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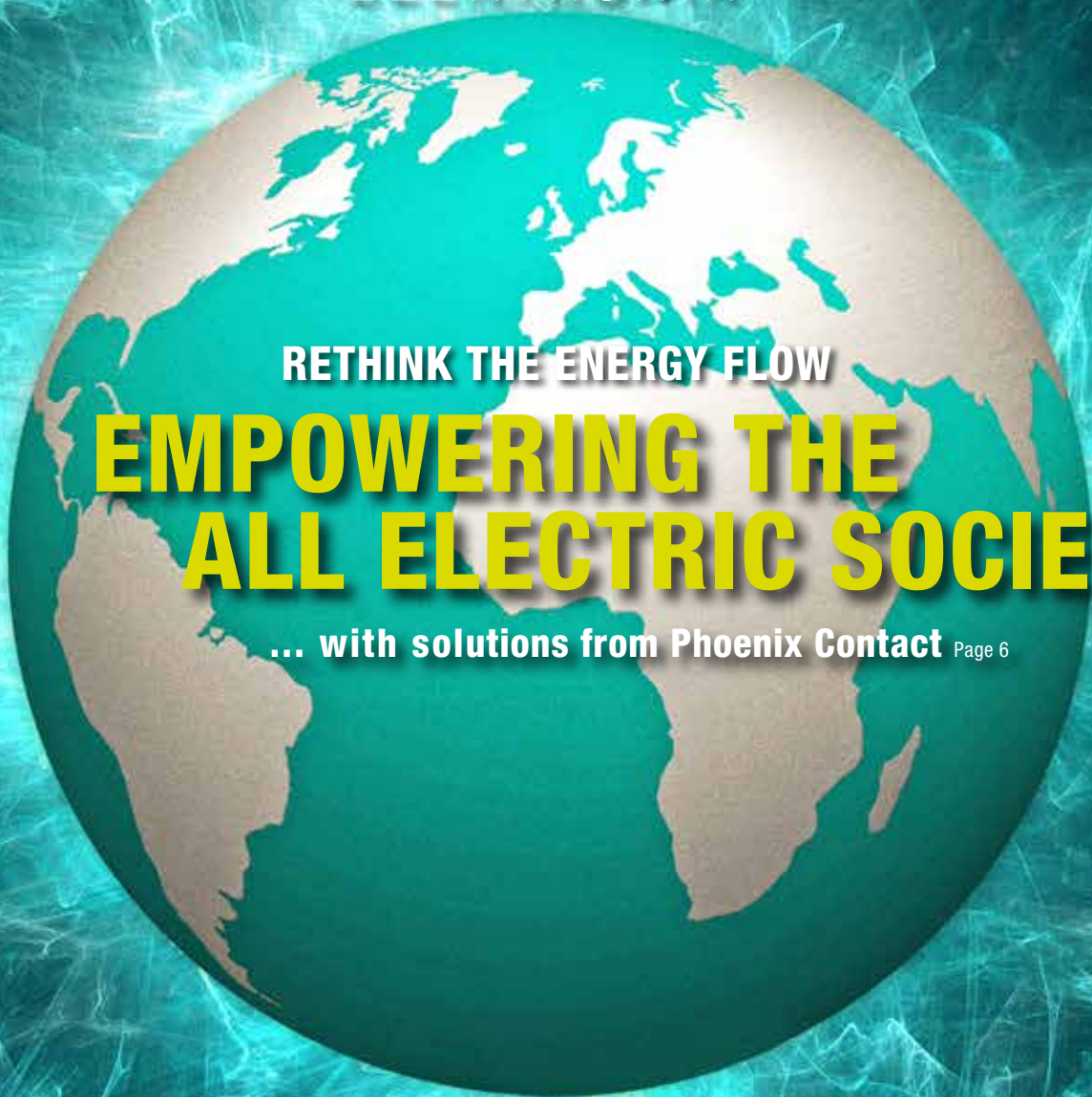

RETHINK THE ENERGY FLOW

EMPOWERING THE ALL ELECTRIC SOCIETY

... with solutions from Phoenix Contact Page 6

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electronica
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Bernhard Haluschak, Chief Editor E&E: Hardly any trend has shaped industry more than digitization. The electronics industry is also benefiting from it. Because the new digital solutions are not only based on software, but a variety of new hardware solutions are also conquering the market. Here I would like to focus particularly on the smart home and ask the following question:

HOW IS DIGITALIZATION SHAPING OUR LIVE AT HOME?

Turn up the heating when you're on the road so that it's nice and warm when you get back, and of course program the coffee machine via the app: cappuccino, espresso or coffee crema – the choice is really difficult. What sounded like science fiction ten years ago has become reality in smart apartments and houses.

All electrical appliances, all lamps, all switches, all blinds and, of course, the heating can be networked with each other using a single smartphone app and with the help of a central gateway in the house. A secure network connection to the smart home is usually sufficient for this or a cloud solution can be used.

The residents of such a smart home undoubtedly benefit from a better quality of life. An open front door or stove that has not been turned off when leaving the house loses its terror. I can confirm that. I personally use the technology as well.

So vacuuming the living room or cleaning the large window fronts is a thing of the past. My electronically controlled helpers – the robots – take care of that. I also appreciate my little service providers for mowing the lawn.

But what I particularly appreciate about the smart home is the digital energy and resource management. I use intelligent sensors to record the energy generated by the photovoltaic system, monitor electricity consumption, analyze the amount of heat from the solar collectors and monitor water consumption throughout my house.

All the information flows together in an intelligent gateway and is evaluated there. The system is thus able to adapt the entire house to my everyday life in terms of energy. That saves money in the long term – I hope so – and is above all fun.

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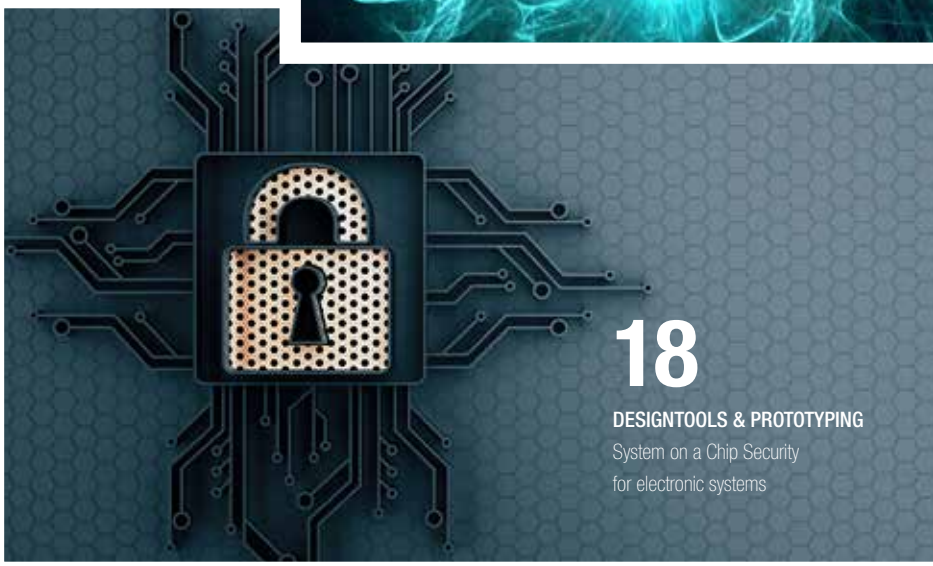

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ENHANCED RELIABILITY OF 1064 NM LASER

LASER MODULES FOR SPACE AND QUANTUM TECHNOLOGIES

The Ferdinand-Braun-Institut has many years of experience in the development, fabrication, and qualification of lasers and optical amplifiers for challenging applications in space, on satellites, and for use in quantum technologies. Currently, the institute manufactures new laser modules, including devices with 1064 nm emission wavelength, to be used for fundamental research on ultracold atoms on board the International Space Station (ISS).

TEXT: Ferdinand-Braun-Institut **PICTURE:** FBH/schurian.com

These new modules are equipped with semiconductor chips that amplify the light of a 1064 nm laser with low output power to high power densities up to 60 MW/cm². The facets of the optical amplifier are extremely stressed by the elevated emission power and must therefore be particularly well protected to ensure that the module functions smoothly. Thanks to improved facet passivation in an ultra-high vacuum, the scientists have now been able to significantly increase the reliability and lifetime of the amplifiers.

Empowering the All Electric Society

Along the energy flow to a world worth living in

How can power generation, distribution, storage, and consumption be optimally designed and perfectly balanced in the spirit of a sustainable future? Phoenix Contact offers technological solutions and paves the way to the All Electric Society.

TEXT: Phoenix Contact **PICTURES:** Phoenix Contact; iStock

At first glance, the major issues that our society currently faces – the fight against global warming and the billions of people striving for prosperity and development – seem to be irreconcilable. The difficult question is, how can we successfully allow energy consumption and still protect the climate? The answer is the All Electric Society. This vision of the future describes a world worth living in: where all of the energy consumption is sustainable and covered by ecological, economically efficient, renewable sources. The speed at which this vision can become reality depends on how decisively we act right now. After all, everything we need for it has already been invented.

With products, solutions, and services for electrification, networking, and automation, Phoenix Contact is a technology company that supports industry and society on the path to the All Electric Society. Sector coupling is a milestone along the way. It connects the key areas of life and work – industry, energy, infrastructure, and mobility – to form an overall system. This ensures the perfect balance between power generation, distribution, storage, and consumption. But what exactly does each station of the energy flow depend on?

Accelerate the energy revolution

When considering power generation, it pays to take a look at Portugal. Over half of Portugal's electricity already comes from renewable energies. However, a look at the installed capacities shows that hydropower and wind power have played a key role, while photovoltaics has hardly been used. This picture is currently changing. By the end of 2021, ground-mounted systems with a total capacity of 1.7 GWp had been constructed in Portugal. Forecasts through 2030 project the construction of an additional 9 GWp. Certified feed-in controllers from Phoenix Contact enable the fast and unbureaucratic grid connection of new systems – without having to wait a long time for the certificate of grid conformity. This way, they do not only simplify but even accelerate the energy revolution. Six of the new Portuguese photovoltaic systems, among others, utilize integrated PV park management from Phoenix Contact. It collects, processes, and evaluates all incoming data in order to make operations as efficient as possible. The data loggers work using an automatic detection mode, which is why all of the systems installed in the PV park can be easily connected via plug-and-play. No configuration is required, which significantly reduces the time to startup.

Distribute power reliably

The sun and wind are carbon-neutral power sources, but they supply strongly fluctuating quantities and are not always available. To provide the required power despite these factors, high installed capacity is needed in many systems distributed across the country. As capacity is expanded, the challenges for

Inside Phenix Contact's digital factory in Bad Pyrmont.

power distribution also grow: grid bottlenecks and voltage fluctuation are expected to increase in the future. To meet these challenges, reliable options for measurement and control are more important than ever. The remote control technology from Phoenix Contact receives current and voltage measured values, as well as status and error messages, and transmits them to the grid operator's control room via remote control protocol. This way, the operator receives an accurate, current picture of the systems in the grid and can intervene if necessary.

At the same time, statistical data on the energy flows in the grid are recorded. They are an important decision-making basis for the next potentially necessary grid expansion phase. Faults in the grid can also be localized more quickly with suitable digitalization and be remedied faster via smart remote control. Supply security increases.

Needs-based energy conversion and storage

Short-term energy storage is also very important for reliable, efficient grid operation. It is necessary due to the major differences caused by both fluctuating generation capacity from photovoltaic systems and wind turbine generators and also by dynamic consumption peaks caused by charging processes for electric vehicles and heat pumps. Battery energy storage systems are the recommended solution. Unlike pumped hydroelectric energy storage facilities, they can be dimensioned and distributed as needed, independently of the geographic conditions. Phoenix Contact supplies safe connection and intelligent control technology for efficient load management and higher-level energy management.

But even in the All Electric Society, not all process and sectors can be completely electrified. Steel production and aviation are two examples. Here, power-to-X processes in which the electricity from renewable energy sources is converted into liquid or gaseous energy sources that can replace fossil fuels are in demand. Through its many years of experience in the process industry, Phoenix Contact has a comprehensive portfolio of solutions and services that can also be applied in the power-to-X industry. They include entire product series with relevant certifications in the fields of functional safety, explosion protection and cybersecurity.

Efficient use of energy

In addition to the consistent generation and use of renewable energy, reducing the demand for primary electricity and resources through efficiency measures is the key to a sustainable future. The PLCnext Factory from Phoenix Contact in Bad Pyrmont demonstrates possible and proven related applications. With only minimally invasive intervention in existing processes, overall equipment effectiveness was increased by 11 percent in 1.5 years. External black boxes were used: utility metering, data collection, and network segmentation boxes.

The open ecosystem from PLCnext Technology that was also used enables different connectivity to the signal and field levels, and to the IT or cloud level, at any time. In this way, applications for the machine learning of artificial intelligence systems to precisely meet customer requirements are possible – and with them, the simple use of enormous potential for efficiency. This is another big key step in the direction of the All Electric Society. ☐

ENERGY: GENERATION, DISTRIBUTION, STORAGE AND CONSUMPTION

The way to the All Electric Society

The central solution approach for the energy transition is the future vision of the All Electric Society. The focus here is on CO_2-neutral electricity generated on the basis of renewable energy that is available in sufficient quantities for everyone. What do you think: Maren Gast, Andreas Flandermeier, Andreas Lautmann and Markus Kick employees at Phoenix Contact?

THE INTERVIEW WAS CONDUCTED BY: Bernhard Haluschak, E&E **PICTURES:** Phoenix Contact

Maren Gast
Global Industry Management Solar Power
Phoenix Contact

Andreas Flandermeier
Product Services Energy
Phoenix Contact

What technological solutions are needed to make the All Electric Society a reality as quickly as possible?

Maren Gast: First, we must put enormous effort into developing renewable energy sources such as photovoltaics and wind power – in Germany, in Europe, and worldwide. As these two types of power generation are highly volatile and only work when the sun is shining or the wind is blowing, we must invest in the energy storage infrastructure at the same time. Above all, more large battery storage systems are needed. In conjunction with residential storage and the bi-directional charging of electric cars, a continuous, reliable power supply based on renewable energy is possible.

Andreas Flandermeier: Electrical power distribution grids are the link between renewable energy sources and the industrial, infrastructure, and mobility sectors. To distribute reliably and flexibly, the grids must be comprehensively modernized. The investment required for this should be done according to needs and based on collected grid data in order to anticipate the level of investment and optimize the plan. Further, the focus should be on grid stability. Alongside smart load management, battery energy storage systems will make a key contribution to grid stability. They enable applications such as peak load management and private consumption increase. Intelligent management systems such as those for the charging infrastructure in the mobility sector can build on them. For all this, improved data management that takes high IT standards into account is important.

Andreas Lautmann: Even in the All Electric Society, the solutions in the foreseeable future will not only be 100 percent electrical. For example, in the industrial sector this applies to steel and cement production, and to shipping and aviation in the mobility

Andreas Lautmann
International Business Development Power-to-X
Phoenix Contact

Markus Kick
International Business Development Factory Automation
Phoenix Contact

sector. To make these sectors as independent of fossil fuels as power generation, the power-to-X industry must be developed alongside renewable energy. In power-to-X processes, renewable energy is converted into gaseous or liquid energy sources that can replace fossil fuels.

Markus Kick: A big step towards the All Electric Society is to create transparency in the industrial sector – namely, in every single factory. After all, to achieve resource-conserving operation, diverse information is required from the entire factory infrastructure. A wide range of data must be properly collected, managed, and used. This way – and with open, interoperable control architecture – is the only way to design all types of production with maximum energy and resource efficiency.

There are so many options: What should we begin with and why?

Maren Gast: To ensure high supply security and stable power grids, we need intelligent control technology. It must be able to intelligently manage decentralized power generation from renewable sources, as well as power feed-in, storage, and bi-directional charging. To accomplish this, standardized interfaces for simple data exchange would be highly advantageous.

Andreas Flandermeier: One of the really first efforts should be to have a more accurate map of the power grid on the distribution level, in other words in the medium-voltage and high-voltage grid. This is the only way to create a development plan in the spirit of the All Electric Society based on needs and valid data. And it is the only way to respond flexibly and promptly to dynamic changes in the grid.

Andreas Lautmann: In the case of power-to-X, the focus should first be on extracting green hydrogen with electrolysis. After all, green hydrogen (extracted in a CO_2-neutral process with renewable energy) can be used directly as an energy source. It is also the basis for many other gaseous and liquid energy sources like synthetic methane or ammoniac.

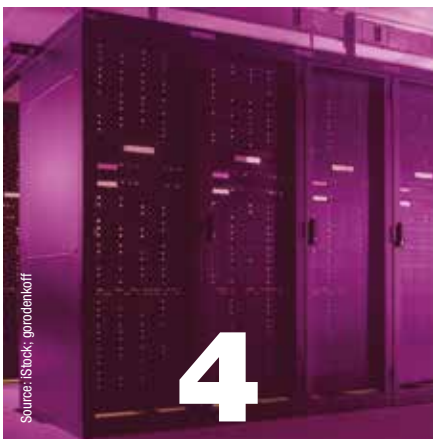
Markus Kick: Not every factory can be completely redesigned and rebuilt overnight to make it completely compatible with the All Electric Society vision of the future. This is why it is important to first optimize existing systems in line with a minimal carbon footprint and resource-conserving production. Here, plenty can be accomplished on the data and control level – with minimally invasive measures and without interrupting or endangering production. By using the existing measuring points and currently available data intelligently for control processes, factories and their products will verifiably become more sustainable. And they will do so at the same or even higher overall equipment effectiveness. ❐

Electronica 2022
Hall B3.103

sps Hall 9
Booth 130

6 HIGHLIGHTS from the Electronica

Electronica 2022 will take place in Munich from November 15 to 18. Many companies will present their innovations and product highlights there. Among them are Varta with its micro batteries, Yokogawa presents a new power analyzer, Swissbit makes IoT systems more secure and Osram focuses on robotics.



Presentation at the Electronica

Microbatteries

VARTA's microbattery product portfolio ranges from rechargeable lithium-ion button cells as well as nickel-metal hydride button cells, primary silver oxide cells, primary lithium button cells and cylindrical lithium batteries to hydrogen generator cells as well as the primary VARTA Alkaline Industrial Pro batteries. They enable a wide range of smart applications from different fields.

1

Meet Varta at booth A4.313.

Presentation at the Electronica

Performance analysis

The WT5000 is the first product in a new generation of precision power analyzers from **Yokogawa**. It is a versatile platform that offers exceptional precision and performance, suitable for even the most demanding applications. Its responsive touch screen, intuitive menu operation and ready-to-use software solutions make the WT5000 the ideal instrument for measurement requirements.

2

Meet Yokogawa at booth A3.117.

Presentation at the Electronica

Power supply

To enable smooth starting for all types of equipment in industrial automation, logistics and warehouse equipment, household appliances, Mean Well developed the HRP-N3 series high-load power supply. There are additional features, which increase application flexibility. In addition to this power supply, **Schukat** will present industrial power supply with peak load capability up to 350 percent.

3

Meet Schukat at booth B4.379.

Presentation at the Electronica

Enterprise Solutions

In recent years, infrastructure telecommunication, such as servers and switches, have become faster in the enterprise market. The challenge is that conventional PCB trace transmission have large insertion losses with limited transmission distance. A co-package system also faces the challenge of high-density packaging. **I-PEX** has begun development of a new Leapwire/Dualine series.

4

Meet I-Pex at booth B2.339.

Presentation at the Electronica

IoT Secure Connect

Add security easily to any IoT system Today, the connection between machines, plants and sensors in the IoT is ubiquitous. But the cost and efficiency benefits are offset by new security threats. Among the known vulnerabilities here is the often inadequate protection in the connection of individual IoT devices. This is where "IoT Secure Connect" from **Swissbit** comes in.

5

Meet Swissbit at booth C3.418.

Presentation at the Electronica

World of Robotic

Intelligent robots are playing an increasingly important role in industrial automation. They relieve us of monotonous or even dangerous tasks. In this way, they help save time while increasing safety. Smart robotics range from traditional robotic arms in production lines to mobile robots in logistics, so-called AGVs or AMRs, which are used in warehouses and other controlled environments.

6

Meet **Osram** at booth B4.279.

World's leading trade fair and conference for electronics

PLACES TO BE

The fair Electronica 2022 in Munich is just around the corner again. For almost 60 years, international experts from the electronics industry have been using this industry meeting place for exciting discussions and inspiration.

TEXT: Rieke Heine, E&E **PICTURE:** Messe München

From November 15th to 18th it's that time again: The world's leading trade fair and conference for electronics – the Electronica – begins and gives international experts and interested parties an exciting insight into the latest topics in the electronics industry.

Systems & Applications

The industry benefits from continuous progress. The Wireless Congress 2022 will take place from November 16th to 17th and will specifically focus on the latest developments in the industry. These include: 5G/5.xG/6G, Wi-Fi 6/6E/7, DECT-2020, TSN for wireless networks, resilient networks, wireless sensors, information-centric networks, software-defined networks (SDN), next-generation LPWAN. *Visit the ICM – International Congress Center Messe Munich!*

Electronica Automotive Conference

The Automotive industry is undergoing a major transition. Experts from the automotive industry come together to discuss the problems and opportunities of the rapidly changing industry environment. The one-day conference will take place on November 14th and will provide an overview of the most important trends and challenges along the entire supply chain.

Sustainability

Electronics and sustainability – how does that fit together? Solutions like E-mobility, smart energy and artificial intelligence solutions show that these topics can be combined in an excellent way. International active innovators from the industry use the fair as an opportunity to discuss these topics under the title "WEEF - World Ethical Electronics Forum 2022". *You can participate on November 15 from 11:00 a.m. to 5:00 p.m. in the forum in Hall B3. Discuss with us!*

Fast Forward

Start-ups are important driving forces in the industry. Not only do they bring in innovative ideas, they have the potential to change the industry in a forward-looking way. Electronica therefore offers young companies a platform to network with other experts and win attractive prizes.

Conferences and program

The program at Electronica 2022 will show what is moving the industry right now, with a focus on knowledge transfer and professional exchange with topics such as cyber security, connectivity, embedded systems, automotive, printed electronics, PCB IIoT and components and sensors and future-oriented lectures. The diverse range of topics is supplemented by special events such as the CEO Roundtable.

All Electric Society

Right before the trade fair, experts from the industry come together to talk about the hurdles and opportunities on the way to an all electric society. One of the exciting key questions is: What contribution can industry make not only for more sustainability, but also for an all electric society? The recorded event is subsequently available to interested visitors under the name "The contribution of the electronic industry to climate protection. The all-electric society – driving the sustainable ecosystem".

Electronica-App

If you would like to find out more in advance, the trade fair app will be available from the beginning of October. Here visitors have the opportunity to get to know each other in advance, the highlights and potential discussion partners. ☐

Next-Generation Vehicles Need Safe HMIs

Under Human Control

Look at any modern car's dashboard today, and you'll see very little in the way of an instrument cluster of dials, gauges, and switches. It wasn't that long ago that analog gauges and dials presented necessary information such as speed, engine revs, and coolant temperature. Today, you'll probably be presented with a sleek glass panel in a prominent position within the cockpit, some of which look more a tablet computer than a vehicle dashboard.

TEXT: Robert Huntley, Mouser Electronics **PICTURES:** iStock, CSA-Printstock, Chesky_W, Sjo, metamorworks

Dashboards with human-machine interfaces (HMIs) are sleek and stylish, and touchscreens are now the norm. They are used to navigate to a new destination, set the vehicle's advanced driver assistance system (ADAS) features, or change the color of the interior trim lighting. Smartphones are tightly integrated into the HMI via USB or Bluetooth through apps such as Android Auto and Apple CarPlay. For motor manufacturers, touchscreen HMIs are ushering in a new era in terms of ease of use replacing mechanical dials, buttons, and switches and advancing the aesthetics of a vehicle's interior design. However, there are a few things to keep in mind.

Critical Factors of Automotive HMI Design

Safety is a critical design factor for any automotive HMI. Its operation should not distract the driver, be intuitive, and, if possible, access to certain features might be disabled while the vehicle is moving. Selecting a different music album to listen to or read a text message are all non-essential actions that result in the driver taking their eyes off the road ahead. With so many functions now available from an automotive HMI, the opportunity for distraction increases significantly, promoting legislation and international standards.

Gesture control makes it easier to operate the comfort functions in the car.

Although still in their infancy, standards such as ISO 15005:2017, which stipulates HMI actions should take 1.5 seconds or less, are beginning to evolve. For example, Volkswagen's HMI monitors the driver's usage and warns the driver if they spend too much time accessing different functions, such as searching for a contact in the address book or attempting to read an item of news.

The use of touchscreen controls in automotive HMIs are increasingly being questioned on safety grounds. Voice control is emerging as a safer, more viable candidate for HMI input and control, although voice recognition does present some technical challenges.

Apart from improving cockpit aesthetics, another driver of automotive HMIs is to present a simple-to-use, intuitive interface to access a host of comprehensive functions, particularly in the case of semi- and fully autonomous vehicles. Electric and hybrid vehicles require many different displays than a conventional internal combustion-powered vehicle, for which a software-driven touchscreen HMI is ideal. In the above examples, an increasing amount of user interface (UI) and user experience (UX) design effort is required to create an HMI that is informative and easy to use.

Over the years, vehicle manufacturers have learned that consumers are particularly attracted to HMIs and that user interface and user experience (UI/UX) is a significant factor in purchasing decisions. Developing custom icons, symbols, and fonts might be a chore for the embedded developer, but such attention to detail pays dividends.

For the driver and their passengers, the HMI permits the personalization of vehicle functions to suit their mood, from comfort features and interior lighting to balancing engine performance with fuel economy. Let's review some of the technologies used and the challenges that extremes of temperature and humidity present to the design team.

Popular Automotive HMI Technologies

HMIs need two essential technologies; a display, typically an LCD screen, and a method of input or control. Touchscreens are a proven HMI method, using projected capacitive touch (PCAP) sensing in a thin stack up above an LCD screen. Voice recognition, using machine-learning neural networks, is another input method that is rapidly gaining popularity based on driver safety. Other technologies used with touchscreen include haptics, gestures, proximity, and force detection. As

Touchless operation is now a standard feature in cars.

application processors become more powerful, the use of eye-tracking algorithms to provide input controls can be useful.

Touch Controls

PCAP touchscreens are a mature technology with widespread adoption for automotive applications. Multi-touch touchscreen controller integrated circuits are available to manage large screen sizes up to 25 inches; for example, Tesla models use at least a 15-inch portrait touchscreen. LCD screens need to meet the demands of rapidly changing ambient light conditions, from bright sunshine to darkness in seconds. High-brilliance, high-contrast LCD screens are crucial to developing a vehicle's HMI. Larger screen sizes are preferred than smaller panels, the latter more likely to distract the driver for longer when using. The UI/UX design is critical, since too much information presented is also distracting for the driver. A UI/UX that is structured, with frequently used controls always in the same location, keeps distraction to a minimum, increasing usability and safety.

Multi-touch controllers are now the norm, with most controller ICs incorporating gesture detection capabilities such as pinch and stretch. Conventional mechanical buttons are also replaced with a button, wheel, and slider features implemented in software. Audible tones provide user feedback during operation. The convenience of the touchscreen approach is further enhanced with the use of some innovative features. Haptic sensors, a vibrating or rotating micromechanical element, provide user feedback. Proximity detection is based on capacitive sensing techniques but indicates a finger approaching the LCD panel. It can be used to switch on the screen or to open up a selection menu. A relatively new touchscreen enhancement is the use of a layer of piezo film in the display stack-up to detect the applied pressure or force of touch. Force detection enables a 3D-user experience that can simplify the UI for some applications, or together with haptics, provide a positive feedback mechanism to emulate the pressing of a mechanical button.

Haptic sensor development for automotive applications continues to evolve, too, with in-air haptics promising a completely different and potentially safer user experience. In-air haptics integrates hand-tracking machine-learning algorithms with a matrix of ultrasonic speakers. The speakers emit an ultrasonic waveform that can be shaped by the speaker array to create an ultrasonic pattern a few inches above a control surface that the human hand can feel. For example, a circular control knob can be projected, which the fingertips can feel and grasp. The hand-tracking algorithm can then detect specific gestures or movements, such as turning the knob. This innovative virtual touch UI offers excellent potential for a wide variety of touchless applications and is ideal for applications throughout the automotive sector.

Automotive HMI Design Challenges

The operating environment of an automotive HMI brings several challenges and technical considerations. Firstly, environmental factors such as extremes of temperature and humidity and rapid changes of both might result in condensation or static to form. Touchscreens are particularly prone to water droplets forming on the active surface, or moisture passed from damp fingers. Typically, this causes erratic control actions or the controller IC stopping completely. Dust and dirt can also result in erroneous touch controller activity, but the surface is easily wiped down to remove unwanted particles. Static never mixes well with sensitive electronics, so all aspects of the touch controller and LCD need to conform with automotive ESD standards. All components also need to be automotive qualified in terms of operating temperature up to 85°C and AEC-

Rear-seat passengers also benefit from the entertainment system's modern touchless functions.

Q200/Q100 stress resistance. With ambient light conditions varying greatly, particularly in soft-tops, and from moving to bright sunshine to a dark tunnel, the display brightness needs to compensate quickly. For voice and speech recognition, extraneous noise from other vehicle occupants, high-frequency tire noise, and low-frequency mechanical rumbles need to be filtered out. Wind noise from open windows or rushing sounds emanating from air conditioning or heating vents also needs management. The use of multiple microphones placed in the cockpit area, coupled with digital signal processing, will aid in reducing unwanted audible noises and in this way extremely improve the intelligibility of the speaker in the car.

Ensuring an HMI conforms to relevant technical standards is a key priority throughout the design and development process. The use of automotive-grade components is essential, and testing against EMI/EMC standards equally important. Wireless communication is ubiquitous within today's vehicles, with Wi-Fi, cellular, Bluetooth protocols the most popular. The likelihood of interference with media player, touchscreen, and ADAS functions is high. Also, electric vehicle drive chains generate significant high-frequency switching signals and high dV/dt transients, the latter potentially causing permanent damage to sensitive electronics if not managed correctly. A final point on functional safety applies if the HMI is involved in the operation of ADAS functions. The automotive functional safety standard ISO 26262 examines the potential risks of any software-based system that controls a vehicle's operation. Risk is assessed based on the potential for harm, the probability that it might occur, and how the system might avoid the risk.

Conclusion

Automotive HMIs have become a crucial part of modern automobiles. The functionality they control and give access to is staggering, everything from in-car media entertainment, wireless connectivity, communication, and navigation. Most utilize a touchscreen as the primary input method. Still, natural language AI-based voice recognition is advancing quickly as high-performance next-generation application processors and inference engines become available. ❐

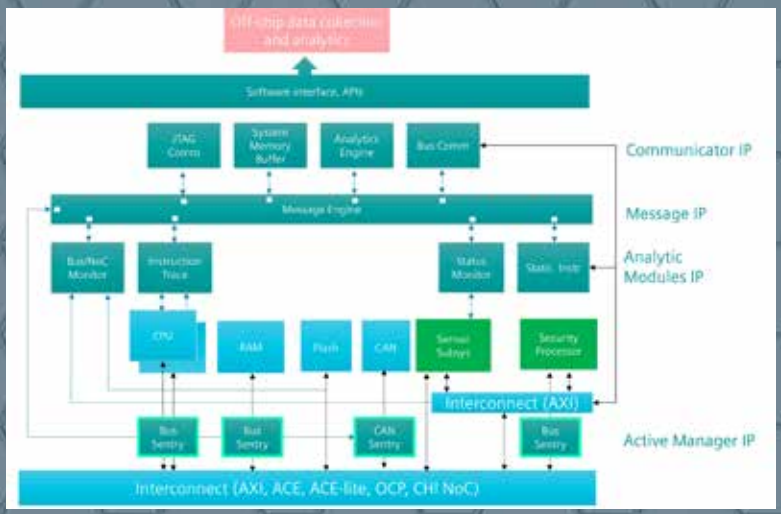
Electronica 2022,
Hall C3.578

Development of a hardware-based threat detection and response system

System on a Chip Security

SoC design teams fill a mission-critical role in ensuring cyber-physical safety and security for electrical and electronic systems that are connected to the internet. The requirements and tools available to achieve this goal are ever-shifting, but we can be fairly sure that traditional software-only security measures are not likely to be good enough; a new class of hardware-level monitoring is also needed.

TEXT: Richard Oxland, Siemens Digital Industries Software **PICTURES:** Siemens; iStock, peshkov



A complete cybersecurity infrastructure for SoCs.

The fundamental focus in systems on cybersecurity is leading to changes in working practices for several reasons, like these:

Concern over legal liability if systems are compromised that leads to loss, death, or injury – here standards like ISO/SAE 21434 and ISA/IEC 62443 attempt to outline the correct approach.

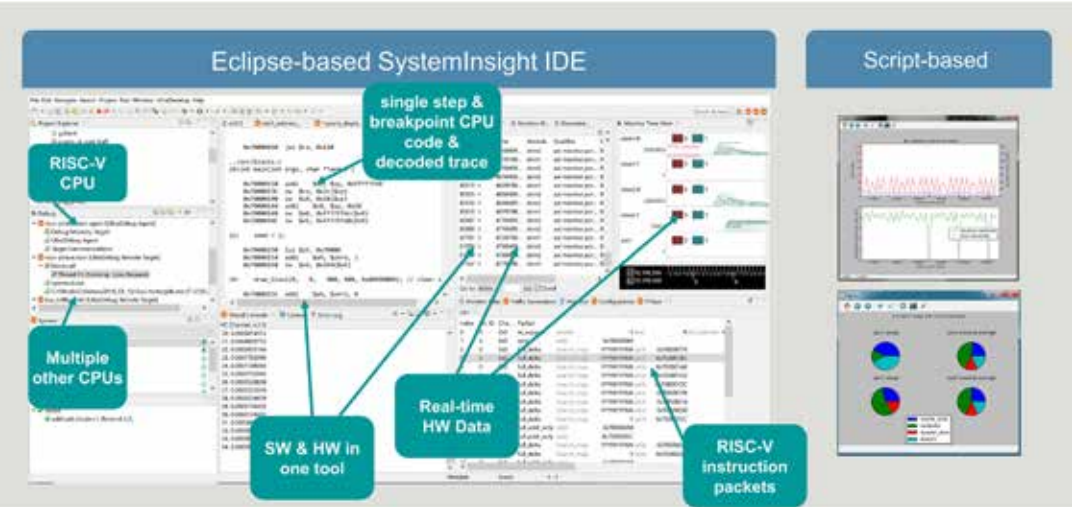
Changes in legislation. The United Nations Economic Commission for Europe (UNECE) has proposed regulations for connected and autonomous vehicles that will be adopted by more than 60 countries, including all EU states. The legislation promotes a shift in approach to cybersecurity for automotive systems from reacting to known attacks with bug fixes and updates, to one based on preventive measures.

Financial. The cost of product recalls when in-the-field updates cannot be achieved saps profitability and reduces the value of a brand in the marketplace. The best way of avoiding these burdens is to deal with cybersecurity issues at design time.

A product lifecycle view of cybersecurity

Securing products containing cyber-physical systems calls for lifecycle management most obviously because in-the-field updates will be vital to ensure that bugs and weaknesses can be patched immediately.

We need a coherent infrastructure that can support the monitoring and control of cybersecurity in deployed systems throughout the operational lifetime of the product. Such an infrastructure should be able to monitor in detail what is happening in the electronics system and automatically check to ensure that operations comply with specifications and rules that support a very secure system or component.



The Bus Sentry provides hardware-level security that is extremely difficult to circumvent, supplementing the capabilities of software-based solutions.

At a minimum, operations that contravene those rules are reported and logged. In many cases, it will be important that the attempted accesses are blocked in a way that does not alert attackers to the nature of the defenses being used. While software is an important part of this infrastructure, stopping attacks to the software itself requires monitoring at the hardware level.

Embedded Analytics platform

Monitoring infrastructure must be able to observe the behavior of the system's interconnects and buses, as well as the processor cores themselves, while also being secured from unauthorized access. The Embedded Analytics platform from Siemens Digital Industries Software provides a unique combination of system- and hardware-level visibility as well as both active and passive security features and total independence from system functions and resources.

Embedded Analytics support the monitoring and control of cybersecurity in deployed systems from the factory to the field. The Embedded Analytics Bus Sentry IP inspects and reports on-chip activity and also provides hardware-based security responses to transactions at hardware speeds. By implementing a set of security rules at the interconnect transaction level, the Bus Sentry can stop malicious activity in its tracks.

With the Bus Sentry, other mechanisms for ensuring security become practical, going way beyond what is possible with purely design- or specification-based security countermeasures. An approach based on Embedded Analytics and a security island enables adaptive defense: rules and countermeasures can evolve during the lifetime of the system, based on learning gathered from a whole fleet of systems.

Advanced on-chip cyber threat mitigation

There are many forms of attack that do not have clear-cut rules associated with them, but which can be learned, detected, and mitigated using an Embedded Analytics security platform. These include:

- Side-channel and denial-of-service attacks
- Using digital signatures
- Statistical anomalies
- Forensic analysis

By implementing the hardware-based security features of the Embedded Analytics platform – responsive security IP, a unique range of on-chip monitors, a secure message infrastructure, and advanced threat mitigation enabled by combining the Embedded SDK with on- and off-chip analytics – mission-critical systems can be secured, by design, through their full lifecycle. The user thus always works on a secure and reliable system.

As part of a full silicon lifecycle solution (SLS), Embedded Analytics also offers Host Services, a suite of software services that helps our customers use silicon lifecycle management data in their existing software workflows and data infrastructure. Host Services fills a key gap for SLS early adopters—the need to extract data from SLS-enabled chips and use that data in existing flows and enterprise software systems.

With the technology Embedded Analytics, mission-critical systems can be secured, by design, through their full lifecycle today and into the future. ❐

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MEDICAL POWER SOLUTIONS

Stop! Standards deliver safety

People and power don't mix well, and that is especially true when the people are patients – either in a medical facility or, increasingly, in a home environment. In order to ensure the safety of both patients and healthcare professionals, the healthcare business is heavily regulated by a range of standards-based requirements and associated product testing.

TEXT: Florian Haas, Traco **PICTURES:** Traco, iStock, oxinoxi

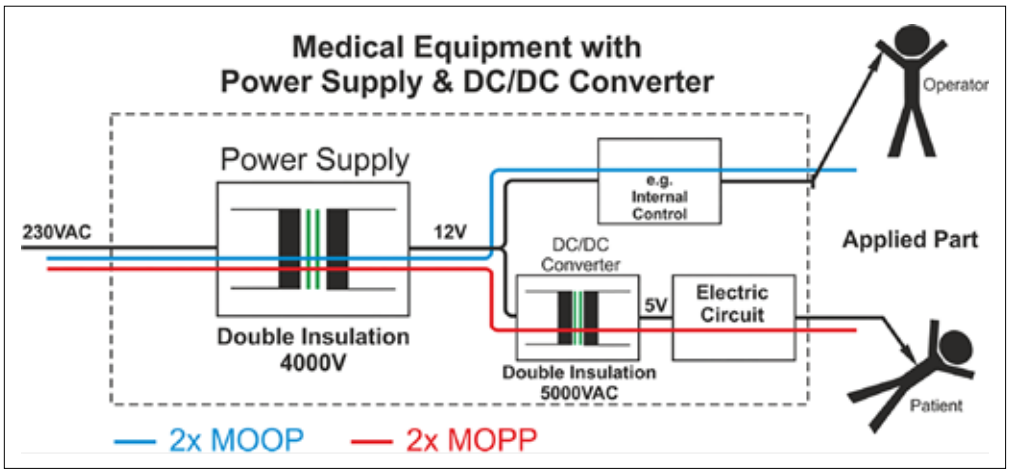
Central to the standards regime is IEC 60601, which is comprised of a suite of requirements specifically for the electrical and electronic equipment used in healthcare. Originally published some 40 years ago, IEC 60601 has kept pace with industry changes.

In this technical article we examine some of the key principles of IEC 60601 as they relate to implementation of the power supply, as well as some of the new requirements, such as the need for risk assessment. Additionally, practical ways for achieving compliance will be reviewed, such as the support that is available for medical device manufacturers.

Introduction

One of the key safety concerns with respect to medical devices is that the patient is often electrically connected to the device. One example of this is the conductive pads of an electrocardiograph. In IEC 60601 these are defined as 'applied parts' (AP) and are an important definition within the standard when defining a medical product's overall requirements.

Medical devices must incorporate at least one Means of Protection (MOP) to ensure that both the patient, if connected via an



Using a DC/DC converter to achieve 2 x MOPP protection

AP, and operator are protected from the risks of electric shock, even under fault conditions. A MOP can be achieved through safety insulation, a protective earth, a defined creepage distance, an air gap, other protective impedances, or by implementing a combination of these techniques.

In the standard, operators and patients are treated differently, resulting in the classifications 'Means of Operator Protection' (MOOP) and 'Means of Patient Protection' (MOPP). One reason for this difference it that the patient may be physically connected via an AP and unconscious when the fault occurs. Because of this risk, the MOPP requirements are the more stringent of the two. Each term is defined in terms of an isolation voltage, creepage distance, and insulation level.

Evolving standards

IEC 60601 has evolved since first being published almost 40 years ago. As power supplies and modules are not medical devices in their own right, the standards do not apply to them directly. However, medical device manufacturers would not be able to achieve standards compliance without power solutions that have been designed with medical applications in mind.

Up until recently, it could be assumed that medical devices would be exclusively used in dedicated medical facilities, such as hospitals and clinics. Such institutions provided dedicated clean power for use by their most sensitive medical devices. Nowadays, patients are demanding convenience and resource-constrained medical facilities mean that medical devices are increasingly being used in the home. Here issues such as electromagnetic compatibility (EMC) are of increased importance due to the prevalence of technologies such as Bluetooth and Wi-Fi. Because of this, the latest version of the standard (4th edition) has changed the testing procedures and acceptance levels for EMC.

Another significant introduction has been the requirement to conduct risk assessment according to ISO 14971. Risk management is seen as a key component in demonstrating regulatory compliance for medical devices and ISO 14971 defines best practices for all stages of a medical device's life cycle.

The Medical Device Directive further adds to the compliance burden, requiring manufacturers to implement a Quality Management System (QMS) that is compliant with ISO 13485. The primary requirement is for an organisation (such as a power supply manufacturer) to be able to demonstrate in detail their ability to meet both customer and regulatory requirements on a consistent basis.

2 x MOPP rated DC/DC converters

The typical approach toward achieving IEC 60601 compliance is to use an AC/DC power supply that is approved for medical use. However, BF rated applications also require the AP instrument to meet the 2 x MOPP rating. Many of the medical approved AC/DC power supplies on the market today do not have a 2 x MOPP rating and are not appropriate as a stand-alone power solution for applications where BF compliance is required. In these cases, an IEC 60601 approved, 2 x MOPP rated DC/DC converter will support BF compliance for the AP. Another common example are medical appliances that implement a battery back-up capability and must fulfil the 2 x MOPP rating during AC failure.

Medical appliances often require various DC voltages driving the AP instrument that are different to the main system DC voltage provided. In order to avoid sourcing a custom AC/DC power supplies, this can be resolved by combining IEC 60601, 2 x MOPP rated DC/DC converters together with, for example, an ITE 60950 rated AC/DC power supply. Other times, engineering confidence is simply raised through the assurance of using 2 x MOPP,

3rd EDITION REQUIREMENTS BY CLASSIFICATION			
Classifications	Isolation	Creepage	Insulation
One MOOP	1500 V ac	2.5mm	Basic
Two MOOP	3000 V ac	5mm	Double
One MOPP	1500 V ac	4mm	Basic
Two MOPP	4000 V ac	8mm	Double

Definitions of MOOPs and MOPPs for IEC 60601

medical grade DC/DC converters for the AP instrument, even when the selected AC/DC power supply has IEC 60601 approval.

The primary requirements for 2 x MOPP are 4000 V AC isolation, 8mm creepage distance and double insulation. Most commonly available DC/DC converters (including those that carry EN60950 approval) offer between 500 V DC to around 1600 V DC of isolation and are, therefore, not suitable for medical applications. However, specialised DC/DC converters are available that will meet the requirements for AP when used in conjunction with such standard off-the-shelf power supplies.

By providing up to 5000 V AC of isolation, double insulation and 8mm of creepage distance through its galvanically-isolating transformer, a DC/DC converter can still protect the patient in the event of a failure of the main AC/DC power supply, thereby avoiding mains voltage levels appearing at any patient AP points.

Medical safe power solutions

At the heart of Traco's approach to delivering world-class power solutions for the medical industry is their transformer technology. Developed and honed over a long period their unique approach ensures the required separation and isolation, while achieving sufficient coupling to allow the DC/DC converter to operate efficiently. A low coupling capacitance between the primary and secondary transformer windings is an important aspect of the protection implementation. Values around 10-15pF ensure that there is negligible transfer of current across the isolation barrier, this ensures patient protection according to the IEC 60601 standard.

Traco also implement their QMS in accordance with ISO 13485, which covers both their design and manufacturing processes. Additionally, further practices over and above the requirements of the standards that ensure high levels of quality and safety within their products.

Industrial-grade components are selected and sourced to ensure the ruggedness of the final product. As a result, devices intended for use in IT equipment are precluded by internal Traco policies. Workmanship is guaranteed through compliance with the international standard IPC-A-610 where Traco operate at level 3, the highest level of workmanship. Combined, these measures enable Traco to offer product warranties of up to 5 years .

As a manufacturer of power solutions, rather than medical devices, Traco is not required to provide risk assessment data. However, Traco is compliant with ISO 14971 and provides risk assessment files covering crucial areas such as insulation breakdown, use while inverted, effects of fan failure, flammability, mechanical shock and more to their customers. The provision of this data contributes to the risk assessment of their customer's final medical products, saving them both time and expense during the whole design process.

Summary

The healthcare market is growing and changing rapidly and the applicable standards, such as IEC 60601, are constantly evolving to keep pace. Medical device manufacturers are ultimately responsible for ensuring the safety of patients and operators of their product. However, by partnering with experienced power supply suppliers, the challenges and risks can be significantly reduced. By leveraging Traco's team, such manufacturers gain access to high quality, reliable and safe products, along with comprehensive and knowledgeable support. ❐

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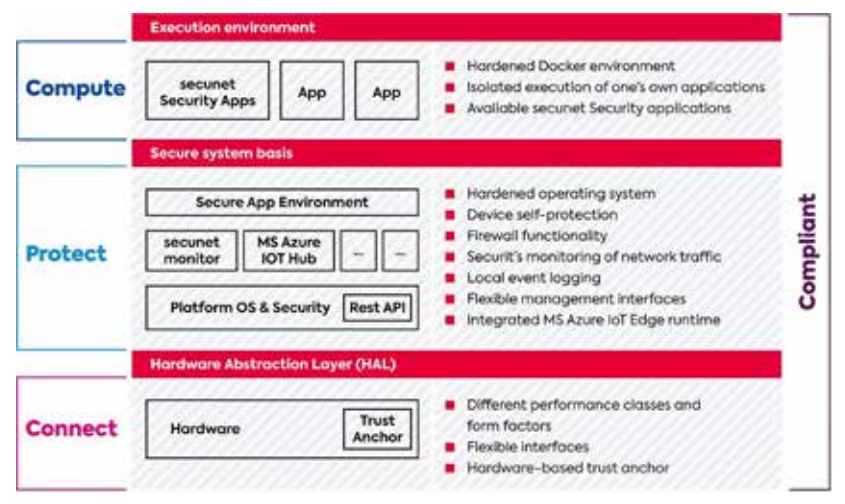
DEVELOPMENT OF CYBERSECURE MEDICAL EDGE COMPUTING PLATFORMS

Co-creation – reaching the goal faster

Medical devices and medical networks need cybersecure gateways for the digitization of healthcare. S.I.E and congatec have entered a strategic value-added partnership to develop dedicated medical edge gateway platforms that enable all players utilizing this new medical technology platform to reach their digitization goals faster.

TEXT: Congatec **PICTURES:** Congatec; iStock, NoraVector

It is a special kind of partnership that goes beyond the classic concept of collaboration, where companies join forces to develop new products and then offer them on the market. In this case, the two companies offer individual co-creation services for customers. This allows medical device manufacturers and hospital IT providers to procure and implement better solutions much faster. One of the first customers to take advantage of this innovative offering based on agile development methods is secunet Security Networks AG. In a remarkable design sprint that took only a few months, the companies involved developed a new class of secunet gateway in two variants. Besides a controllable information flow for medical digitization concepts, it also offers a protected connection to centralized services and a secure execution environment for users' own applications.



The secunet medical connect product family is based on secure gateway technology that bundles modern security and IT technology solution concepts in a single platform.

Trustful cooperation creates trustful products

With secunet medical connect Carna, the partnership has created a medical device gateway for the point-of-care (POC) environment. This gateway is designed for use as a medical IT accessory as well as for medical device approval. For safety-critical networking scenarios, it therefore not only provides the functions but also the necessary formal requirements from a single source – including essential approval information and evidence of quality management system ISO 13485:2016 or risk management ISO 14971 compliance. This gateway separates the connectivity layer of medical devices from the actual medical device, which makes it possible to regularly update the interface to the outside world without having to recertify the medical device itself. This ensures that the security and the operation of the various interfaces that change over time is always up to date. The medical device itself remains in the field unchanged. For data-intensive use cases or clusters of medical technology devices, the 19-inch rack server family Athene was built. It can be deployed in individual department networks or also centrally in the hospital data center. Depending on the design, it can be used either as a cloud frontend, security gateway or as a secure execution for AI tasks close to the medical data source.

Open and secure – that's a challenge

Such application-ready medical gateway and server platforms are immensely important as digital healthcare transformation poses major challenges for all players involved. Medical device manufacturers must open their systems so that the collected data can be exchanged. At the same time, they must meet the highest security standards to protect this data exchange and their devices. Hospitals, on the other hand, must open their IT networks for such devices, while at the same time meeting legal requirements to ensure critical infrastructure (CRITIS) security and data protection (GDPR). As a result, all companies involved in the digitization process must pay constant attention to the IT security aspects of critical medical technology and its sensitive data. Yet this is not a core competence of the medical OEMs nor of the hospital operator. That is why secunet, as one of Germany's leading cybersecurity companies, has joined forces with S.I.E and congatec to develop medical-device-compliant solutions that meet this need. The focus is on compliance with numerous standards and regulations – from EN 60601-compliant interfaces, to MDR and FDA cybersecurity guidelines to ISO 80001.

The early bird catches the worm

To co-create these products, the companies got together very early on in design sprints for hardware and software system integration. Functional prototypes were in place after just four and a half days. With a classic approach, it would have taken months for anything comparable to emerge. This is because internal company secrets and added value are normally protected and sealed off from other companies. A system design and integration house like S.I.E, which also takes care of the series production and assembly of such OEM platforms, does not usually bring its module supplier to the customer's table during a pitch. The module supplier could all too easily decide to cooperate directly with the customer.However, considering the high division of labor within the embedded and edge computing supply chain, the immense lead times from initial idea to first prototype or finished series product are severe bottlenecks for OEM customers. To break down the walls between departments and companies, they are therefore looking for holistic solutions. After all, all development tasks should run in parallel and in constant synchronization with customers in order to create best-practice solutions. ☐

Read the full article online via the link in the QR code and at: industr.com/2670922

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Source: Messe München

Visitors from 80 countries attended the last Electronica fair in Munich. With 3,100 exhibitors from 50 different countries, one thing is clear: It's a place for world's leading companies and experts.

The trade fair and conference for electronics opens the doors for visitors from all over the world again and will take place in Munich from November 15 to 18. Visitors can be inspired by industry-moving trends and future-oriented solutions.

Read more on page 12.