion), plus zinc and clear passivate of CR4 steel panels. Other customization services include bespoke sizes, custom front panels, CNC machining, fixings and inserts, and photo-quality digital printing of graphics, legends and logos.

www.metcaseusa.com

Microchip announces functional safety certification packages for its FPGAs



Systems used in many high-reliability commercial aviation, space, defense, automotive and industrial applications require certification to the IEC 61508 Safety Integrity Level (SIL) 3 functional safety specification. To reduce the cost of this process and accelerate time to market for system developers, Microchip Technology continues to certify its products and tools to industry safety specifications and has now added IEC 61508 SIL 3 certification packages for two more of its System-on-Chip (SoC) FPGA and FPGA families. Microchip's safety packages are built on top of the SEU-immune, Flash-based FPGA fabric of the SmartFusion 2 and IGLOO 2 devices, and these FPGAs are certified by independent safety assessor TÜV Rhineland. Package deliverables include certification of Microchip's Libero SoC Design Suite v11.8 Service Pack 4 and associated development tools, plus 28 Intellectual Property (IP) cores, safety manuals, documentation and device data sheets. A safety certificate from TÜV Rhineland is also provided.

www.microchip.com

Metawave announces industry's first 77GHz beamforming chip



Metawave Corporation, a world leader in high-end sensing and perception solutions for terrestrial and aerospace mobility applications, has successfully demonstrated the industry's first 76-81GHz antenna-in-package (AiP) module for defense and commercial high-resolution 4D imaging radar.

News continues on page 06 >

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Metawave's advanced aerial and automotive imaging radar technology enables unmatched long-range and point-cloud resolution making vehicles safer and smarter.

The new SPEKTRA AiP module is key in the realization of Metawave's high performance hybrid analog beam-steering and MIMO radar for long-range imaging. SPEKTRA AiP enables the seamless implementation of Metawave's 76-81GHz MARCONITM beamforming chips with Texas Instruments' cascaded AWR2243 transceivers and NXP's best-in-class S32R45 microcontroller in the Metawave 4D imaging radar architectures.

www.metawave.com

OrionVM and Blaize announce new AI-as-a-Service (AIaaS) offering

OrionVM, the infrastructure as a Service (IaaS) provider and cloud computing pioneer, has announced the addition of technology partner Blaize, the artificial intelligence (AI) computing innovator revolutionizing edge and automotive computing solutions, to create a new AI as a service (AIaaS) offering. This first-of-its-kind partnership will empower organizations across multiple industries to launch their AI solutions more quickly and efficiently, including machine learning across vast data sets. Under the agreement, both companies' global sales teams will sell Blaize's AI applications, enabled and powered by OrionVM's optimized cloud platform.



These AIaaS solutions can be utilized in a variety of scenarios: (1) Blaize's unique Graph Streaming Processor (GSP) chips for edge AI and sensor fusion applications cards can now be virtualized on the OrionVM cloud platform, (2) Dedicated AI environments for clients can be easily created with virtualized GSPs. For example, they can be integrated into video surveillance technology on the edge providing sophisticated and constantly updated analysis of events, and (3) The latest version of Blaize AI Studio is now available on the OrionVM cloud platform, allowing for the development of AI applications that can quickly be set up to perform workloads without needing to purchase and configure complex hardware environments.

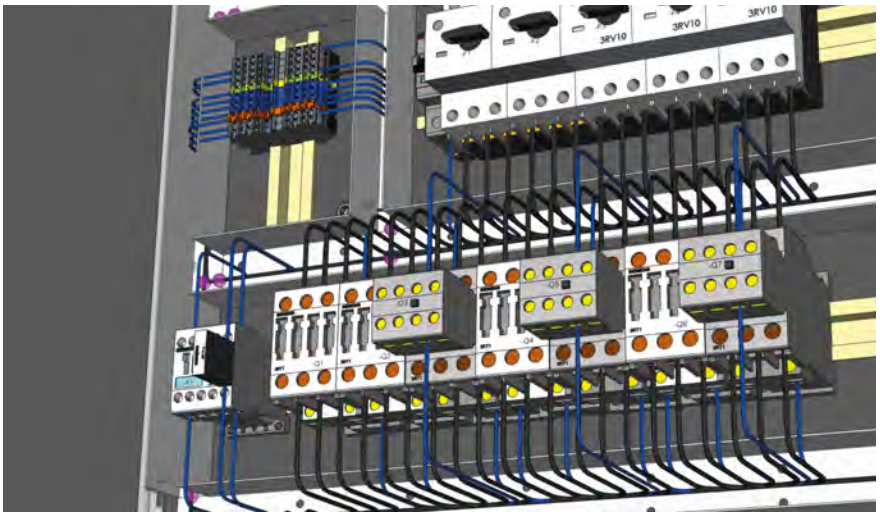
www.orionvm.com
www.blaize.com

Zuken improves the digital twin creation process for smart manufacturing

Zuken's E3. series is a leading single platform solution to take a design from concept to manufacturing. It is a reimagined wire harness, control cabinet, switchgear, and cabling systems design solution. Zuken has announced the release of E3.series 2022, introducing enhancements to empower design teams to create digital twins with functional and manufacturing details captured in a single cutting-edge tool suite. The enhancements to E3.series 2022 cover all areas of electrical design through to the manufacturing process, including: wire routing, data visualization, design rule checks, change management and much more.

The latest release of E3.series includes more than 50 new features, enhancements, and tools to improve reliability, efficiency, and productivity. Cabinet design enhancements aim to improve the 3D visualization of parts and wires to simplify the assembly process. The cable and wire harness enhancements target improving design reuse and capturing additional manufacturing details. The overall usability enhancements focus on further simplifying the application to increase productivity, while improvements to active and passive design rule checks ensure design quality.

www.zuken.com





1887

Emile Berliner receives the patent for the gramophone.
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Compound semiconductors are transforming electronics



Wayne Johnson, Executive Vice President - Sales & Business Development at IQE

Design engineers should be implementing these state-of-the-art semiconductor materials into their latest projects

With silicon fast approaching its physical limitations in the semiconductor space, engineers are faced with the task of identifying new materials that can effectively solve today's technological bottlenecks. The most promising solution to many of the present challenges is provided by compound semiconductors, the next generation of materials delivering the efficiency and performance demanded by applications such as 5G infrastructure, high-capacity data centers, electric and autonomous vehicles, and even the metaverse.

What are compound semiconductors?

Compound semiconductors are everywhere and underpin a vast assortment of today's technologies that demand the ability to operate at high frequencies, withstand high temperatures, or efficiently emit and detect light. This makes them the indispensable choice in technological segments where standard silicon simply fails to deliver

Rather than attempting to push silicon beyond its physical limits, an alternative is to combine two or more elements to achieve specific performance parameters. These compound semiconductors are split into two groups, the first being the 'Three-Fives,' i.e., chemical compounds made up of one or more Group III materials (B, Al, Ga, In) combined with one or more Group V materials (N, P, As, Sb, Bi). Examples of 'Three-Fives' include gallium arsenide (GaAs), indium phosphide (InP), and gallium nitride (GaN).

The second 'Group IV' compound semiconductors are, as their name would suggest, made up of combinations of Group IV elements (C, Si, Ge, and Sn). Silicon carbide (SiC) and silicon germanium (SiGe) are common examples of Group IV compound semiconductors.

How are compound semiconductors made?

Compound semiconductors are made using a complex manufacturing process called 'epitaxy' whereby crystalline layers of the aforementioned compound semiconductor materials are deposited onto a substrate to make a wafer, which is then subsequently used by chip makers to produce semiconductor devices.

By determining the composition and sequence of the layers in epitaxial growth, the optical and electrical properties of the wafer can be finely tuned to deliver very specific performance characteristics.

In fact, an epitaxial wafer can include hundreds of individual layers, each of which may be as thin as two or three atoms. To get this staggeringly complicated process exactly right, epitaxial wafer makers need a tremendous amount of expertise and decades of experience—for example, IQE has been honing its epitaxial know-how for more than 30 years and currently holds around 250 patents.

What advantages can compound semiconductors offer?

Compound semiconductors are making an impact across many applications. For example, they are critical in many wireless applications where they achieve broad bandwidth and low latency whilst maximizing power and efficiency. Compound semiconductors also form a key component in photonics applications, such as 3D sensing and facial recognition.

Despite being more complex to manufacture and requiring a high level of expertise, these III-V compound semiconductor materials significantly outperform silicon. They enable operation at higher frequencies, offer more efficient emission and detection of light, provide a higher breakdown voltage, present better thermal performance, and can withstand higher temperatures.

So, what has changed and why do we now need to focus so much on compound semiconductors? Simply put, whether we like it or not, we are being driven forward by the megatrends of our decade: 5G connectivity, e-mobility, IoT, AR/VR, edge AI, and cybersecurity, which demand more powerful and multifaceted electronics that silicon-only semiconductors simply cannot provide.

There are three key areas in which compound semiconductors outperform standard silicon:

Power & efficiency at high frequencies: The first, and perhaps most important area, is efficiency: compound semiconductors materials are very efficient at high frequencies. Technically, this is since they have higher electron mobility and—as frequency increases—compound semiconductor materials become far more efficient than standard silicon. This makes them the material of choice for high-power, high-frequency applications such as advanced mobile handsets.

The key takeaway here is that it is the high efficiency of compound semiconductor materials that give today's smartphones their long battery life. Were it not for compound semiconductors, the battery life of next-generation handsets would be measured in minutes rather than hours or days!

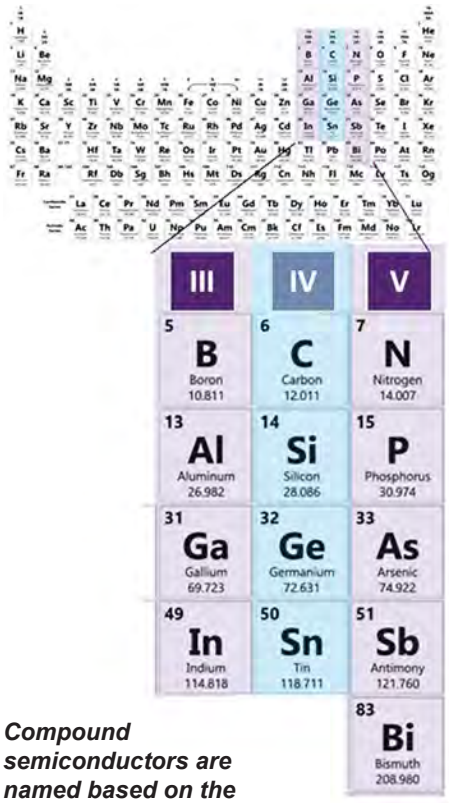
Efficient light emission and detection: Secondly, III-V compound semiconductors are extremely efficient emitters and detectors of light, which is something that has been exploited in one of the earliest applications of compound semiconductors materials—LED lighting. For example, the optical efficiency of compound semiconductors materials has enabled the replacement of traditional 100W filament light bulbs with more reliable and flexible 7W LED light bulbs. Imagine the amazing reduction in power consumption when all the light bulbs in the world are factored in. The inherent high efficiency of compound semiconductor materials across myriad applications makes them an essential element on humanity's path to Net Zero.

The efficient emission and detection of light provided by III-Vs makes them essential for facial and gesture recognition, wearable health monitors, etc. If we also include effective 3D mapping for AR and VR, and ultra-high-resolution displays utilizing micro-LEDs for Metaverse applications, we can see that the scope of optical capability of the Three-Fives is set to play an indispensable role in the future.

Furthermore, by defining their composition, compound semiconductors can be finely tuned to emit or detect specific wavelengths of light. This enabling characteristic has made them the foundation upon which high-speed data communications over optical networks have been built.

Efficient power handling capabilities: Finally, IV compound semiconductors materials such as GaN and SiC have outstanding power handling capabilities, making them ideally suited for power electronic applications from computer power supplies to electric vehicles (EVs) to grid-based voltage conversion. The way forward to Net Zero in the area of transportation is the electrification of vehicles, where compound semiconductor materials are vital, both for the vehicles themselves as well as the charging infrastructure.

And EVs are just one of several important elements of the Net Zero strategy. Consider the fact that the current worldwide energy loss resulting from voltage conversion is equivalent to twice the amount of energy generated by all renewable sources combined. This "silent" loss can be reduced considerably by simply replacing silicon-based power components with compound semiconductor devices.

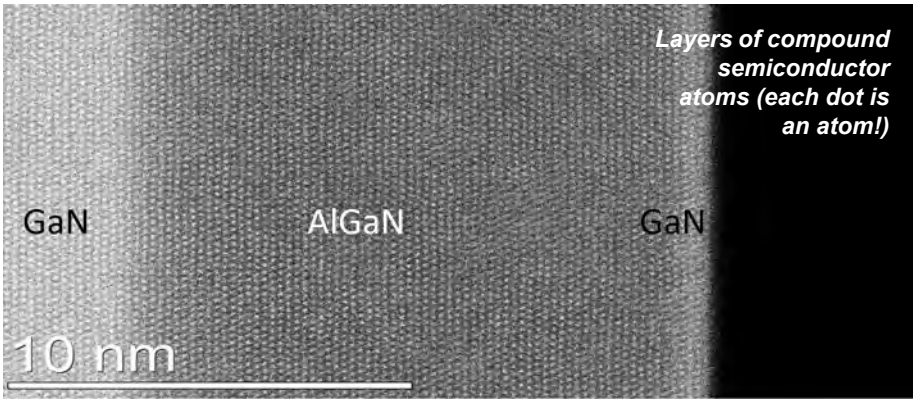


Compound semiconductors are named based on the positions of their constituent elements in the periodic table.

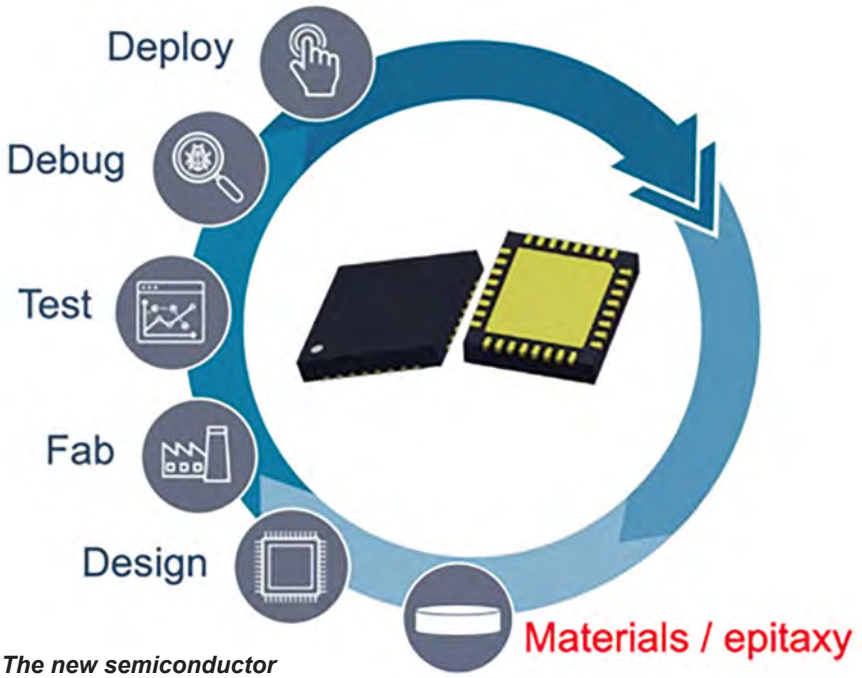
Opening up new horizons

While thinking at the circuit level is the most natural and familiar approach for system designers, it is important to understand that material optimization will become increasingly central to both device and system-level advancements.

The system designer will, of course, specify a particular property for a device, such as its gain, turn-on or breakdown voltage, etc. However, by working with a



Layers of compound semiconductor atoms (each dot is an atom!)



The new semiconductor design cycle includes materials selection

"We are being driven forward by the megatrends of our decade: 5G connectivity, e-mobility, IoT, AR/VR, edge AI, and cybersecurity."

materials provider, designers now have the opportunity to evaluate entirely new alternatives to meet their specific requirements, and they may discover out-of-the-box design options that they could not have imagined before!

Let the examples speak for themselves!

To illustrate the value of compound semiconductors, let's consider just a few examples as follows:

GaN and GaAs for 5G base stations and Wi-Fi 6 routers: The telecoms industry is currently in the midst of rolling out 5G base stations around the world. However, unlike earlier generations, these 5G base stations typically incorporate the power supply unit within an integrated architecture.

Without a separate power supply and with only a single heatsink and less space for cooling, the efficiency of the power system suddenly becomes very important, particularly since operating at elevated temperatures can reduce equipment reliability. This is where the higher power handling efficiencies of compound semiconductors, such as gallium nitride (GaN), are highly valued. Similarly, the superior efficiency of GaAs semiconductors has seen them become an integral part of 5G handsets and the latest Wi-Fi 6 routers.

VCSEL-enabled LiDAR advanced driver assistance systems (ADAS): Compound semiconductors are also becoming increasingly important in automotive applications. To give one example, advanced driver assistance systems (ADAS) utilize LiDAR (light detection and ranging) to 'see' what is around them. However, due to the factor of 'eye safety at street level,' it is desirable to use longer wavelengths wherever possible. To achieve this, light is generated using a vertical-cavity surface-emitting laser. This VCSEL technology consists of a compound semiconductor-based laser diode that emits a highly efficient optical beam vertically from its top surface, thus saving valuable space on the circuit board.

Power electronics and efficient high-speed data connections: Vehicle electrification also requires highly efficient power electronics that are underpinned by GaN technology, whilst autonomous vehicles will require ultra-reliable high-speed data connections. Once again, compound semiconductors are leveraged to deliver the high bandwidth and low latency required.

What does the future hold?

Looking ahead, many exciting advances in electronic products will be enabled by compound semiconductors. For example, IQE, a company at the forefront of long wavelength photonics (typically more than 1100nm), is developing advanced products based on the InP material. These products are particularly suitable for applications such as environmental gas sensing, health monitoring, and advanced 3D sensing.

As we move into the new era beyond Moore's Law, the unique properties of compound semiconductors hold the key to overcoming the fundamental limitations of silicon. An important focus will, without a doubt, be placed on integrating compound semiconductors with leading-edge CMOS technology to fuse the advantages of both these approaches and to raise the bar on semiconductor technologies and the amazing products they enable.

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Ubiquitous connectivity is the future of wireless

Ubiquitous connectivity is increasingly becoming a "must-have" in the modern world

Connecting people and everything, no matter where they are, has always been the main goal of wireless communications. Whether it is people talking on their mobile phones, vehicle communication (V2X) platforms helping cars negotiate traffic turns, or Internet of Things (IoT) devices monitoring smart factories, today's wireless systems are striving to realize that dream.

This power means that ubiquitous connectivity—systems capable of seamlessly using satellite, cellular, and local area networks to maintain a fast, secure, and reliable online connection—is no longer a "nice-to-have" feature but rather a "must-have!"

For the engineers building these technologies, the challenges of designing wireless systems optimized for ubiquitous connectivity have grown along with their capabilities. These include ensuring a device's compliance with standard protocols for system and device interoperability; optimizing multidomain system parameters that integrate algorithms, antenna, array, and RF transceiver design choices; and verifying the designs of hardware prototypes with automated over-the-air tests and realistic channel and impairment models.

Fortunately, techniques and best practices exist that engineers can use to design, model, and test these systems, ensuring they work together to provide businesses and consumers alike with not only wireless access, but with true ubiquitous connectivity.

The evolution of wireless

From a technical perspective, the concept of ubiquitous connectivity is nothing new. However, it's been a challenge to execute for economic, technical, and physical reasons. Economically, the number of access points has been historically limited by cost and therefore reserved mainly for high-density population areas. Technically, high throughput links could not be constructed seamlessly over a variety of ranges and distances, and each technology has catered to its own niche market. And, physically, each communication link is limited by the interference provided by other systems using the same or adjacent spectra. This has made coordination between various systems a necessity. While modern high-level wireless systems have overcome many of these challenges—for example, Low Earth Orbit (LEO) satellites are more cost-effective than their Medium Earth Orbit (MEO) and Geostationary Orbit (GEO) counterparts, with their signals capable of providing substantial throughputs at large distances—other challenges remain.

5G, Wi-Fi, and satellite-based communication devices, for instance, rely on multi-user multiple-input and multiple-output (MIMO) beamforming technology to reach users in the service area. MIMO and beamforming-enabled devices are equipped to send and receive multiple signals, necessitating engineers to optimize the use of multiple frequency bands at once. However, this requires constant monitoring of available signal space and precise scheduling as well as channel modeling and measurements on both ends of the link to connect two devices.

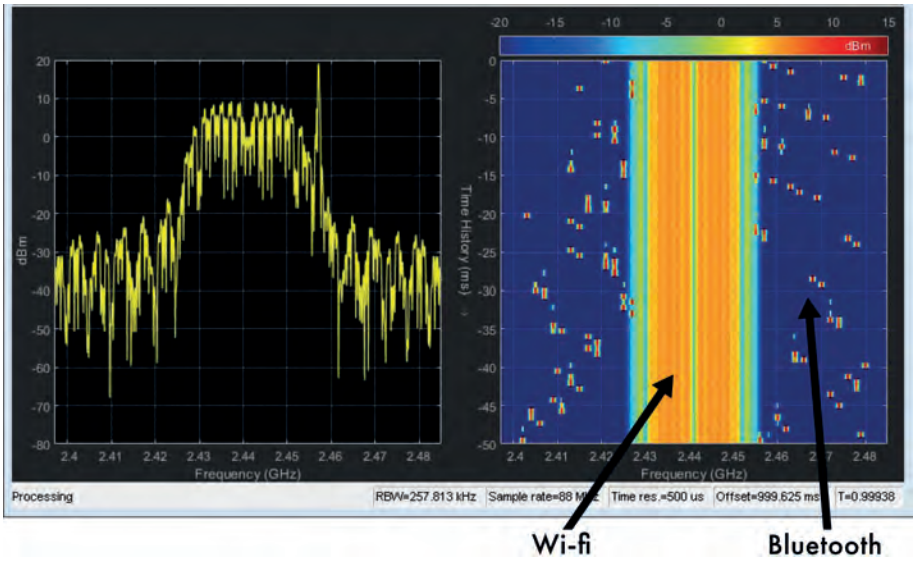
When designing for ubiquitous connectivity, engineers have typically



Houman Zarrinkoub Ph.D., Principal Wireless Product Manager, MathWorks

designated Wi-Fi systems for shorter-range and cellular systems for longer-range communications. These heterogenous types of networks can operate in tandem, so that, for example, signals beamed to a congested cellular service areas can be offloaded to a Wi-Fi service network and vice versa.

Bluetooth also has a role to play in ubiquitous connectivity. While not meant to be part of a high-throughput wireless network, the low power and ISM (industrial, scientific, and medical) band usage of its basic rate, enhanced data rate, and Bluetooth low energy (BLE) standards makes the platform ideal for sending short-range signals. Engineers can leverage the short-range signals provided by Bluetooth



Spectral view of Bluetooth and WLAN coexistence (Image source: The MathWorks)

as they best indicate whether a device needs to connect to the internet. Alternatively, Bluetooth can also help engineers save bandwidth and keep devices offline when they do not need to be connected.

Ensuring each of these types of networks—broad area networks such as satellite links, cellular wide area networks including 4G and 5G, local area networks (Wi-Fi), and personal area networks such as Bluetooth—are in sync providing ubiquitous connectivity requires extensive testing. For engineers working on these problems, such testing is better conducted through modeling and simulation than with live equipment. This is where the value of large-scale simulation platforms becomes apparent.

How simulation can help achieve ubiquitous connectivity

Solving the challenge of ubiquitous connectivity requires engineers to not only understand the relationships and interferences between all wireless communications protocols and standards in place today, but also to test the standards' compatibility with each other.

Engineers can use large-scale modeling and simulation tools such as MATLAB and Simulink from MathWorks to design, model, test, and analyze systems before deployment, thereby ensuring the reliability of their systems long before a physical device is built.

For example, a key challenge when developing cellular network systems is the number and complexity of parameters associated with each mode of operation. Engineers need to understand that each parameter needs to be tested against a variety of channel conditions that can occur in a typical cellular network. If all the testing conditions are not met, the system cannot be certified.

To address this, engineers can use simulation platforms to provide an environment that makes reviewing all potential parameters and evaluating them against other systems easier, faster, and more reliable than physical testing. Faster testing methodologies are largely possible due to the advancement of technologies included with MATLAB and Simulink, such as ease of test waveform generation and use of automatic C code generation, along with the use of graphics processing units (GPUs) and parallel computing for accelerating simulations.

Of course, multi-user MIMO and beamforming systems are only as effective as their ability to accurately point to and connect with target devices. This necessitates simulation platforms such as MATLAB and Simulink to make the task of verifying accurate positioning and localization easier. These solutions not only provide engineers with industry-standard compliant tools generating individual signals including Bluetooth, 5G, LTE, and Wi-Fi, but they also provide a visualization and testing environment enabling them to see the effect of indoor and outdoor RF propagation on maps. This will help them ensure that the connections between multiple devices are accurate.

Ubiquitous connectivity is increasingly becoming a "must-have" in the modern world. This ultimately means that simulation platforms too will have to adapt to remain essential for engineers as they design systems capable of seamlessly using a multitude of modalities, including satellite, cellular, and local area networks, all while maintaining fast, secure, and reliable online connections.

www.mathworks.com

"Ubiquitous connectivity is no longer a 'nice-to-have' feature but rather a 'must-have!"

System design: Make sure you secure your data at rest (DAR)



Chris Kruell, Director of Marketing, CRU Data Security Group (CDSG)

Working with data is the point of a computer system in the first place, and securing that data has never been more important

Cybersecurity is like the old saying about project status: "Steady progress, never closer." It's hard to escape the message that cybersecurity has never been as important as it is today, even if we're not paying attention to the daily headlines about ransomware, data theft, security breaches, and so on. And cybersecurity will be even more critical tomorrow and in the days to come. The escalation of threat vs. defense will continue, hence the view that while we're making progress, and while we've never been closer to a solution, we'll never quite reach that final destination.

Cybersecurity may not be the first thing you think about when designing a computer system but—in the long run—it is likely more important than choosing the CPU, motherboard design, graphics processor, I/O ports, etc. After all, working with data is the point of a computer system in the first place, and securing that data has never been more important.

But first, what is DAR?

Like any other specialty, the world of cybersecurity and data protection includes a lot of jargon. For example, the term "data at rest" or "DAR" refers to what most of us just think of as "data"; that is, data stored on our computer's SSD, external hard drive, on our phones, or in the cloud. DAR is one of three data states, another of which is data in flight, that is, data being transmitted within a computer or between systems. The third state is data in use, or data that is actively being updated, processed, accessed, erased, or read by a system.

When many of us think about cybersecurity and protecting ourselves from ransomware, we think about anti-virus software, spam filters, and passwords more complex than "password123." Many organizations with sensitive data, especially those that have regulatory requirements or security protocols, have expanded their cyber focus to include protecting data at rest. This includes the US Government. In the spring of 2021, President Biden issued an Executive Order that, among other mandates, called for encrypting and securing data at rest.



A DIGISTOR Citadel C Series M.2 NVMe FIPS-certified and CC/NIAP-listed SED with built-in MFA and PBA.

Use SEDs!

While the selection of many, if not most, computer components is neutral to addressing cyberthreats, there are a few elements that greatly enhance data security, starting with the choice of internal SSD or hard drive.

New computer system designs likely take advantage of speedy NVMe SSDs using PCIe Gen 3 or Gen 4 protocol in the M.2 form factor; others may use 2.5-inch SSDs or even traditional rotating media hard drives. While speed and capacity matter, system designers should consider whether to use a self-encrypting drive (SED). An SED incorporates hardware technology to encrypt data as it is being stored and decrypt it as the data is read. If an encrypted drive is separated from its host computer, its 256-bit AES encryption will ensure

it would take millions of years for the most powerful quantum computer to decipher the data.

When choosing a SED, select a FIPS-certified device, perhaps even a Common Criteria (CC) and NIAP-listed unit. FIPS stands for Federal Information Processing Standards, which are maintained by the National Institute of Standards and Technology (NIST). NIST developed FIPS for use in computer systems by non-military American government agencies and government contractors. NIAP is the National Information Assurance Partnership, the organization responsible for the US implementation of the Common Criteria.

Remember removables

Another security-enhancing choice is to specify a computer chassis that has at least one drive bay that can be dedicated to easily integrated removable drives. Removable drives are useful for separating the hard drive or SSD from the system (one way to air gap your data).

Many organizations have specific policies and procedures that require the use of removable drives for physically securing data by locking them up in safes or for use in secure facilities. In addition, removable drives are often used in creating onsite/offsite backup workflows or in transporting large amounts of data.

Protect your boot drive with PBA

Encrypting data is a good step to keeping it private. Going hand-in-hand with encryption is pre-boot authentication (PBA) technology. PBA requires that a computer user enter authorized login credentials to the SSD itself before the computer will even recognize that the SSD is present. After all, if the computer can't see that the drive exists, it can't be read or attacked.

PBA precedes the normal startup procedure such that a user is communicating directly with the SSD for the authentication process. Once proper authorization is obtained, the computer recognizes the presence of the SSD and continues with its boot sequence.

Double things up with MFA

But wait, there's more. A good PBA will employ multi-factor authentication (MFA) in its startup process. MFA, also known as two-factor authentication or 2FA, augments the username-password combo with another credential. MFA is a combination of the following:

- Something the user has, such as a security token or key.
- Something the user is, such as a fingerprint, voice, or even typing speed.
- Something the user knows, such as a password.
- Somewhere the user is, such as a GPS coordinate.

Hardware security dongles (a YubiKey, for example) contain a license key or some other cryptographic protection mechanism that the user plugs into a USB port. Some organizations do not allow active USB ports in their computer systems. In the case of organizations like federal agencies and the DoD (including civilian employees and contractor personnel), a common option is to employ a smartcard called a Common Access Card (CAC), which will require the system to be equipped with an appropriate card reader.

System design is holistic

Not surprisingly, we get so focused on "the latest and greatest" or on using technology to solve our problems that we often neglect the human part of the equation. We have predictable habits. We choose easily guessed shortcuts.

Technology does its best: Think about some of the ways in which we use security tools today that we didn't know about just a few short years ago: fingerprint or facial recognition to unlock our smartphones, for example, or receiving a security code via text message or email to make sure that you are you when logging into your credit card website.

These now-commonplace measures can be bolstered with secure data storage in everyday laptop and desktop computer systems. The more system designers use these components while thinking ahead to the cyber challenges that will continue to be with us, the more secure our systems and our data will be.

www.digistor.com
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Visualization of how a removable drive is integrated into a standard desktop computer.

"It's hard to escape the message that cybersecurity has never been as important as it is today."

Lithium batteries take the IIoT everywhere



Monitoring level and flow in a sewer system using an Ayyeka IoT edge device powered by an $LiSOCl_2$ battery

Industrial grade lithium batteries provide the on-demand power required to expand digital connectivity into remote locations and extreme environments

On the fast lane to becoming a multi-trillion-dollar industry, the Industrial Internet of Things (IIoT) has ushered in the age of Industry 4.0, where manufacturing and industry increasingly rely on smart data and analytics to deliver more intelligent decision-making.

At the heart of the IIoT and Industry 4.0 are lithium battery-powered devices that operate in extreme environments, enabling AI on the edge, machine-to-machine (M2M) communication, machine learning, and other advanced technologies to expand almost limitlessly without the need for expensive hard-wiring.

Battery-powered devices serve to capture, exchange, store, analyze, and apply data more intelligently to improve operational efficiencies, identify problems, enhance quality control, track assets, promote greater environmental sustainability, optimize supply chains, enhance field service, and initiate predictive maintenance programs that save time and money and reduce downtime. Popular applications include supervisory control and data acquisition (SCADA), process control, industrial robotics, asset tracking, safety systems, environmental monitoring, M2M, AI, and wireless mesh networks, to name only a few. Lithium batteries are at the heart of this digital transformation.

Specialized batteries are required for long-term deployments

To support long-term deployments, the ideal power source must be capable of operating for extended periods without having to replace the battery. To conserve energy, these devices need to employ low-power chipsets, low-power communications protocols (i.e., WirelessHART, ZigBee and LoRa), and proprietary techniques aimed at minimizing energy consumption during 'active' mode. While beneficial, these energy-saving techniques are dwarfed by the choice of battery.

Numerous primary battery chemistries are available, each offering unique advantages and disadvantages. At one end of the spectrum are consumer alkaline cells that deliver high continuous current but suffer from very high self-discharge rates (up to 60% per year) that make them generally unsuited for long-term deployments. Alkaline cells have low capacity and low energy density, which adds size and bulk. These cells also contain water-based constituents that are more likely to freeze, thus limiting their use to indoor settings and moderate climates.

On the opposite end of the spectrum are lithium-based chemistries. As the lightest non-gaseous metal, lithium features an intrinsic negative potential that exceeds all other metals, delivering the highest specific energy (energy per unit weight), highest energy density (energy per unit volume), and higher voltage (OCV) ranging from 2.7 to 3.6V. Lithium cells are also non-aqueous and therefore less likely to freeze in extremely cold temperatures.

Among lithium primary batteries, bobbin-type lithium thionyl chloride ($LiSOCl_2$) chemistry is overwhelmingly preferred for remote wireless applications. Bobbin-type $LiSOCl_2$ chemistry delivers the highest capacity, highest energy density, an extended temperature range (-80 C to +125 C), and an incredibly low self-discharge rate (less than 0.7% per year for certain cells). The benefits of this chemistry include higher reliability, long operating life (up to 40 years), wider temperature range, higher energy density, and higher voltage.

Bobbin-type $LiSOCl_2$ cells were specifically developed for use with devices that draw average current measurable in micro-amps with pulses in the multi-amp range. Meanwhile, niche applications are also arising that require milli-amps of average current with multi-amp pulses, drawing enough average energy to prematurely exhaust a primary (non-rechargeable) battery. These specialty applications often require an energy harvesting device in combination with an industrial grade

Continues on page 18>

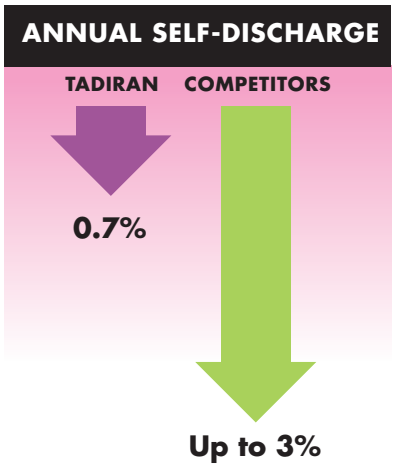
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rechargeable Lithium-ion (Li-ion) battery to store the harvested energy and generate high pulses.

Low battery self-discharge increases return on investment

Every battery suffers from some amount of self-discharge, as chemical reactions continually drain current even while the cell is not being used or is disconnected. This problem is especially acute for devices intended for long-term deployment that operate mainly in a 'standby' mode, where more energy can be lost annually as a result of self-discharge than is required to operate the device.

Bobbin-type $LiSOCl_2$ cells are uniquely designed to minimize self-discharge by harnessing the passivation effect. Passivation occurs when a thin film of lithium chloride (LiCl) forms on the surface of the lithium anode, separating it from the electrode to greatly reduce the chemical reactions that lead to high self-discharge.

Leading battery manufacturers have developed ways to maximize the passivation effect. As a result, top quality bobbin-type $LiSOCl_2$ batteries can have a self-discharge rate as low as 0.7% per year, retaining nearly 70% of their original capacity after 40 years. By contrast, lesser quality bobbin-type $LiSOCl_2$ cells can have an annual self-discharge rate as high as 3% per year, exhausting roughly 30% of their available capacity every 10 years, which severely limits their operating life.

High pulses drive two-way communications

To support two-way wireless communications and other forms of connectivity over public and private networks, a remote battery-powered device can require high pulses of up to 15A to support data queries and transmission. Standard bobbin-type $LiSOCl_2$ cells cannot deliver high pulses due to their low-rate design. This challenge can be easily solved with the addition of a patented hybrid layer capacitor (HLC).

Under this hybrid approach the standard bobbin-type $LiSOCl_2$ cell delivers low-level background current during 'standby' mode while the HLC delivers the high pulses needed to power two-way wireless communications and other advanced functionality. The patented HLC also features a unique end-of-life voltage plateau that can be interpreted to deliver 'low battery' status alerts to support predictive maintenance programs that reduce downtime.

Remote wireless devices benefit from long-term solutions

With any long-term deployment, it obviously reasons that the ideal battery-powered solution should last for the entire lifetime of the device to reduce or eliminate the need for costly battery change-outs.

Unfortunately, a lower quality battery with an elevated self-discharge rate may be hard to distinguish since the cumulative annual capacity losses may take years to become fully measurably. Additionally, the theoretical models and algorithms used to calculate expected battery life can be highly unreliable since they tend to underestimate the passivation effect as well as long-term exposure to extreme temperatures. As a result, careful due diligence is required when specifying batteries to ensure a robust solution: a process that begins by demanding all potential battery suppliers to supply fully documented and verifiable test results along with in-field performance data under similar loads and environmental conditions.

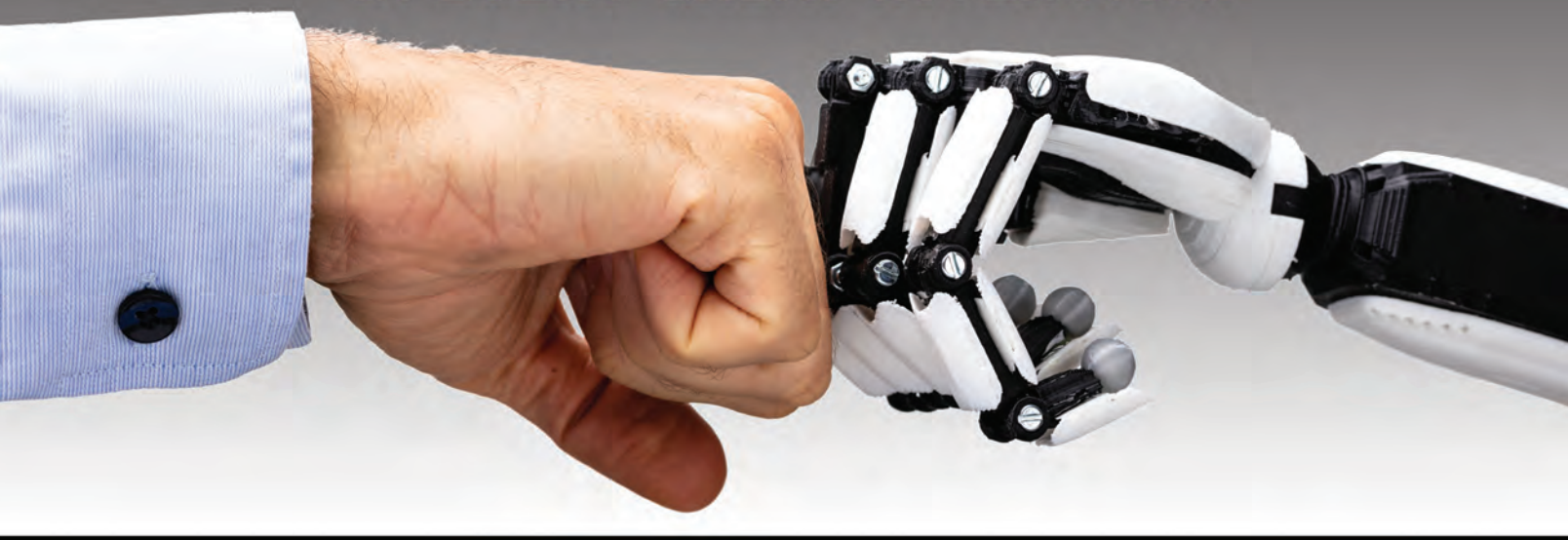
Wireless technology is spreading everywhere, and industrial grade ultra-long-life primary and rechargeable Li-ion lithium batteries are playing a central role in providing the longevity and high pulse energy required for high-speed IIoT connectivity.

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"At the heart of the IIoT and Industry 4.0 are lithium battery-powered devices that operate in extreme environments."



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ROBOTS, AUTOMATION & THEIR ELECTRONICS

Featuring Battery Clips, Contacts & Retainers

Though robots and automation are in use today in a wide variety of industries, robotics is still considered a futuristic idea. Many may be surprised to learn that the first electronic robots were built in 1948. What's even more surprising is evidence of the first automaton taking us back 800 years and writings from Turkey indicating automatic devices used to entertain.

Entertainment was the main drive behind the development of automatons for many centuries. Eventually, the benefits of automating simple, repetitive functions reached the manufacturing sector and grew into the complex, computer-driven automation we know today.

Advances in computers and electronics have facilitated fast progress for industrial automation. Factories and other industrial operations use robots for a wide range of automated processes.

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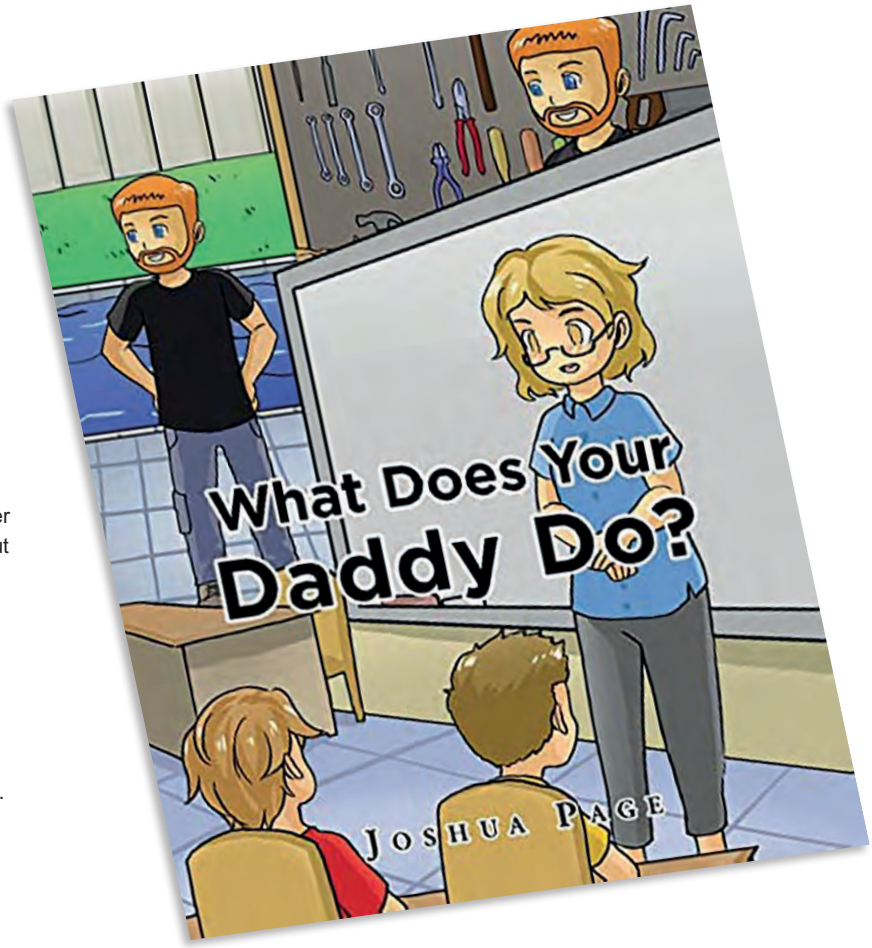
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See our Blog

What Does Your Daddy Do?

Going to college is not the only option open to young people.



On my meandering wanderings through life, I've met people festooned with achievements and awards who would be ranked as geniuses on any academic scale you'd care to mention. Some of them are great guys and gals; some have the common sense of a walnut; and some are slimeballs in whose presence you will find me absent. I've also met numerous people without any form of engineering degree who can out-engineer me any day of the week without breaking a sweat.

Prior to WWII, my dad was a dancer with his two brothers on the variety hall stage. After WWII, with one of his brother's beaten to death in a prisoner of war camp and my dad unable to dance (he was riddled with bullets and shrapnel), he took a position as storekeeper at an engineering company.

One of my dad's sisters married an ex-serviceman from Yugoslavia. Another married an ex-serviceman from Poland. They all emigrated to Canada. One of these uncles owned a gentleman's barbershop while the other was plumber (paradoxically, he ended up teaching plumbing at university).

One of my oldest friends is a painter and decorator. Another is an insurance salesman (but we won't hold that against him). One of my cousins used to sell large meat pies to small shops (actually, he was the best salesman I've even known—he could sell you something you already owned if you weren't careful).

All of these people enjoyed (are still enjoying) wonderful lives without being burdened with a degree. The thing that really gets up my nose is when people with academic qualifications and "white-collar" jobs (the folks who typically work in airconditioned office settings in clerical, administrative, and management roles) look down on everyone else, including blue collar, black collar, and pink collar. "Damn them for their impertinence," I cry.

The reason I mention all of this here is that I just heard about a book called "What Does Your Daddy Do?" by Joshua Page. An electrician by trade, Joshua is passionate about informing the younger generation of all the career options they have in addition to college.

For several years, Joshua has been speaking to kids on career days at High Schools. The idea behind his book, which is geared to fourth-to-sixth graders, is to plant seeds in younger minds that the trades are an excellent option by describing some of the neat things that tradespeople get to do every day.

I think this is an awesome idea. Everyone should feel good about what they do. There really are more options in life than going to college. Having one or more degrees is great if that's what floats your boat, but not having a degree means not a thing in the grand scheme of the universe. Not everyone is lucky enough to do cool stuff like welding underwater. Some of us are forced to spend our days in poky offices squinting at flickering computer screens and sweating over computer keyboards (I try to be brave). All I know is that when things go pear-shaped in my home, I worship the ground my plumber, electrician, and HVAC guys and gals walk on.



Clive "Max" Maxfield, Editor at DENA, CTO of LogiSwitch, and freelance technical writer and consultant

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Silicon Carbide is Finally a Hit Despite Design and Sourcing Challenges

Investment in silicon carbide is surging on strong EV demand even as OEMs and design engineers extend its use for a widening range of power applications

Silicon carbide (SiC) is at last getting a shot at stardom. After decades of playing a secondary role to silicon semiconductor, its more successful and widely used cousin, SiC is increasingly in the news nowadays and on the minds of automotive semiconductor design engineers, their managers and senior executives at the biggest suppliers of wafers, epiwafers, substrates and power devices to OEMs in the transportation, industrial and medical equipment markets.

Technology developments, especially in the automotive industry where OEMs are avidly chasing the long-held dreams of autonomous driving and robotaxis, contributed to the newly found interest in SiC devices. Beyond the automotive space, semiconductor vendors such as Infineon, ON Semiconductor, Rohm, ST Microelectronics and Wolfspeed are pushing for greater adoption of SiC by developers and enterprises in the electrification, industrial, medical and power generation and distribution markets.

"The rising usage of SiC-based chips in the electronic section of electric vehicles (EVs) is anticipated to positively influence the dynamics of the industry. The prominent EV manufacturers, including Tesla, use SiC-based chips in their vehicles," said analysts at Grand View Research, in a report. "The adoption of SiC power devices in electronics, renewable energy systems, and automotive has increased tremendously over the last few years and is anticipated to gain additional thrust over the coming years."

Market researchers say sales of SiC devices will more than triple by the end of the decade as manufacturers from various ends of the electronics industry design them into end products. Grand View Research, for example, is projecting an increase in SiC sales to approximately $8 billion by 2030, from just under $3 billion, in 2021, growing at a compound annual growth rate of 11.7 percent. Figures from Yole Group, a Lyon, France-based market research firm, indicate demand for SiC could be even more aggressive. Yole forecasts an increase in SiC market sales to $6.3 billion by 2027, citing increased demand from the EV market with contributions from other applications.

"With a multi-billion-dollar prospect in the coming five years in a strong market mainly pulled by EV applications, SiC is expected to enter more and more applications," said Poshun Chiu, technology and market analyst at Yole.

The robust growth prospect for SiC devices is also prompting changes in the dynamics of the market. SiC suppliers are expanding production capacity and reshaping their business models to take advantage of rising opportunities and to ensure adequate supplies of substrates and raw wafers. SiC vendors are also bringing back the integrated device manufacturer (IDM) model to ensure they get the highest returns on investments, according to analysts.

"SiC raw wafer cost represents more than 60 percent of the epi-wafer cost for 1200V SiC MOSFETs," said Amine Allouche, technology and cost analyst at System Plus Consulting, in a report. "Even though SiC wafer capacity has been expanding, there is still a strong motivation for innovation in quality, throughput, and cost."

Changing Landscape

A raft of news releases in just the last few months confirm how dramatically the SiC landscape has changed since a handful of companies began quietly investing in the segment about 20 years ago. Infineon Technologies, for example, introduced its first SiC-based diodes in 2001 and power modules integrated with SiC components in 2006. The company has since ramped its investment in the sector. Earlier this year, it announced plans to spend more than $2 billion on new capacity at its SiC and GaN facility in Kulim, Malaysia. The additional investment will help boost revenue at the site by more than $2 billion annually, the company said.

"The expansion of our SiC and GaN capacity is readying Infineon for the acceleration of wide bandgap markets," said Jochen Hanebeck, CEO of Infineon, in a statement announcing the investment. "We are creating a winning combination of our development competence center in Villach and cost-effective production in Kulim for wide bandgap power semiconductors."

The company has since made further moves to strengthen its presence in the SiC market. Aiming to expand its SiC sales to $1 billion by 2025, Infineon in August signed what it called a multi-year sourcing agreement for silicon carbide with supplier Coherent Corp., one of the top suppliers of wide-bandgap compound to semiconductor suppliers. The deal helps to secure Infineon's supply of SiC substrates but will also serve to support Coherent's as it expands investments

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in 150mm and 200mm fabs, the companies said.

"Infineon is increasing investments in its SiC manufacturing capacity to meet the rapidly growing demand from our customers," said Angelique van der Burg, chief procurement officer of the Munich-based semiconductor supplier. "SiC compound semiconductors set new standards in power density and efficiency. We are leveraging them to deliver on our strategy of decarbonization and digitalization."

Wolfspeed Inc., one of the market's leading suppliers, in September announced what promises to be the industry's largest manufacturing expansion, which also accelerates the company's plan to become a major SiC device vendor. The company said it will spend $1.3 billion on the first phase of a fab capacity addition that could eventually reach $5 billion, according to some analysts. By focusing on 200mm SiC wafers, which are 1.7 times bigger than 150mm wafers, the company expects to both increase output and sharply scale down costs.

"Demand for our products continues to grow at a rapid pace, and the industry continues to be supply constrained," said Gregg Lowe, CEO of Wolfspeed, in a statement. "Expanding our Materials production will further our market leadership and allow us to better serve the growing needs of our customers."

Other SiC players have stepped up their own games too. Competitors are jostling for market share as well as

Angelique van der Burg**, chief procurement officer, **Infineon



pushing to assure customers of sufficient supplies considering recent procurement snafus in the automotive industry, according to observers. Analysts said the trend now within the industry is towards the IDM model or as close to this as possible.

STMicroelectronics has said it wants to increase the amount of SiC substrates it produces internally to 40 percent of its requirements and in October announced plans to build a new manufacturing facility in Italy. It expects to spend about $730 million on the facility in Catania and said it should begin production in 2023. The new plant will produce 150mm SiC epitaxial substrates at the facility and complement sourcing from suppliers, according to ST executives.

"ST is transforming its global manufacturing operations, with additional capacity in 300mm manufacturing and a strong focus on wide bandgap semiconductors to support its $20 billion-plus revenue ambition. We are expanding our operations in Catania, the center of our power semiconductor expertise and where we already have integrated research, development and manufacturing of SiC with strong collaboration with Italian research entities, universities and suppliers," said Jean-Marc Chery, ST's CEO, in a statement announcing the new SiC investment. "This new facility will be key to our vertical integration in SiC, reinforcing our SiC substrate supply as we further ramp up volumes to support our automotive and industrial customers in their shift to electrification and higher efficiency."

On Semiconductor appears to be using the same strategy. The company has this year announced several transactions buoying its presence in the SiC market. In August, it announced the expansion of its SiC facility in Hudson, New Hampshire, with the goal of increasing boule production by up to "five times year-over-year," to give the company greater control over the supply chain. It followed up one month later with the inauguration of its newly expanded SiC fab in the Czech Republic, raising output at the site "by 16 times".

"Together with our SiC boule production expansion in Hudson, NH, these increased SiC manufacturing capabilities enable Onsemi to provide customers the critical supply assurance to meet the rapidly growing demand for SiC-based solutions," said Simon Keeton, general manager of power solutions group at Onsemi, in a statement. "Full control over our SiC manufacturing supply chain and the market-leading efficiency of our products underscore Onsemi's progress toward SiC leadership."

Chinese players have also entered the SiC market. Local demand has increased due to strong Chinese presence in the EV market as well as encouragement by the government, which is making efforts to wean China off foreign semiconductor supplies and technology. More than 50 Chinese companies have joined the race for SiC market share in only the last few years, many of them targeting the substrates segment while others are shooting for a bigger role via the IDM model, according to Yole's Chiu.

"It is still the case that the Chinese market needs devices from major SiC companies based in Europe, North America, and Japan," Chiu said, in a report. "With the strong demand for EVs, in addition to the development of renewable energy and industrial applications, Chinese companies see opportunities from a long-term perspective and adapt their strategy accordingly."



Gregg Lowe**, CEO at **Wolfspeed



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Not all robots are shaped like humans

New robots include sea-creature-inspired robots and self-replicating robots

Hello, my name is Amelia and I love robots. I love robots in all shapes and sizes. As the host of Amelia's Weekly Fish Fry podcast at EEJournal.com, I have had the privilege to report on the advancements and innovations in robotics quite a bit over the last ten years and two of my all-time favorite stories involve very small robots.





Amelia Dalton, Host of Amelia's Weekly Fish Fry podcast at EEJournal

Tiny, sea-creature-inspired robots

Have you heard of the tiny, octopus shaped robots developed by Northwestern University? Inspired by sea creatures and made to be used in aquatic environments, these centimeter-sized robots are shaped like four legged octopi and are made of up of around ninety percent water by weight. These tiny aquatic robots can walk at human speed, climb hills, transport cargo, and do a funny little break-dance motion to release a particle as well. And they do all of this without complex hardware, electricity or hydraulics. How? They are activated by light and walk in the direction of an external rotating magnetic field.

These sea-creature-inspired robots are constructed of a soft matter that includes a hydrogel that contains a scaffold-like structure made up of ferromagnetic nanowires that change shape in response to light. So, when these robots encounter light, the molecules in the hydrogel become hydrophobic. When this hydrophobic process occurs, the robots repel water which causes the robot to change from the flat position to a standing position. When the light is turned off, the robot will return to its flat position because its water molecules have gone back to their original state.

These robots also respond very quickly to rotating magnetic fields. When they are in a bent position and a rotating magnetic field gets close to them, their embedded skeleton exerts cyclic forces to activate their legs. When the magnetic fields rotate fast enough, these tiny robots have the ability to walk as fast as a human.

When the team from Northwestern University combined these steering motions and walking motions together, they were able to remotely operate and direct the robots through narrow passages and complex routes.

Once the robots' responses to magnetic fields and light were coupled, the

researchers managed to make the robots pick up cargo and deliver it to a specific destination by rolling or walking. To drop cargo off at its destination, the robot can either invert its shape, thereby allowing the cargo to just slide off, or it can perform a breakdance spin-type motion to dislodge the cargo.

Samuel Stupp, head researcher on this project at Northwestern University, puts his research in perspective like this, saying: "Conventional robots are typically heavy machines with lots of hardware and electronics that are unable to interact safely with soft structures, including humans. We have designed soft materials with molecular intelligence to enable them to behave like robots of any size and perform useful functions in tiny spaces, underwater or underground."

Seeing a bright future for future applications, Samuel says: "Eventually, we'd like to make armies of microrobots that could perform a complicated task in a coordinated way. We can tweak them molecularly to interact with one another to imitate the swarming of birds and bacteria in nature or schools of fish in the ocean. The molecular versatility of the platform could lead to applications that have not been conceived at this point."

The world's first self-replicating living robots

Did you hear that a team of researchers created the world's first millimeter-sized living, programmable organisms? With the help of some programmed repurposed living cells scraped from frog embryos, along with a specialized algorithm that created thousands of simulated designs for new life-forms, a team of researchers from the University of Vermont, Tufts University, and the Wyss Institute for Biologically Inspired Engineering at Harvard University created a new class of artifact called Xenobots. A mere eleven months later, this team was able to design these Xenobots to replicate themselves, thereby discovering an entirely new form of biological reproduction.

So, how does this new form of reproduction apply to these new millimeter-sized living, programmable organisms? The team found that their Pac-Man shaped Xenobots could swim out into their petri dish, find single cells, gather hundreds of them together, and then assemble these "baby" Xenobots inside their mouths. And then, BAM! A few days later, there were new Xenobots that look and move just like their "parents."

An important key in this new discovery within Xenobot replication is the use of an artificial intelligence (AI) program that uses the Deep Green supercomputer cluster at UVM's Vermont Advanced Computing Core. This algorithm was able to test billions of body shapes in simulation—pyramids, triangles, starfish, squares—with the goal to find a body shape for the parent Xenobots that would be the most effective at motion-based kinematic replication, Eventually, it came up with the shape of Pac-Man, and it worked.

This kind of kinematic replication is not new—it's a well-known method to reproduce molecules—but, until now, it had not been observed at this scale.

Michael Levin, Ph.D., a professor of biology and director of the Allen Discovery Center at Tufts University and co-leader of the new research, puts it in focus like this: "This is profound. These cells have the genome of a frog but, freed from becoming tadpoles, they use their collective intelligence, a plasticity, to do something astounding."

So, where are we going with this research? Joshua Bongard, Ph.D, a computer scientist and robotics expert at the University of Vermont who co-led the new research contends that this type of research goes beyond building Xenobots in petri dishes. As he says: "The speed at which we can produce solutions matters deeply. If we can develop technologies, learning from Xenobots, where we can quickly tell the AI: 'We need a biological tool that does X and Y and suppresses Z,' that could be very beneficial. We need to create technological solutions that grow at the same rate as the challenges we face."

Would you like to listen to more stories about robotics? To celebrate the five hundredth episode of my EE Journal Fish Fry podcast, we launched a special playlist that highlighted nine different podcast episodes that feature stories about robotics. These include my interview with Florian Pestoni, CEO of InOrbit, about the future of AI and robotics in the workforce, and also my discussion with HanBin Lee, CEO of Seoul Robotics. You can check out these episodes on youtube.com/eejournal or by visiting eejournal.com and selecting the "Fish Fry" header at the top.

www.eejournal.com

"We need to create technological solutions that grow at the same rate as the challenges we face."

Increasing the lifetime of optocouplers

The reliability of an optocoupler can be increased by employing a burn-in procedure

Power supplies, home appliances, and battery chargers for smart phones are all examples of applications that need galvanic isolation between two circuits. Galvanic isolation can be achieved using transformers, capacitors, or optocouplers. Optocouplers offer many advantages, including the elimination of impedance mismatching and excellent noise immunity with high isolation voltage in a small package.

Structure of an optocoupler

The simplest optocoupler consists of an infrared LED optically coupled with, but electrically isolated from, a phototransistor. When the LED emits light, current will flow in the phototransistor proportional to the light intensity.

There are two types: DC input optocouplers have one LED on the input side and therefore conduct current in only one direction. These are commonly used in switching applications. AC input optocouplers have two LEDs connected in reverse parallel allowing current flow in both directions resulting in half waves of an alternating input signal.

Choosing the right optocoupler

One important factor is isolation voltage, which is determined by creepage, clearance, and insulation thickness (the package, so to speak). Different package sizes and types with various leadframe options (DIP4, SOP4, LSOP4, THT, or SMT mounting packages, etc.) allow engineers to pick suitable components for their applications.

An important parameter describing an optocoupler's performance is the current transfer ratio (CTR), which is defined as the ratio of the current flowing through the LED, I_F and the current flowing through the phototransistor, I_C.

To build stable applications when designing with optocouplers, it is important to understand that the CTR value is affected by the ambient temperature and that it degrades over time.

The Würth Electronics optocoupler portfolio provides customers with the ability



EMI/RFI

Conductive heat-shrink tubing for EMI/RFI cable shielding

Heat-shrink tubing can provide a versatile EMI RFI shielding solution in industrial, medical, and Mil/Aero applications

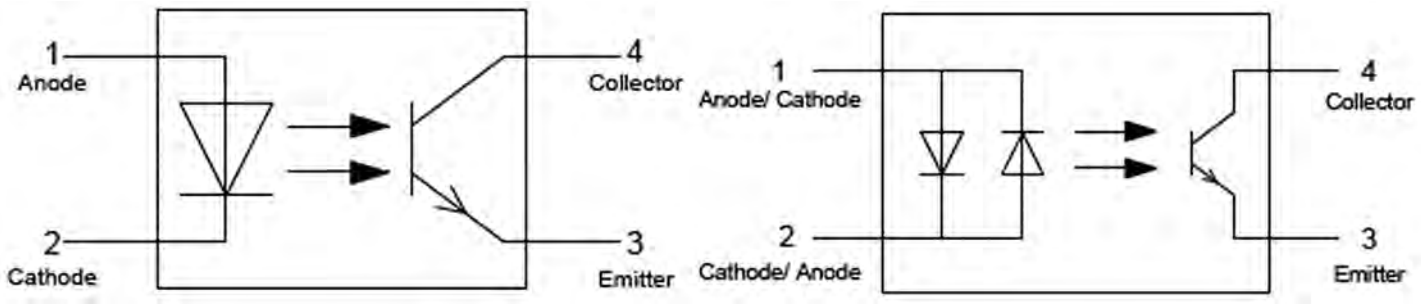
Are you designing an interconnect system that could be susceptible to electromagnetic or radio frequency (RF) interference? If so, you have several options, but one cost-effective and lightweight solution could be your best "electronic bandage."

This solution, using shielded conductive heat-shrink tubing with a metallic conductive ink coating on the inside of the tube provides electrical continuity and EMI, RFI, and ESD shielding around the joints being connected. This tubing can solve a variety of EMI/RFI problems easily and inexpensively and does not require that the designer, the engineer, or the user have in-depth knowledge of electromagnetic and RF interference and their attendant shielding issues.

ECCO's ShrinkMate combines use of MII-I-23053/5 polyolefin tubing, or clear medical grade polyester tubing, and a highly conductive polymer thick film silver coating. The coating reduces evenly with the tubing using a heat gun, oven, or any conventional heat source. When the tubing is set, the conductive layer provides an electrical connection between the outside surface of the objects being joined by the tubing. Coaxial cable butt joints and cable to shielded connector housing joints can be made fast and easy and without the use of solder.

Although not all EMI/RFI cable shielding problems can be fixed with a single product like heat-shrink tubing, this can be the most cost-effective and easily implemented solution to address many EMC challenges.

www.eccoconnectors.com



to choose ratios from 50% to 600% depending on the application.

Ensuring long life

One of the main considerations in circuit design is expected lifetime, which is based both on the product itself and on its constituent components. Components can fail completely or degrade in performance over time. For optocouplers, performance in the form of the CTR degrades over time depending on the operating conditions.

Since the lifetime of optocouplers can exceed several decades, an accelerated stress test is performed using increased operation conditions. When testing optocouplers with increased temperature and current, the degrading mechanisms occur much faster than they would under normal operation conditions with smaller temperature and lower current.

The main thing to note is that CTR degradation can be reduced by reducing the operation temperature and driving forward current of the LED.

Some suggested design guidelines to increase the lifetime of optocouplers are (1) decrease the effective operating time of the optocoupler, (2) decrease the operating diode current and power dissipation from the LED, (3) minimize peak transient currents through the LED, and (4) adjust the duty cycle of the LED to keep the average current low.

Additionally, in the case of safety-critical products, such as devices with medical application, the reliability of the optocoupler can be increased by employing a burn-in procedure. However, to avoid damage of the devices, the burn-in parameters should be kept below the absolute maximum ratings.

www.we-online.com



Computing at the speed of light

Welcome to a new world in which communication and computation is performed using light



Clive "Max" Maxfield, Editor at DENA, CTO of LogiSwitch, and freelance technical writer and consultant

I love science fiction. One of my favorite scenes is the "Tears in rain" monologue by the character Roy Batty (portrayed by Rutger Hauer) in the 1982 Ridley Scott film "Blade Runner." This classic scene starts with Roy saying: "I've seen things you people wouldn't believe..." I know what he meant because I've recently been seeing things in the optoelectronics domain that even I don't believe.

FMCW LiDAR

Most light detection and ranging (LiDAR) systems tend to be big, bulky, power-hungry, and expensive. These systems are based on a time-of-flight (TOF) approach, which means they generate powerful pulses of light and measure the round-trip time of any reflections.

By comparison, a relatively new incarnation called frequency modulated continuous wave (FMCW) LiDAR sends out a continuous laser beam at a much lower intensity than its pulsed TOF cousins. This form of LiDAR makes it possible to extract instantaneous depth, velocity, and polarization-dependent intensity on a per-pixel basis while remaining fully immune to environmental and multi-user interference.

I was recently chatting to the folks at SiLC Technologies (www.silc.com) who have now demonstrated the ability to perceive, identify, and avoid objects at a range of more than 1 kilometer with their highly integrated Eyeonic FMCW LiDAR.

In-Chip Optical Interconnect

Another company that has developed some very interesting optoelectronics technology is Ayar Labs (www.ayarlabs.com). For a modern data center to offer peak performance, it's necessary for data to be able to pass from chip-to-chip, shelf-to-shelf, and rack-to-rack at lightning speed. Unfortunately, the bandwidth requirements we expect to see in the very near future far exceed the capabilities of traditional copper-based electrical interconnect technologies.

The solution is to use optical interconnect, but it is not sufficient to take existing host devices (CPUs, GPUs, etc.) and then add external optics. The highest levels of performance can be achieved only by implementing the optical input/output (I/O) in the form of chiplets that are incorporated inside the host device package.

This is what the folks at Ayar Labs have done. As a result, it's now possible for CPUs, GPUs, memory, and storage to be located tens, hundreds, or even thousands of kilometers from each other.

Optical AI

I recently had the opportunity to talk to a company called CogniFiber (www.cognifiber.com), whose tagline is "Computing @ The Speed of Light."

When most people think about the optical systems used in data communications, they assume optical cables containing multiple individual fibers. However, a new approach for ultra-high-capacity applications employs multicore fiber (MCF) involving special optical fibers containing multiple cores in a single cladding.

In traditional data communications applications, engineers strive to keep any crosstalk between cores as low as possible. By comparison, the folks at CogniFiber endeavor to maximize the crosstalk between cores and to use this crosstalk to perform AI/ML type computations.

What we are talking about here is a neural network implemented inside a single optical fiber composed of thousands of cores. Depending on the diameters and proximity of the cores, it's possible to perform computations using fibers only a few centimeters long. The result of this in-fiber processing is to deliver a 100-fold boost in computational capabilities while consuming a fraction of the power of a traditional semiconductor-based solution. We truly do live in interesting times.

www.designing-electronics.com



Harwin extends high-power connector series



Supports standard cable connections and made-to-order cable assemblies

For over 70 years, Harwin has been supplying engineers with the connectors they need to meet the most demanding specifications.

Building on the success of its 3kV-rated Kona high power connectors, Harwin has introduced more variants to this popular range. The new additions are male connectors suitable for use with both standard cable connections and made-to-order cable assemblies. Initially launched in November 2020, the award-winning Kona series is widely used in many applications, including electric vehicles, UAVs, robotics, and NewSpace (i.e., the emergence of the private space industry). These compact, high-reliability connectors have contacts rated at 60 Amperes each, giving a total current carrying capacity of 240 Amperes when using the four-contact version.

The new male connectors provide connections for all Kona contact count options. In addition, engineers can select housings with or without panel mount fixings (compatible with the thumbscrew fixings on the female). Reverse-fix thumbscrews (compatible with female reverse-fix panel mount fixings) are also available, and all fixings are designed to mate-before-lock.

Kona cable assemblies are available on-demand, produced at the company's dedicated cable assembly facility. Options include double-ended and single-ended variants with supporting male-to-male, male-to-female, and female-to-female configurations.

Engineered and manufactured at Harwin's production facility in Portsmouth, England, the 60A-rated high-current Kona product line is fully quality-assured and complimented by EMI/RFI shielding cans and a comprehensive range of board-level hardware including spacers, spring contacts, cable clips, and jumper links.

www.harwin.com

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Harwin's connector products are proven to perform in extreme conditions, with shock, vibration and temperature range rigorously tested.

Micro connectors start at 1.25mm pitch delivering 2A per contact, up to 8.5mm and 60A - we cover a wide range of applications for when SWaP matters most.

With our quality, service, support, and highly reliable products, you can depend on Harwin.

Connectors shown actual size



Supplying and selecting Perfect Parts

Planning has never been more important than it is in today's global marketplace

We are living in a day and age where information and electronic part data has never been more important. Both global demand and political turmoil are straining supply chains. Making the right choices in selecting parts for your design is the only way to secure your future production and the life cycle of your end products. Perfect Parts understands that making data driven decisions is essential to the design of your board and identifying the gaps in semiconductor manufacturing. With a design focused approach to distribution, Perfect Parts is bridging the gap between design and production.

We are currently in the process of launching design tools complete with supply chain solutions all in one platform which is set to release in 2023. Perfect Parts will provide information for engineering, design, and purchasing professionals including datasheets, product descriptions, RoHS, environmental compliance data, drawings, application information, parametric, alternate parts, crosses, and product availability. Part data will be available for hundreds of millions of electronic parts and will be readily available at your fingertips for your next design.

Perfect Parts has an extensive global network of trusted OEM and EMS partners around the world. This network includes exclusive sources of excess electronic components, as well as factory direct material from across the globe. We fully guarantee our material for fit, form, and function. Our parts and vendor processes are the best the industry offers with access to full traceability where its required or third-party test reports. We have access to hundreds of millions unique components including active, obsolete, and end-of-life lines. We stock a wide selection of integrated circuits and semiconductor product lines, as well as, a variety of active components, high performance processors, relays, transformers, connectors, tantalum capacitors, thin film capacitors, memory, and much more.

Partnering with the right distributor has never been more important to keeping your supply chain running smoothly. It is important to select the right distributor with the capability and the experience to supply not only parts but the information necessary to make your next design challenges easier. Choosing the right partners can ensure a higher level of success by ensuring your projects get ahead of soaring product costs, high allocations, and raw material shortages. Planning during the design stage has never been more critical than it is in today's global marketplace.

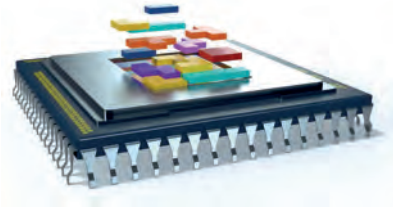
OEM and Contract manufacturers are finding that due to time constraints and soaring costs many designs are overbudget and redesigning is the option for future success. Perfect Parts is an experienced partner in finding alternative parts and crosses ensuring future success across all industries including Automotive, Industrial, and Semiconductors. With millions of datasheets and a highly knowledgeable staff, overcoming supply chain challenges has never been so easy.

Perfect Parts not only offers electronic components for sale, but also aids our clients in selecting the best components with reliable life cycles. As a semiconductor distributor it's an important task to ensure customers are selecting products that will complement the lifetime of the product build. Buying electronic components can become a stressful task when monitoring hundreds or thousands of parts in an electronic assembly. Perfect Parts' electronic components catalog is one of the largest and most complete catalogs in the world. Wholesale electronic component distributors normally try to limit their line cards and forget that they are not servicing the customer's full bill of materials and the customer is sent into a frenzy trying to locate all the components needed for electronic design and manufacturing. Most importantly, an engineer must know the full product details regarding the electronic components they want to select. Knowing whether a semiconductor has a cross reference component to another electronic component manufacturer is smart when designing a product. Reach out to Perfect Parts to help you in locating both the information and products to help you build your next design. Our team is dedicated in assisting engineers in locating the correct parts and offering buyers the tools they need to execute a safe and continuous supply chain. No matter at what stage a problem presents itself, Perfect Parts is here to support you and your team.

www.perfectelectronicparts.com



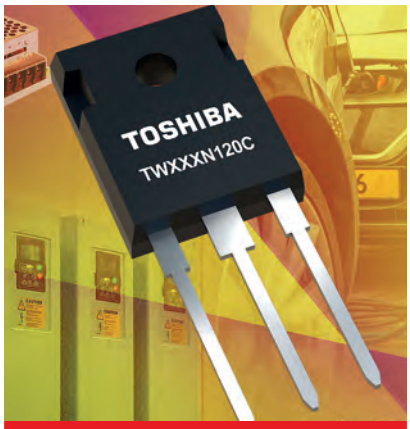
Agile Analog launches new digital standard cell library



Based in Cambridge, England, Agile Analog, the analog IP innovator, has launched its Digital Standard Cell Library (DSCL). This provides a comprehensive library of digital cells enabling designers to implement the digital circuits required to control analog blocks in mixed signal solutions. The new digital library is available in thick-oxide based cells, operating above the core voltage domain, minimizing leakage and allowing easy migration across different process nodes, even in FINFET technologies.

These digital cells will operate within the analog voltage domain, which avoids excessive level shifting to the core domain and enables digital control to be tightly coupled to analog IP. The DSCL has been developed to be process agnostic and therefore is available in the same processes as Agile Analog's analog IP.

www.agileanalog.com



1200V SiC MOSFETs from Toshiba boost industrial power-conversion efficiency

Toshiba has launched five 1200V silicon-carbide (SiC) MOSFETs that leverage the company's third generation SiC technology to boost the energy efficiency of high-voltage industrial applications. These devices are used in equipment such as EV charging stations, photovoltaic inverters, industrial power supplies, uninterruptible power supplies (UPS), and bidirectional or half-bridge DC-DC converters.

By improving the on-resistance x gate-drain charge (RDS(on) x QGD) figure of merit by more than 80%, Toshiba's latest SiC technology elevates both conduction and switching performance in power-conversion topologies.

www.toshiba.com



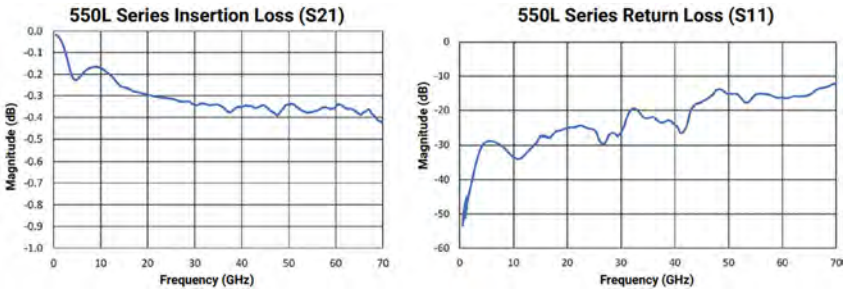
Ultra-broadband capacitors for optoelectronics

A new single component coupling/ DC blocking capacitor is now available

Optoelectronics is becoming more of a commodity industry as the number of data centers continues to grow in support of cloud computing, 5G, and AI. When this is coupled with the way in which remote regions are becoming increasingly accessible and how social media is becoming increasingly pervasive to everyday life, it becomes clear that the performance and reliability of optical transmission networks will continue to grow in significance as well.

Typical ROSA (receiver optical sub-assembly) and TOSA (transmitter optical sub-assembly) circuits have DC blocking capacitors immediately after the photodiode. Also known as AC or RF coupling capacitors, the performance of these components across frequency are crucial to reducing signal processing errors, but achieving the desired performance can be difficult to implement because optical networks support very large bandwidths.

A common DC blocking (or coupling) implementation would be to have multiple capacitors of different values because there is a limited bandwidth at which they can provide this function, but one of the latest advancements in multi-layer ceramic capacitor (MLCC) technology includes a device with low-loss performance up to ~70GHz.



S21 and S11 of 550L104K (Kyocera-AVX Components)

In addition to saving board space, having only one DC blocking capacitor also obviates the need for robust modeling of multiple blocking capacitors.

In the case of a 550L104K ultra-broadband EIA 0402 (0.04" x 0.02") SMD capacitor from Kyocera-AVX Components, for example, the S21/S11 performance exhibits less than 0.4 dB of insertion loss up to about 67GHz. Smaller sizes exist, down to an EIA 01005, with a slight penalty to frequency performance but still well under 1dB of insertion loss up to the maximum frequency of 70GHz.

This high frequency performance is achieved by understanding and characterizing where parasitic capacitive/inductive losses are inherent in an MLCC. By employing equipment that can resolve unique electrode and termination geometries, these losses are minimized, and manufacturing tolerances are also minimized to improve lot-to-lot consistency.

By comparison, to remain cost competitive, standard MLCCs do not prioritize lot-to-lot consistency, nor are there design change notifications required. Standard MLCCs do suffice as coupling capacitors for many applications, but when it comes to high-speed digital or when frequencies of operation are above a gigahertz, care should be taken as to what level of signal integrity is acceptable.

Capacitor advancements typically fall under one or some combination of three main categories: support for high temperature, high voltage, or high frequency environments. The decades long trend of miniaturizing electronics has helped the case for MLCC high frequency capability because smaller case sizes naturally decrease the size of inductive loops.

However, the transition from metal to glass for the transmission of optical signals pushed the viable frequency spectrum beyond what the smallest standard MLCCs could support. Even terminating MLCCs on their side—so that their electrodes were perpendicular to the mounting surface—provided marginal increases in performance. Also, providing 2-capacitor modules as a "single component" solution were hard to process, model, and added to overall height.

For the optoelectronic and high reliability signal integrity markets, a new high frequency capacitor design was needed for a single component coupling/DC blocking capacitor, and this solution is now available.

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Improving connectivity and compliance for remote workers

Smart sensors detect human presence and enable optimal performance and standards compliance

Since the start of the COVID-19 pandemic, the time consumers spend on their devices—computers, tablets, and smartphones—has dramatically increased. According to eMarketer, in 2020, adults in the U.S. spent more than seven hours per day on their smartphones, desktops, and other devices. eMarketer expects such usage to rise even more, surpassing eight hours per day by the end of 2022. Similarly, a study of 11,000 RescueTime users found the average respondent picked up his or her phone 58 times per day.

As the rise in screen time increased, a Statista survey reported that the average American had access to more than 10 connected devices in their household. Additionally, Fortune Business Insights reports that the consumer electronic market is projected to grow from $689.45 billion in 2020 to $989.37 billion in 2027.

Understanding what consumers—especially remote workers—expect out of their devices is critical. The requirements are simple: consumers are seeking CE products that deliver stable connectivity and long battery life while also complying with industry regulations.

Virtual employees do not want to worry about network lags, failed email deliveries, or dropped conference calls. This means that original equipment manufacturers (OEMs) need to develop products that balance performance and connectivity while meeting industry compliance requirements. With the help of smart proximity sensing, these products can run efficiently at peak performance and maintain compliance at all times.

Driving factors for compliance regulations

In 1996, the Federal Communications Commission (FCC) adopted practices to ensure mobile phones, laptops, and tablets adhere to regulated levels of radio frequency (RF) output power in the presence of a human body. The limits specified by the FCC are rated in terms of Specific Absorption Rate (SAR), which is a measure of the amount of RF energy absorbed by a human body when using a wireless device.

Connected devices sold in each market are tested to ensure that they meet regulatory requirements. In the U.S., the FCC sets the SAR limit to be 1.6 watts per kilogram (over 1g of tissue) with a separation distance of 25 mm from the user. The European standard is 2 watts per kilogram (over 10g of tissue) with a separation distance of 5mm from the body.

Smart proximity sensors help maintain global compliance and improve RF performance in smartphones, tablets, and laptops. By monitoring human presence, smart sensors enable active RF power management when a user is in close proximity. These sensors are highly accurate, ensuring that the device is operating at peak performance and in compliance at all times.

Smart human sensors can distinguish between a human and an object and adjust power levels accordingly. For example, the device will lower RF power when it is being used in a consumer's pocket or in the user's hand. If the sensors detect an object instead of human, RF power can be maintained, thus ensuring optimal RF performance.

Some of the most important features of intelligent sensors in connected devices are as follows:



David Wong, senior director of consumer sensing products for Semtech's Wireless and Sensing Products Group

Best-in-Class Detection Performance: Using an advanced analog front end (AFE) enables higher detection distance or smaller sensor area.

Increased Proximity Intelligence: This innovative smart sensing feature differentiates between human and inanimate objects to enhance device responsiveness and reliability.

Enhanced Stability Over Temperature: Enables low-temperature variation over a longer duration. This limits the chances of false human detections with environmental temperature changes.

To understand the workings of a smart RF sensor, consider the functions of a device with a 2-channel



SAR safety standards by regions (Source: Semtech)

capacitive SAR controller (SX9320). With the two sensor inputs that feed to its smart engine for SAR, this can distinguish between an inanimate object and a human body. The chip feeds its decisions about nearby humans to an external processor via an I2C serial bus. When the chip senses something nearby, an alert is sent to the host processor to either determine the relative proximity distance or simply obtain an indication of detection.

Connectivity is essential for remote workers. Maintaining SAR compliance and designing devices that support the fastest 5G network can be a design challenge for OEMs. That being said, this is the ideal time for RF designers to address the challenges and deliver industry-compliant products ahead of a mass 5G adoption. According to Juniper Research, 5G smartphones are expected to reach $337 billion by 2025. That will be more than two-thirds of smartphones on the market.

As 5G networks rapidly grow, smart proximity sensors are vital to the future of widespread 5G implementation and adoption. In the design process, RF engineers have to add more RF antennas to accommodate additional network frequencies. This may introduce potential design challenges. Increased RF connectivity may lower a device's battery performance.

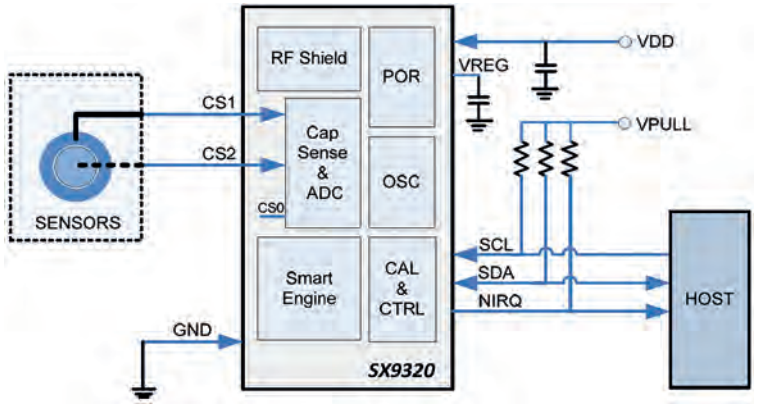
With intelligent sensors, devices can support wireless standards from 5G to Wi-Fi 6, providing the best connectivity for users regardless of the device and the protocols it supports.

The future of intelligent sensors

Smart sensors detect human presence and enable optimal performance and standards compliance. Designed for connected devices, these sensors intelligently modify the RF transmission levels of connected devices when humans are in close range. As the number of remote workers continues to rapidly grow, OEMs must provide always-on connectivity, high performance, and longer battery life to allow workers to work anywhere at any time. By embedding intelligent sensors in connected devices, OEMs deliver better consumer experiences by offering a variety of desirable benefits, including SAR compliance, increased performance, and impressive battery life. This means remote workers can rest assured that they can be productive whenever and wherever they choose to work.

www.semtech.com

"Virtual employees do not want to worry about network lags, failed email deliveries, or dropped conference calls."



SAR Compliance for 5G Devices (Source: Semtech)

Why RISC-V is transforming silicon design

RISC-V is rewriting the silicon industry just as surely as the Linux kernel rewrote the software industry



Chris Jones, VP Products at SiFive

If you worked in the tech industry in the mid 1990s, you'll remember the incredible wave that crashed on the shore of industry when Linus Torvalds released version 1.0 of the Linux kernel—the core of the Linux operating system (OS). The idea that software could be open, not proprietary, seemed outrageous to many. Pundits and programmers alike predicted the quick demise of Linux because it did not come initially with a GUI interface like Microsoft Windows or the Mac OS.

Fast forward almost 30 years and Linux now powers the majority of web and cloud servers. The ability to easily modify the software for uses as diverse as Android phones, the Google Chrome web browser, and Kubernetes for porting legacy applications to cloud servers makes Linux a popular choice for developers and businesses alike. This is especially true because Linux distributions remain current and supported by communities of developers from across the industry. The result saves companies design time and effort by leveraging open source software from the global community—whether it's for a tiny piece of their business or a central part of a technology offering.

A similar revolution is occurring in the silicon industry right now as companies embrace open standards to innovate faster and less expensively. No longer locked into proprietary processor architectures, businesses of all sizes are turning to alternatives to meet the challenging computing needs of artificial intelligence (AI), machine learning (ML), and other cutting-edge technologies. Enter the RISC-V instruction set architecture (ISA). The rise of RISC-V processors coincides with the decline in Moore's Law coupled with the huge demand for more processing power. And so, RISC-V is rewriting the silicon industry just as surely as the Linux kernel rewrote the software industry.

An ISA for today's workloads

Historically, the silicon industry was dominated by proprietary processor architectures, which limited companies' design freedom. But RISC-V's streamlined base ISA is built from the bottom up to handle the latest compute workloads. This ISA differs vastly from proprietary architectures that are decades old and burdened with legacy instructions. Collaboration drives the RISC-V ISA, which was created with flexibility, extensibility, and scalability in mind. By freeing organizations from a single vendor for their product roadmaps, RISC-V makes custom silicon far more accessible.

Similar to the Linux community, RISC-V also provides community-shared tools and development resources to reduce development time and effort. The shared nature of the RISC-V ecosystem gives companies endless opportunities to build more innovative solutions. Leveraging the shared ecosystem also enables a faster time-to-market (TTM) and reduces the need for an extensive in-house design team. Everyone benefits from the power of open standard collaboration. It inspires a surplus of innovation, which is especially important as computing requirements become more complex.

Surprising collaborations

This culture of collaboration in the RISC-V community also means that companies you might not expect regularly work together to develop new RISC-V solutions and tools. As a result, many surprising collaborations take place.

Earlier this year, Intel and SiFive announced a partnership to build high-performance RISC-V platforms optimized for Intel's process technology. While Intel has long advocated for its own x86 architecture, it is now embracing RISC-V as a key driver for the Intel Foundry Services (IFS) ecosystem. Intel explains that "RISC-V offers a level of scalability

and customization that is unique in the industry" and "there is strong demand from foundry customers to support more RISC-V IP offerings."

Another notable collaboration is NASA awarding a $50M contract to Microchip to develop aerospace solutions based on SiFive's Performance X280 processor IP. These new RISC-V based solutions demonstrated 100X the performance of current space computers, opening up new possibilities for innovation in the technologies used in space exploration. One of the selection criteria was the vibrant RISC-V ecosystem and the belief that, with it, products will have support for 10 years or more, which is important to planning space expeditions.

From AI to automotive

In addition to aerospace, another industry where you might be surprised to hear that RISC-V is getting a lot of traction is the automotive market.

As this market transitions to zonal architectures, manufacturers are looking for the simplicity, security, and software flexibility RISC-V offers. Using a single ISA across all zonal architectures increases code portability and can greatly reduce cost and TTM. In addition, RISC-V vector extensions are bringing enhanced ML and DSP capabilities to automotive manufacturers. The robust global RISC-V ecosystem ensures that there is a wide choice of supported tools and solutions. Working without proprietary lock-in, automotive manufacturers can license from multiple vendors and have more flexibility to design their own IP where needed, all while maintaining ISA compatibility.

In August 2022, SiFive introduced its Automotive E6-A product series to address next-generation automotive needs for applications like infotainment, cockpit, connectivity, ADAS, and electrification. SiFive's automotive solutions offer much more tailoring compared to other CPU vendors, providing IP options that are both area and performance optimized for different integrity levels like ASIL B, ASIL D, or mixed criticalities with split lock, in line with ISO26262. These tailored solutions will help automotive manufacturers customize solutions for specific markets as they design the next generation of digital vehicles.

Like NASA, automobile manufacturers want to know their products will be supported for five to 10 years or more, and the RISC-V ecosystem, with university students around the world now studying it in class, looks to stand the test of time.

The future market

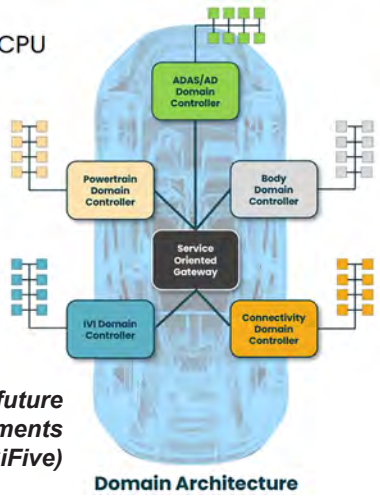
RISC-V is already in billions of cores on the market, and promises to continue reshaping silicon design in almost every industry imaginable. Semico Research forecasts that RISC-V-based AI SoCs will see an impressive 73.6% compound annual growth rate (CAGR) by 2027. For the data center market, Semico also estimates that there will be a 98.1% growth rate for RISC-V AI SoCs by 2027. In another performance-driven market, SDDs, Semico predicts 88.5% growth for RISC-V AI SoCs during the same time frame.

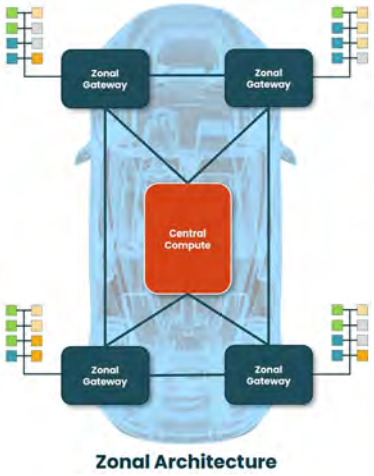
While automotive and aerospace applications are new, RISC-V use is growing in the data center. Google recently highlighted how they are using SiFive RISC-V processors as companion cores in AI and ML applications, creating what they called a division of "technical and business labor"and allowing Google to focus on their expertise while taking advantage of the proven performance of RISC-V cores and the support of the wide ecosystem.

I look forward to seeing how RISC-V will continue to usher in exciting new innovations that transform the way we all compute and live.

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Addressing current and future market requirements (Source: SiFive)

Continuing Supply Chain Woes

As an executive at an electronics manufacturing company, I have to say that I'm in the thick of the supply chain woes. From where I sit, this will continue to be the biggest challenge in 2023. The labor shortage will remain as a compounding factor throughout the year. However, the industry is learning to adapt and manufacturing output will increase next year. Even if the overall economy slows down, electronics will not.

One of the biggest trends I see is the consolidation of component and design variations. For example, programmable sensors where one component can be adapted with simple programming to replace multiple variations of the part. You will have fewer component varieties to choose from, but the chip and MEMS fab lines won't need to change up so many times to accommodate endless varieties of nearly identical parts. For all types of families, passive and active, the smaller package size parts will be the first to get back to something close to predictable availability. If you are a designer and have resisted the latest round of miniaturization with chip scale microcontrollers and 0201 passives, now is the time to take the "small" plunge.

You should also expect additional cost increases throughout the first half of 2023 as world-wide finances settle to a more stable place. The good news is that smaller components are often less expensive to purchase, which can allow you to reduce PCB real estate and product size leading to some cost savings for the finished product.

www.screamingcircuits.com



Duane Benson, Director of Marketing at Screaming Circuits

Increasing Need for Cyber Resilience



Eric Sivertson, Vice President of Security Business at Lattice Semiconductor

Similar to the last couple of years, the digital footprint is ever-expanding as we continue to explore hybrid work environments with greater use of cloud and highly connected supply chains. Having these new technologies deeply embedded in our organizations and personal lives exposes new and challenging risks. With new software and new hardware devices deployed, cyber criminals and bad actors will develop new ways to attack.

With these growing challenges, we are seeing more and more companies taking a proactive approach to protect their data from various threats and attacks, including focusing on cybersecurity planning within their executive teams, integrating holistic incident response plans, and embracing new technologies.

Making the system itself a cyber resilient system with new technology will be one of the key areas that the industry should focus on. Cyber resilient systems continuously deliver an intended outcome despite cyberattacks, embracing information security, business continuity, and overall organizational resilience. Platform Firmware Resiliency (PFR) can be sought after as a specific domain form of cyber resilience related to compute. PFR, using a hardware-based solution, is a new approach to securing enterprise server firmware that comprehensively prevents attacks on all firmware in a server.

As cybersecurity continues to evolve, guidelines on security standards are constantly being evaluated and updated, shaping how systems and solutions are built today. With more businesses beginning to pay attention and understand these threats and the importance of precautions, I believe we will see a lot more designs on the market that are built to withstand inevitable cyberattacks.

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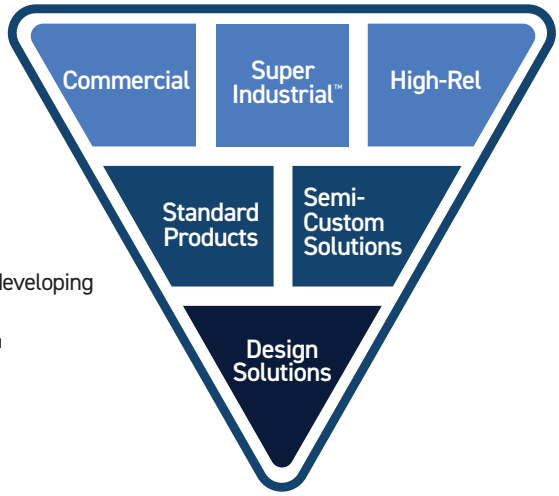
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Rising Demand for Sustainability

There will be changes in 2023 as the supply chain re-adjusts itself, a topic I am sure many other articles will talk about. Instead, I would like to talk about the growing demand for sustainability in consumer and industrial products. In 2023, we will continue to see Europe lead the rest of the world in addressing this, but the U.S. and many other international regions will also make major moves to catch up.

There are many ways to improve sustainability and reduce our impact on the environment. One way that will see a lot of traction next year towards sustainability will be the adoption of energy harvesting to reduce, or completely replace, the need for batteries in our connected devices. Every year, billions of batteries are thrown away into landfills, so solving this problem will have a huge impact.

Although there are many ways that connected devices can harvest energy, photovoltaic (PV) cell technology is likely to account for the greatest levels of adoption in the coming years. Connected devices, ranging from remote controls and wireless keyboards in the smart home to beacons and e-Badge readers in enterprise/industrial environments, will be powered by PV energy. PV technology is more sustainable as it reduces battery waste, but other benefits also provide a reduction in maintenance time and cost, which become particularly important in large IoT deployments.

www.atmosic.com



David Su, CEO at Atmosic

Growing Importance of Verification



Dave Kelf, CEO at Breker Verification Systems

2023 will see several initiatives becoming more commercially robust. For example, the continued commercialization of the RISC-V ISA. We will see the advent of more advanced application processors, as opposed to the currently available controllers and smaller embedded devices. This in turn will lead to more changes in SoC design and verification given some of the new capabilities that RISC-V brings, such as custom instructions. Multiple providers are supplying these devices with compatibility differences, giving developers a complicated landscape of decisions and creating opportunities for design and verification tool providers.

The growing IC "democratization" movement will offer more advancements in open-source design and verification tools. We can expect more availability of free versions of commercial tools for simpler designs, particularly those in non-traditional applications that include medical and industrial.

Verification engineers will observe the increased use of synthesis for test content. That's because test content is now the most significant bottleneck in verification, which—in turn—is the most significant bottleneck in IC development. Companies are looking more closely at using synthesis techniques with languages such as the new Portable Test and Stimulus standard from Accellera. These will become more important, and more verification will be performed at the SoC level with more test content reuse.

Finally, it will become far more apparent in 2023 that IC design verification is growing in importance due to more complex use cases, application segments, device requirements (e.g., safety and security), and extended lifecycles. The requirement for functional verification runs throughout the entire electronic product design and manufacturing supply chain. Without thorough verification, the supply chain could be compromised.

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The Democratization of Chip Design

2023 will showcase the growing success and momentum of the democratization of chip design through a host of new applications in new markets and prove it is a reality.

An affordable cost structure for making chips for new applications will start to explode opportunities. The result will be a different semiconductor ecosystem that is far more able to meet the needs of society. Some of the credit can be attributed to community-based, open-source platforms taking root with easy-to-use, easy-to-access tools. The move to chiplets also is changing the fabric of the semiconductor industry that can no longer concentrate on high-density designs by offering solutions that expand the application space before they become high-density. And the widespread availability of FPGAs gives engineers the ability to tailor designs that are flexible and far more affordable. The combination of tools, chiplets, and FPGAs are giving creativity a way to make an impact on society.

The semiconductor industry dynamics are changing. Democratization of chip design is a trend the semiconductor industry will embrace in 2023. It has the potential to drive exponential semiconductor industry growth and market expansion by creating new applications and opportunities and giving flexibility to engineers to live and work where they choose. I can see that the semiconductor industry will find a way to support all human beings and I am looking forward to it.

www.lanzatechventures.com



Lucio Lanza, Managing Partner at Lanza techVentures

EVs, Edge AI, and Quantum Computers



Ty Garibay, VP of Engineering at Mythic

While the electronics industry might suffer through a down year, along with the rest of the larger economy, there are always interesting developments in products and technologies to look forward to. One bright spot is electric vehicles (EVs). Nearly every major brand is introducing highly competitive and reasonably priced vehicles for the 2023 model year. These EVs will continue to drive the demand for more semiconductors to support battery management, infotainment, self-driving, etc. The biggest challenge will be whether the limited availability and price of lithium for massive batteries will limit unit growth. New battery technologies are on the horizon but are still years out.

Edge AI wearables coming out next year will offer a lot of potential for the Metaverse, such as Meta's next generation Oculus (or Quest) headset and the rumored headset from Apple. It is even possible that Apple could launch a glasses product in 2023. These products will drive the need for high-performance neural network processing in the energy and thermal envelop of a wearable device, creating new opportunities for novel technologies such as analog and neuromorphic computing.

A final trend for 2023 will be a first set of truly usable quantum computers from the large number of startups that have been funded over the last couple of years. Most of these players will continue to focus on quantum computing as a service (QaaS), but some will roll out the first chip-level proposals and prototypes for quantum processors that could be built into multiple end products.

www.mythic.ai

The Inevitability of RISC-V Adoption

The momentum of RISC-V over this past year has been incredible, and it's clear that the pace of RISC-V adoption will continue to accelerate at breakneck speed into 2023. RISC-V is inevitable. There are already billions of RISC-V cores on the market, and we'll see that number multiply in the coming years. One key driver of growth has been the community's focus on building out hardware, software, and tools for RISC-V designs. The rapid uptake of the hardware and software ecosystem is a testament to the portability to RISC-V and the design freedom and flexibility that allow companies to beat performance metrics.

In terms of specific industries, some of the biggest areas for RISC-V growth in 2023 will be the datacenter market, telecom and communications, and consumer IoT devices. We've already seen some big announcements from companies bringing RISC-V solutions to the automotive and aerospace markets as well as high-performance computing (HPC), and we anticipate many more high-profile announcements by year-end. What's exciting is that there's no one breakout market for RISC-V. RISC-V is truly everywhere: from the edge to the cloud and from tiny devices to supercomputers and spaceships.

From a technical standpoint, RISC-V vectors are playing a pivotal role in the RISC-V ecosystem where we have seen acceleration across all levels of the stack. Companies know that RISC-V is here to stay, and they aim to bring out capabilities at every level. You'll also see RISC-V International announce some newly ratified specifications and extensions to meet the evolving needs of our community.

www.riscv.org



Calista Redmond, CEO at RISC-V International

The Holy Grail of AR/VR/XR



Theodore Marescaux, Founder and CEO of Swave Photonics

The metaverse is coming in 2023, representing the future of the internet and beyond, defined by immersive visualization technologies such as augmented reality/virtual reality/extended reality (AR/VR/XR) and Web 3.0 principles, including the decentralization and devolution of user data and greater interoperability built on open standards and blockchain technology.

Current AR/VR/XR technologies are still in their infancy and have limitations that must be overcome before the metaverse can scale. Next-generation Holographic eXtended Reality (HXR) technologies designed to address these challenges will accelerate the metaverse in 2023.

The Holy Grail of AR/VR/XR interfaces and displays is 3D holographic technology that will enable users to experience the metaverse without headsets or glasses, delivering lifelike, high-resolution 3D images that are viewable with the naked eye with no compromises. Swave Photonics has developed HXR technology that enables 1000x better pixel resolution with billions of tiny, densely packed pixels to enable true realistic 20/20 vision without requiring viewers to wear smart AR/VR headsets or prescription glasses. Soon, AR/VR/XR applications will be capable of passing the visual Turing Test in which virtual reality is practically indistinguishable from real-world images that humans can see with their own eyes.

Advances in AR/VR/XR technology in 2023 will also play a key role in future workplaces by enabling employees to engage in immersive video conferences while working remotely.

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