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Outdoor Surveillance in Smart Cities p26

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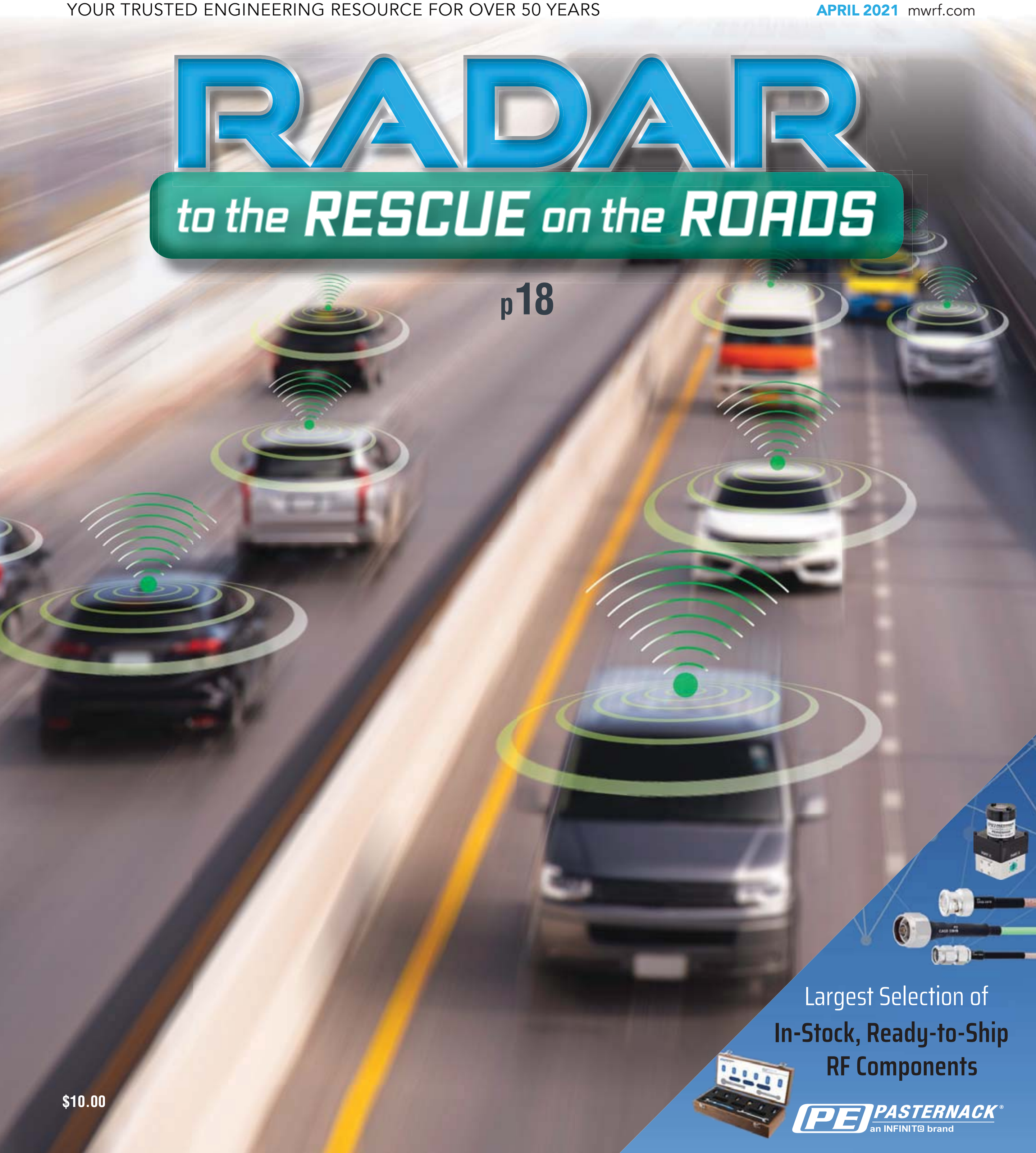

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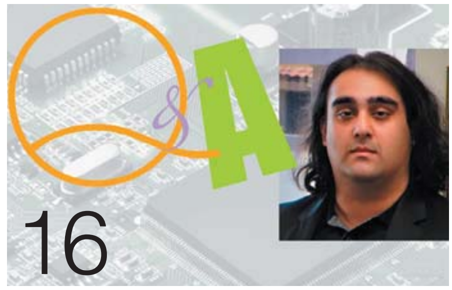

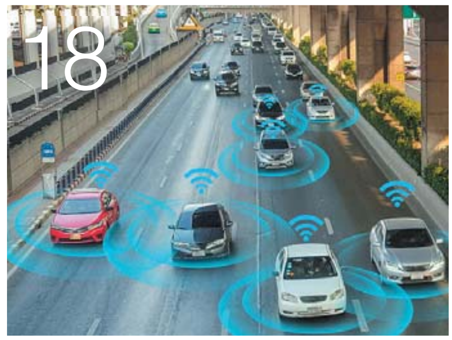

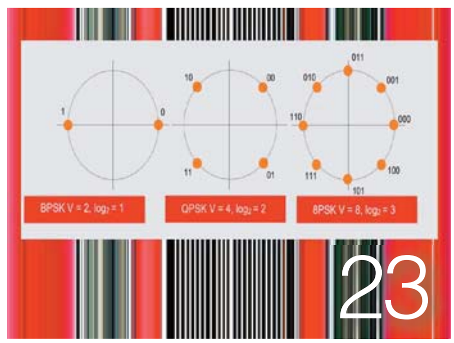

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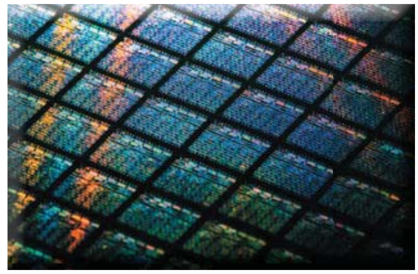
Editorial

DAVID MALINIAK | Editor
dmaliniak@endeavorb2b.com

EDA Keeps Moore's Law Afloat

The EDA industry, as it has for decades, continues to provide the tools that make designers' jobs possible, even as it broadens its scope to full system level.



Back in 2012, when I was the electronic-design-automation (EDA) technology editor at our sister publication, *Electronic Design*, cutting-edge semiconductor process technology was at the 22-nm process node. Industry observers like myself wondered when Moore's Law would finally succumb to a) physics, b) photolithography limitations, or c) both. Indeed, a technical expert at the Defense Advanced Research Projects Agency (DARPA) predicted in 2013 that Moore's Law would be dead by 2022.

Today's most advanced process technology yields 7-nm feature sizes, and Intel's roadmap says we'll see the 5-nm node by 2024. But does that mean the number of transistors will continue to double for the same silicon-substrate area every two years, as Gordon Moore forecast in 1975? The jury's still out on that; most high-end foundries don't even count transistors anymore.

It's fair to say that the law still holds for some types of high-end chips, like smartphone SoCs, but not others. However, even if the law isn't upheld in its strict sense through process technology, it's not a foregone conclusion that it can't be upheld with respect to overall functionality and processing power through other means.

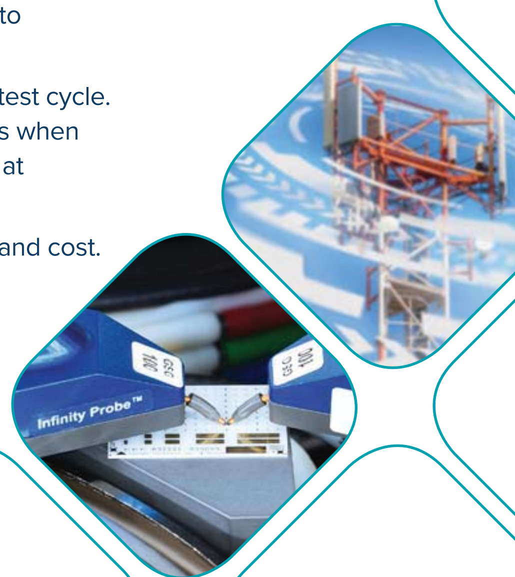
That's where the EDA industry comes in. In a recent series of discussions with major EDA vendors, I learned of some of their strategies to keep Moore's Law alive.

For one thing, the EDA vendors' approach is trending toward a holistic system-level methodology. These days, when EDA vendors speak of system-level design, it's not so much about high-level synthesis or verification from behavioral models, but more in terms of folding into the design process aspects of overall system design that perhaps have been siloed historically. I'm thinking of, say, electromagnetic issues, thermal analysis, and packaging.

A big element, of course, is system software, which once was nearly totally divorced from hardware design. Now, software is the differentiator in chip design, not hardware. There are burgeoning concerns like silicon lifecycle management, artificial intelligence, and machine learning. Modern—and future—EDA toolchains will bring many domains together in multi-discipline simulation and analysis that accounts for all of them simultaneously.

The EDA industry is keenly aware that designers need, and miss having, a full solution approach. When a vendor has a broad array of tools and IP that touch many and varied facets of design, the design teams in each industry vertical—e.g., automotive/ADAS, mobile/5G, IoT, aerospace/defense—need help making sense of that tool palette. This certainly applies to the connectivity aspects of the system, especially if that connectivity is wireless, but it also includes elements such as low-power design, security, and safety. EDA vendors are trending toward offering more tailored toolsets that address all of these concerns in a way that's most meaningful and efficient for the customer. mw


5G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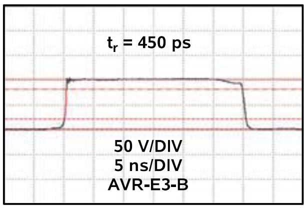

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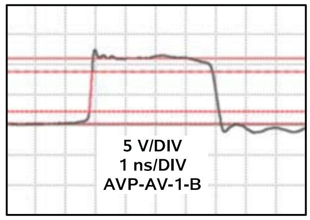

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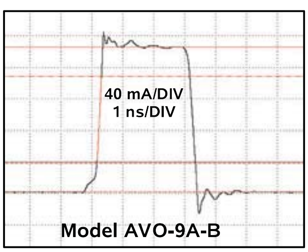

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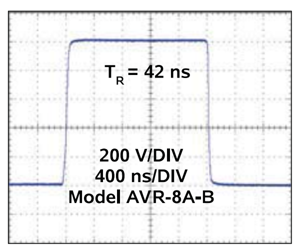

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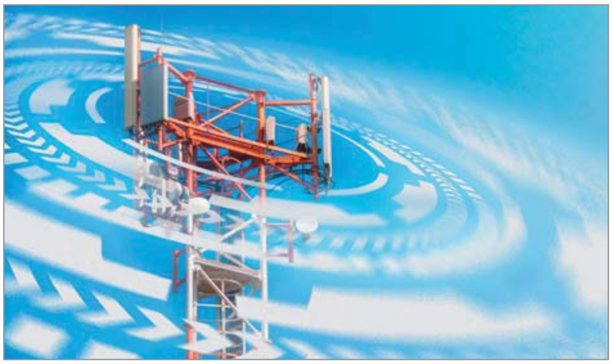

Integrating 5G into the Wireless Infrastructure

In this Q&A, we talk to Raza Khan, senior marketing manager at Semtech, about 5G fronthaul applications.

https://www.mwrf.com/technologies/systems/article/21160312/evaluation-engineering-integrating-5g-into-the-wireless-infrastructure

Nothing is Real on April 1st

There's nothing to get hung about, either. It's all in good fun and besides, who can't use a diversion at this point?

https://www.mwrf.com/community/editor-columns/whitepaper/21159559/microwaves-rf-nothing-is-real-on-april-1st

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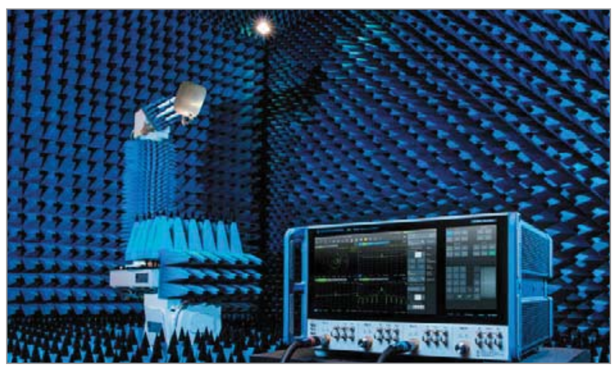
Detecting and Locating Cell Phones in Prisons

Learn about a tool that can be used to detect and locate cell phones and other contraband devices, helping to keep prison populations, staff, and the public safer.

https://www.mwrf.com/technologies/test-measurement/article/21158373/thinkrf-detecting-and-locating-cell-phones-in-prisons



Special Report: Vector Network Analyzers

Offering a variety of features, from excellent RF characteristics to a wide variety of analysis functions, the latest VNA solutions facilitate the capture and evaluation of important performance parameters.

https://www.mwrf.com/technologies/test-measurement/article/21159100/evaluation-engineering-special-report-vector-network-analyzers

News


Sondrel

SONDREL PREPARES TO Tape-Out Its First Rad-Hard Chip

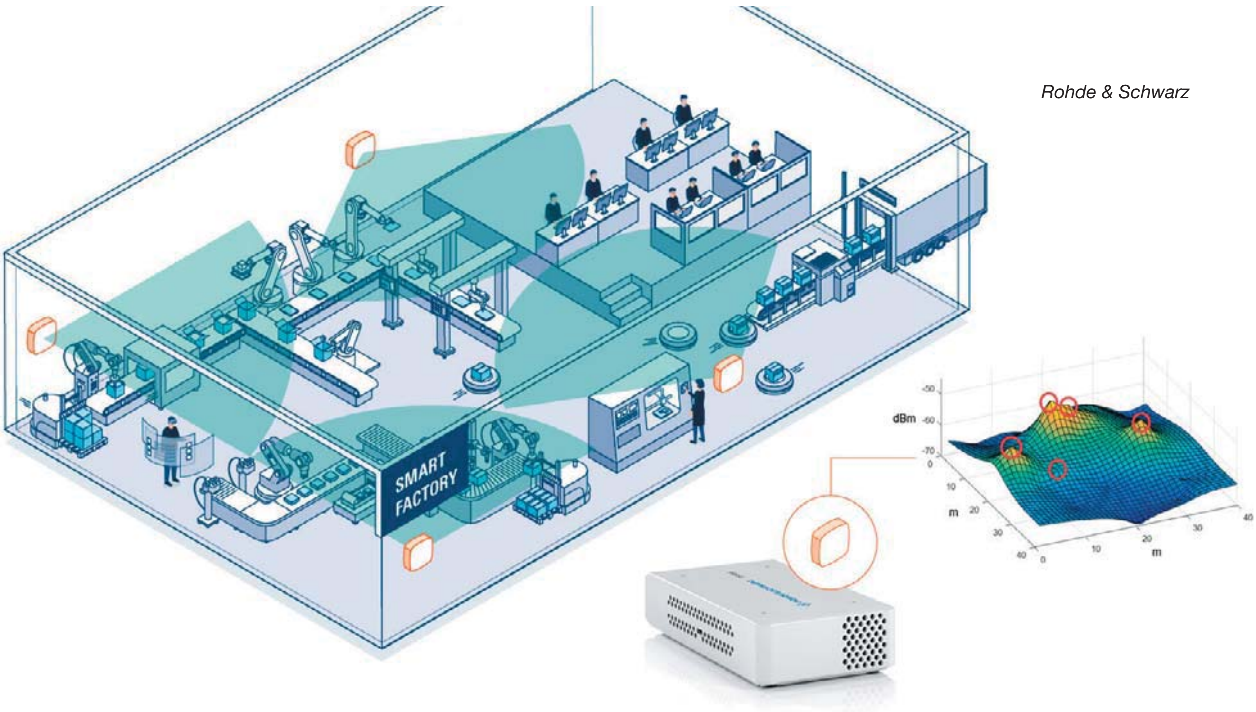
In designing a satellite modem IC, Sondrel took a redundancy approach to ensure reliability in the face of ionizing radiation.

Chips meant for service in satellites must be designed for radiation hardness; otherwise, the device is subject to glitches due to the incidence of ionized particles. To meet those requirements, Sondrel is designing its first radiation-hardened (Rad-Hard) chip for a customer. That chip, which is due for tape-out shortly, is a satellite modem IC.

Graham Curren, Sondrel's CEO, said, "The customer came to us because quality and reliability are paramount for a chip that goes into space. It must work correctly all the time as you can't get an engineer to swap it over if a problem occurs. Our work on functional safety for chips that are used in mission-critical applications in cars and planes means we understand how to design for all eventualities. It takes really outside-the-box thinking to imagine what could possibly go wrong and design solutions should that occur. The engineers really enjoy the brainstorming sessions to come up with unusual scenarios and solving them as it stretches their imaginations in a very rewarding way. In pre-COVID days, those session were like a party game with everyone chipping in ideas over pizzas."

According to Kirthi Kishore, Staff Engineer Level 3 at Sondrel's office in Hyderabad, India, "Neither the process nor the cells and IP are specially designed to be radiation hardened. The key is to build in redundant logic in case of damage or to take over while an affected part is rebooted. In the case of the ARM 853 processor at the heart of the chip, the design has to ensure that the processor reboots correctly if a hard reset is needed due to a radiation event."

The satellite-modem design is for GlobalFoundries' 22-nm process, which is less susceptible to radiation than smaller process nodes. It has an area of 200 mm^2 with 15 IP blocks with over 46 million instances. mw



Rohde & Schwarz

IRL DRESDEN, ROHDE & SCHWARZ Research Industry 4.0 Wireless Tech

Rohde & Schwarz's network scanners help IRL Dresden to explore reliable and resilient wireless technologies for industrial applications.

TO REALIZE INDUSTRY 4.0 use cases such as mobile robots or automated guided vehicles, industrial network deployments must guarantee very high availability, reliability, and, in many cases, low-latency communications. 5G NR technology (inclusive of its latest enhancements specified in 3GPP Release 16) enables ultra-reliable, low-latency communications (URLLC), ideal for private campus network deployments. However, as with any wireless system, the communication link is subject to potential interference on the deployed spectrum bands.

The Industrial Radio Lab (IRL) Dresden is dedicated to researching and testing radio systems for industrial applications. In this effort, they cooperate with Rohde & Schwarz, a leading provider of 5G NR test solutions, which includes portable and easy-to-use test equipment for assessing a network's performance in the field. Rohde & Schwarz has provided its high-performance network scanners to the IRL Dresden for distributed real-time radio spectrum and interference monitoring. With this application, the researchers gather important data on how to detect, locate, and prevent interference and to keep a local spectrum band clear for reliable wireless connectivity.

IRL Dresden is one of the four regional labs of the Industrial Radio Lab Germany (IRLG) that engages in research and development of current and future wireless technologies in industry. The IRLG creates innovations, supports companies, and collaborates with stakeholders in economy and politics to ensure knowledge transfer towards a digital society. IRL Dresden has a particular focus on detection, localization, and mitigation of interference and improving network resilience through real-time measurements of time- variant channels and cooperative spectrum sensing.

Dr. Norman Franchi, project lead at IRL Dresden, says: "The capabilities to cope with predictable as well as unpredictable disturbances and to provide appropriate self-optimization and self-healing mechanisms are still insufficient. Automated and reliable methods based on real-time measurements and AI analysis to detect, localize, and avoid unintentional self-interference as well as intentional interference like jamming are becoming increasingly important and challenging. This is especially true in dynamic industrial use cases and communications scenarios. The goal of the cooperation is to analyze and evaluate the requirements on the measurement sensors and network, and to derive which real-time performance can be achieved."

Anne Stephan, Vice President Mobile Network Testing at Rohde & Schwarz, says: "Industrial campus network deployments, whether based on private spectrum or provided through network slices from a public operator, generally establish a demanding use case scenario. By partnering with a leading research institute like the IRL Dresden, we not only support fundamental research, but gain first-hand insights that we can use to adapt our leading mobile network testing solutions for Industry 4.0." ■

MICROPHONE "HEARS" Distant Turbulence

An infrasonic microphone capable of detecting sound waves below 20 Hz warns of distant clear-air turbulence that can endanger manned and unmanned aircraft.

RESEARCHERS AT NASA have developed a form of microphone capable of perceiving infrasound waves below the range of human hearing, from 0.001 to 20.000 Hz, and capable of detecting suddenly occurring and potentially dangerous aeronautical turbulence many miles away. The unique microphone *(see figure)* may provide information on currently unknown environmental conditions such as clear-air turbulence and help change flight planning for safer air travel.


NASA

Clear-air turbulence is currently undetectable because there are no atmospheric features, such as clouds, to warn of these sudden events which can be so disruptive to aircraft in flight. Researchers Qamar Shams and Allan Zuckerwar at NASA's Langley Research Center (Hampton, Va.) have experimented with the detection of clear-air turbulence since 2007, developing an infrasound signal for the events which could serve as warnings for air traffic controllers and aircraft pilots. As Shams explained, it would take a special microphone: "We have combined expertise in instrumentation, so why don't we design a microphone ourselves?"

The sudden turbulence sometimes experienced when flying is called clear-air turbulence, so named because there are no visible clouds or atmospheric features to warn of the disruption. Turbulent invisible air can seemingly come out of nowhere and wreak havoc on aircraft. Though it is not easily detected visually, clear-air turbulence has a definite infrasound signature. Shams and Zuckerwar realized that if air traffic controllers or pilots could listen in on these whirling vortices before airplanes encounter them, an alternate route could be plotted.

Their experiments began in 2007, but, unsurprisingly, initial tests showed that they could not grab just any off-the-shelf microphone and expect it to work with infrasound. The long-wave frequencies tend to get overpowered by higher-frequency sounds, which results in interference.

"We found that the sensors get saturated, and they don't perform well," Shams said. "We thought, 'We have combined expertise in instrumentation, so why don't we design a microphone ourselves?'"

The researchers used a novel microphone design with a wide-radius, low-tension diaphragm, and a large, sealed air chamber behind it to allow the microphone to hear these sub-audio sound waves that travel such great distances. Manufactured by PCB Piezotronics under contract with NASA Langley, multiple infrasonic microphones were tested by placing them in an equidistant triangular pattern around the grounds of Langley's runway. They could detect and identify atmospheric turbulence more than 300 miles away in skies above Pennsylvania.

The technology has developed with encouragement from the U.S. Department of Defense (DoD), Sandia National Laboratories, and Stratodynamics, Inc. (Lewes, Del.) also a developer of unmanned aerial vehicles (UAVs). After licensing patents from NASA, the company developed the microphone/sensor system for a stratospheric glider, the HiDRON, developed by Canadian affiliate Stratodynamics Aviation, Inc. The balloon-launched HiDRON glider has safely reached heights of more than 100,000 feet with the guidance of the infrasound microphone and wind probe. The company continues to work with NASA in using the infrasonic microphone to detect and identify the intensity and distance of unseen turbulent conditions. ■

ULTRA-PORTABLE SPECTRUM ANALYZER Supports 6 GHz to 20 GHz

FIELD ENGINEERS AND TECHNICIANS performing link planning, installation, site acceptance, maintenance, and troubleshooting of wireless networks need reliable and highly portable test instruments to get their jobs done. With coverage of 6 to 20 GHz, SAF Tehnika has expanded its Spectrum Compact family of ultra-portable handheld microwave spectrum analyzers with a model that delivers durability at affordable pricing.

SAF Tehnika

The new instrument has high sensitivity of -110 dBm at 30 kHz resolution bandwidth, long battery life of up to 4 hours, and instant-on functionality for quick start-up and operation. It all comes in a rugged, ultra-compact form factor that measures only 135 x 83 x 34 mm (5.31 × 3.27 × 1.34 in.) and weighs 0.57 kg (20.11 oz). It's suited for deployment by mobile carriers, telecommunications professionals, internet service providers (ISPs), and contractors responsible for regulations and compliance, drone applications, and satellite operation.

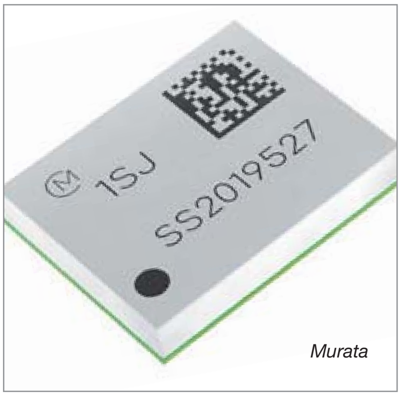
Every aspect of the Spectrum Compact family of instruments is designed to address the challenges of field applications. Like other models, the new 6- to 20-GHz handheld spectrum analyzer has a resistive touchscreen for operation with gloves, and high contrast and full display modes for easy readability in bright light environments. Durable thumbscrews for the waveguide adapter connections help the analyzer to withstand harsh environments. Users may save spectrum traces in the onboard 8 GB of memory for offline analysis, investigation, and reporting using the Spectrum Manager PC software.

All of the Spectrum Compact devices are well-suited for mobile operators, carriers, and tower installation crews deploying 5G networks, Wireless Internet Service Providers (WISPs), local government institutions, public-safety departments, and critical network-infrastructure owners. Field engineers and technicians can use the ultra-portable handheld microwave spectrum analyzers to conduct site surveys, radio parameter verification, antenna alignment, interference detection, line-of-sight verification, signal strength mapping, and interference hunting.

SAF Tehnika has developed a virtual demo of Spectrum Compact for viewing *(visit https://saftehnika.com/en/sc_emulator*). ■

WORLD'S SMALLEST LoRaWAN Modem Module Drives IoT Devices

MURATA HAS EXPANDED its Type 1SJ product line with the addition of a new LoRaWAN modem solution. The AT-Command-controlled modem module version measures only 10.0 mm × 8.0 mm × 1.6 mm, which the company claims is the smallest available in the world today. Operating from a single supply rail up to 3.9 V dc, the device incorporates several low-power modes that allow the real-time clock (RTC) to operate while drawing a typical current of just 1.3 µA. With current consumption so minute, a single battery could run the device for years. Additionally, the resin-mold package provides physical ruggedness with a –40 to +85°C temperature range.



Murata

Based on a second-generation Semtech SX1262 RF IC, the Type 1SJ LoRaWAN modem module comes preloaded with AT Command-controlled modem firmware and a LoRaWAN stack with an AT-Command middle layer. These features enable a faster time-to-market and ease design challenges for IoT developers. The device currently supports the U.S. 915-MHz band in North America. Future adaptations of the module are intended for Europe, India, China, and Pacific Rim markets. It is suitable for a wide range of applications where a miniaturized footprint, long range, extended battery life, and advanced security are all critical requirements. Examples include asset tracking, utilities, agriculture, smart cities, smart buildings, industrial, and other IoT applications.

The initial launch module supports the U.S. 915-MHz band only, but modules supporting other bands such as the EU868 band will be launched afterwards. ■

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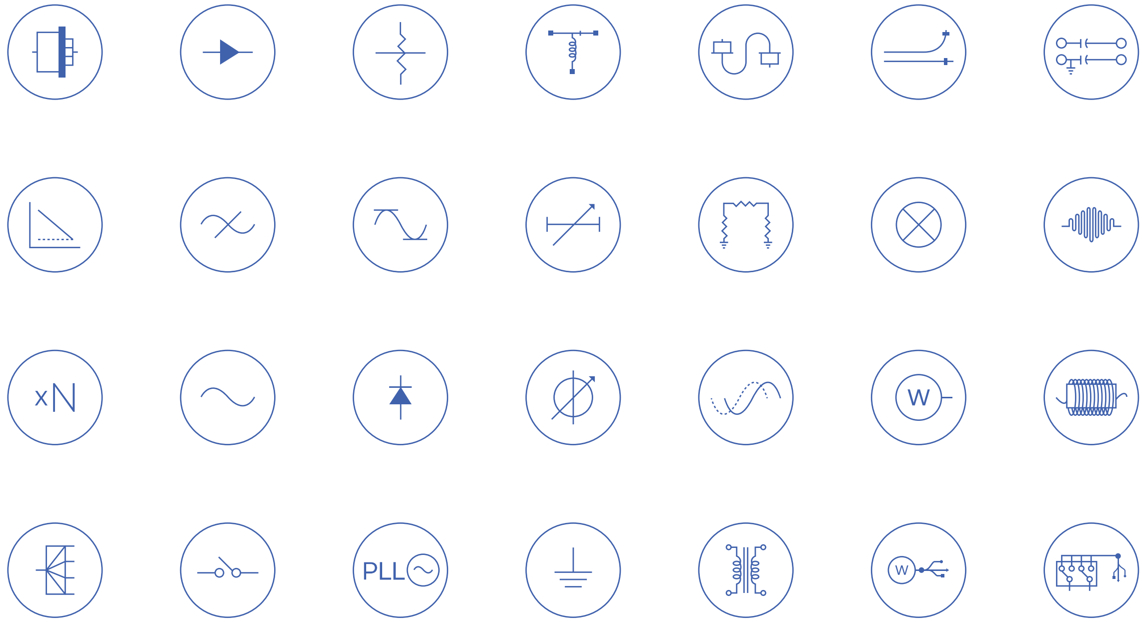

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DAVID MALINIAK | Editor

An Inside Look at EDA Startup Avishtech

Keshav Amla, founder and CEO of Avishtech, an EDA startup, discusses how the company's PCB simulation and stackup tools can close the gap between PCB design and manufacturability.

Today's high-frequency, high-data-rate products (112 Gb/s/channel and 5G/mmWave applications) deliver mountains of data in a hurry. That can come at the cost of challenges to traditional PCB design approaches. PCBs meant for these kinds of products afford very little "wiggle room." The slightest misstep in the PCB design can result in a product that's unmanufacturable, inoperable, or both. While traditional EDA toolsets provide insight into the specifics of designing a working PCB, they don't offer any perspective into the critical types of manufacturing information that can make or break a PCB design.

I had the chance to sit down with Keshav Amla, founder and CEO of Avishtech, an EDA startup that has developed two new EDA toolsets—a stackup tool, Gauss Stack, and a 2D field solver, Gauss 2D, both of which are meant to build a bridge between EDA, manufacturing processes, and end-product reliability.

How did Avishtech come to be?

My experience, interests, and education lie in mechanical engineering and materials science and engineering. While I was pursuing my undergrad at Caltech, I planned to start a company.

Avishtech began while I was a grad student at Stanford. Our co-founder and CTO is my father, Dr. Tarun Amla, whose primary educational background is in mechanical engineering, modeling and simulation, and electrical engineering. More critically, he's a leading expert in the electronic materials sector and has been central to many of the key materials advances in the industry for a long time.

For many years, he's had concerns regarding the gap that exists between the PCB design/development process and subsequent manufacturing processes. As these high-frequency/high-data-rate products evolved, that gap reached a critical point at which the slightest change in the design stage could result in a failed product at the manufacturing, test, or field operations stages.

We envisioned significant enhancements to the PCB stackup design process that would enable a product to work right the first time and every time thereafter. These enhancements incorporate a real integrated approach in which product developers can carry out electromagnetic and thermomechanical simulations, manufacturability checks, and reliability predictions before committing to manufacturing operations.

What are the key issues that people need to worry about with high-frequency/high-data-rate designs?

Of course, the primary concern for these applications is signal integrity with a heavy emphasis on impedance and losses. Typically, field solvers do a good job of modeling impedances. But at higher data rates and frequencies, the proximity effect becomes quite significant and ground-plane losses can account for 20% or more of the total loss.

Beyond this, there are several things that product developers haven't had to consider before as critically in terms of manufacturability and reliability. The specific constructions used in a particular stackup design can lead to issues such as glass stop, which is responsible for problems like conductive anodic filaments (CAFs), voiding, and drill-induced crazing.

When you move into high-frequency, high-data-rate designs, those are the hidden "gotchas" that will determine if your product works as designed or even if the product can be successfully manufactured. Relying on just one or two material attributes will not suffice for these types of end-application products.

How were these issues addressed before?

Previously, the process consisted of "best guess" estimations, or, more often, general rules of thumb that could only be verified by building a test vehicle board. If problems were detected at this level, the only solution was to go back to square one and start the design process all over again, often with a new material, which may or not have been the culprit in the first place. This led to time-intensive and expensive rework that could then impact critical time-to-market windows, competitive advantages, and overall profitability of a product line.

The old paradigm was the only one available at the time, so the seemingly endless series of product re-spins was expected and accepted. But, with the current set of challenges for high-frequency/high-data-rate designs, the tolerances have reduced to the point that product developers are hitting these walls more often, which calls for an integrated approach.

What are the types of data that your technology can provide?

For instance, by accounting for the ground-plane losses I mentioned earlier, something that's not available in competitive offerings, we can accurately model insertion losses. We can also accurately predict resin starvation and glass stop that includes the effects of dielectric filler and conductor roughness.

At the highest level, we accurately simulate the PCB thermomechanical properties that are critical for reliability predictions. Then, based on these thermomechanical properties, we can predict plated through-hole, microvia, and solder-joint reliability. In addition, we simulate for impedance, frequency, and roughness-dependent losses that are associated with the dielectric materials. Not only that, but we can also flip the problem to simulate the line widths required to achieve a target impedance for the entire stackup.

A number of these operations are accomplished rapidly with a single click and virtually no learning curve, all in a fully integrated environment.

Many EDA tools offer large databases of materials information. How is your technology any different?

It's not just about having massive amounts of data. It's the ability to quantify and qualify that data in such a way that it's relevant to your design before you commit it to hardware. We haven't just built another iteration of the same mouse trap—a broad-based laminate database.

We have incorporated a level of intelligence into our technology in the form of a proprietary algorithm that's able to extract detailed mechanical properties at the polymer level that are critical to the thermomechanical simulations performed by our stackup tool. These properties are stored in our library for use as inputs into our thermomechanical simulations, which provide board-level properties that can't be simulated through other means.

As I'd mentioned earlier, these simulations allow us to determine how such properties will impact the design, manufacturability, long-term operability, and reliability of the end product. All of the necessary functionality is built directly into the toolset. And, we have done extensive validation of our predictions on several built test vehicle boards. All of our results have been within experimental error of the test measurements.

How have the materials suppliers responded to the information you incorporated into your toolset?

They have responded quite well. Our materials library consists of permittivity (Dk) and dissipation-factor (Df) data and construction lists that come from the laminate materials vendors. They've been happy to provide this data and are pleased that we can provide the detailed thermomechanical information on boards built using their materials.

Beyond the product solutions we deliver to our customer base, we're focused on educating the market. We're educating our end users, the materials suppliers, and the fabricators. The concept of providing a bridge between design and manufacturing is a new one and there are several audiences for the information that we provide.

The characterization capabilities you provide sound quite complex. How easy is it to use your stackup tool?

Actually, it's quite easy to use and that's been something that we have focused on since day one; it also ties into our focus on education. Any EDA toolset is only as good as the designer using it. And, quite honestly, that's been the shortcoming with a lot of the competitive products available in the marketplace.

Only the most skilled engineers could utilize the toolsets and even after they attained that information, the process would fall short, because these offerings would still not provide much of the most important information pertinent to manufacturability and durability in the field. So, that meant several simulation iterations followed by several real-world validation iterations to learn whether the material and design they had chosen would work in their product.

To make matters worse, some minor modifications to the constructions used in the stackup would inevitably occur between the prototyping stage and the manufacturing stage, leading to problems that seemed to come out of nowhere. This is where our broader vision comes into play. It doesn't do any good to specify a material for a certain design only to find out that the design won't be manufacturable, reliable, or meet long-term operation requirements. We built our Gauss products specifically to bridge this gap.

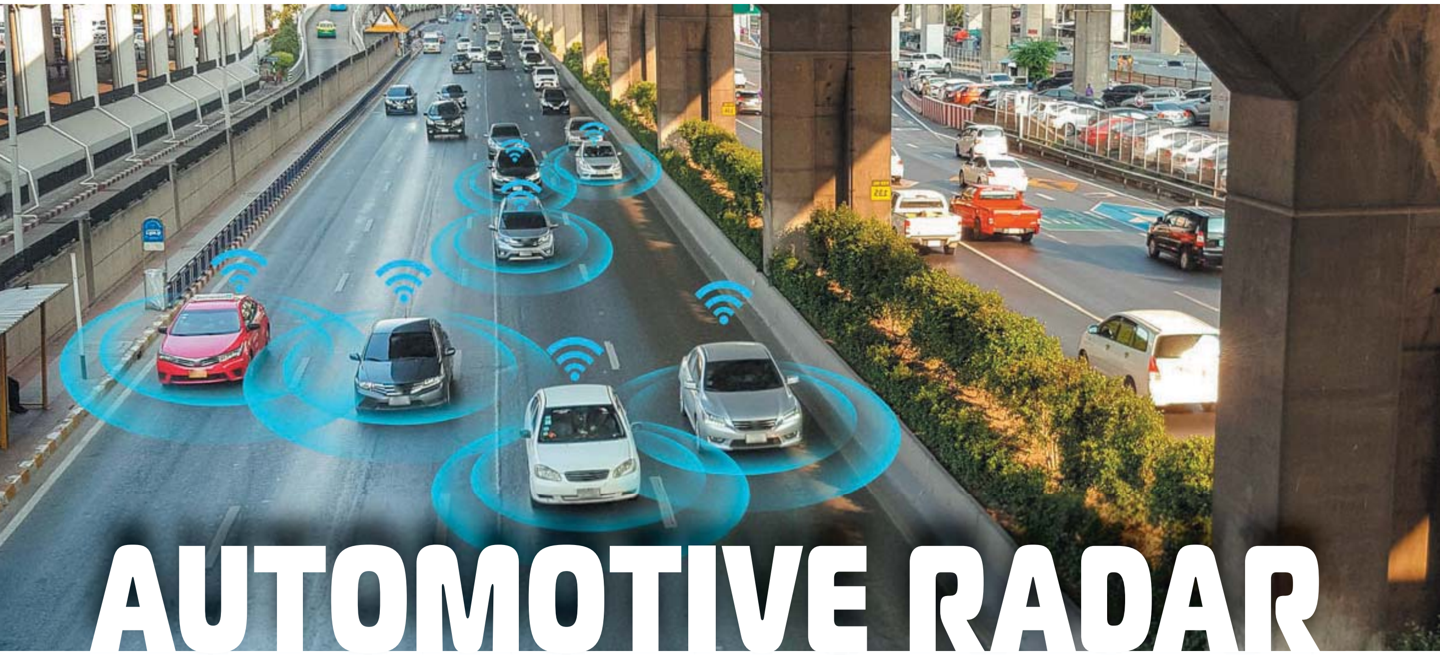
What's the response been thus far to your approach to the design process and the technology that you have created?

It's been very positive. Product developers are very excited to see a tool that provides a new breadth and depth of insight into the PCB product development process. Fabricators are enthusiastic that our tool provides a new level of validation that the designs they receive from their customers will be manufacturable in volume.

Likewise, business managers welcome a solution that enables them to create a product-development timeline that's achievable and cost-effective and will allow them to deliver a very competitive, profitable product to the marketplace. We've been seeing strong and enthusiastic adoption of our offerings across the market.

In addition, we have received critical validation from one of the industry's foremost experts in PCB design and simulation, Lee Ritchey. As is well-known, Lee is skeptical when it comes to companies that introduce new EDA toolsets and he has never publicly supported a design tool before. We demoed our tool for him, and he then provided us with the stackup of a product that he had previously designed. The results we provided to him were the same that he got, but he had to build a test board to acquire them. mw

JACK BROWNE | Technical Editor



AUTOMOTIVE RADAR Paves the Way to Safer Roads

Low-power radar MMICs at 24 and 77 GHz provide the electromagnetic-sensor data that combines with video cameras and LiDAR systems for reliable ADAS coverage.

Radar systems are typically associated with military aircraft flying at high speed, but they have quickly made their way to civilian roadways and into commercial automobiles. Millimeter-wave (mmWave) radar systems are being integrated into new vehicles as part of advanced driver-assistance system (ADAS) electronic equipment for safer driving experiences. While fully autonomous, "self-driving" vehicles may still be a few years away, ADAS functions such as blind-spot detection and collision avoidance protect many drivers now. Low-power, high-frequency radar detection is vital to making it all happen, ultimately creating a safer driving experience.

Automotive radars are one of three essential sensor technologies contributing to ADAS capabilities, along with light detection and ranging (LiDAR) and camera-based sensors such as red-green-blue (RGB), infrared (IR), and near-IR cameras. Automotive radars function effectively at 24 GHz, although wider available bandwidths at 77 GHz are encouraging a growing number of frequency-modulated-continuous-wave (FMCW) radar integrated circuits (ICs) at those higher mmWave frequencies. Radar can differentiate between stationary and moving targets and detect multiple targets simultaneously, even calculating the relative velocity of a detected vehicle by its Doppler shifts.

Radar operates with consistent accuracy under all lighting and weather conditions, day and night, and across a wide range of temperatures. Sensor fusion by ADAS processors can use the data from the three types of sensors to create 3D images of detected targets. Developments in sensor fusion, notably leveraging radars at both frequency ranges, are clearing the way to producing 4D radar-based data for target range, angle, velocity, and elevation required for future autonomous-vehicle control.

Radar receivers, transmitters, and transceivers for ADAS are typically implemented as highly integrated monolithic microwave integrated circuits (MMICs) using high-frequency/high-speed semiconductor technologies such as silicon germanium (SiGe) or silicon (Si) BiCMOS. The MMICs usually support modular functionality, with separate MMICs for transmit and receive functions, or, as transceivers, with single or multiple transmit and receive channels per chip.

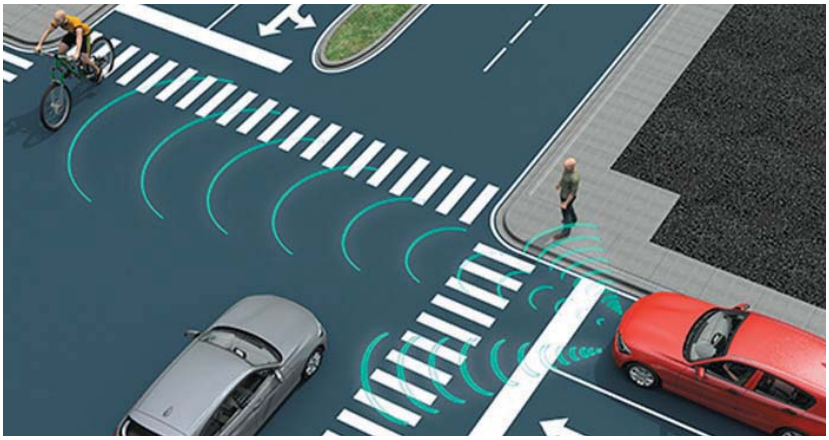
Whether at 24 or 77 GHz, ADAS radar circuit and system designers can specify major system function blocks like microprocessors, digital signal processing (DSP), and power supplies as packaged ICs to save space. A central ADAS processor performs sensor fusion by combining radar data with LiDAR and camera imag-

ing data to create as much of a 360-deg. target detection field as possible *(Fig. 1)*.

MMICs for ADAS mmWave radars are available for 24 and 77 GHz in short-range radars (SRRs) for detection to about 20 m, medium-range radars (MRRs) to about 60 m, and long-range radars (LRRs) to about 200 m or further. Current 24-GHz radar MMICs, which operate within the industrial, scientific, and medical (ISM) band from 24.00 to 24.25 GHz, have been used for non-automotive industrial and medical applications, including intruder detection in warehouses and heart-rate detectors, respectively.

Now, government regulators of frequency spectrum, including the U.S. Federal Communications Commission (FCC) and the European Telecommunications Standards Institute (ETSI), plan to free more bandwidth around 24 GHz for ultra-wideband (UWB) radars with increased target resolution compared to current 24-GHz ADAS radar MMICs.

With most drivers expecting new cars to include ADAS electronic solutions for increased safety, demand is ramping up for automotive mmWave radar solutions. More semiconductor suppliers, including some already making 24-GHz ADAS radar ICs, are developing radar ICs for the approximate 5-GHz bandwidth around 77 GHz (76 to 81 GHz) for SRR, MRR, and LRR ADAS applications.



1. ADAS-equipped vehicles rely on fusion of sensor data from radars, LiDAR, and camera-based systems to create a 360-deg. field of target detection. *(Courtesy of Xilinx)*

Scanning Radar Solutions

Automotive radar ICs targeting 24-GHz ISM-band systems are highly integrated, fitting the functionality that once required a rack full of equipment into several chips. One example is the BGT24A family of ADAS radar transceiver and receiver ICs from Infineon Technologies.

Members of the BGT24A family include the BGT24ATR11, a 24-GHz radar transceiver with one transmit and one receive channel; the BGT24ATR12 with one transmit and two receive channels; the BGT24AR2 and BGT24AR4 with two and four receive channels, respectively; and the BGT24AT2 with two transmit channels, which can be added to either of the transceivers for enhanced situational awareness. The ICs come in VQFN packages *(Fig. 2)* for easy mounting on low-profile printed circuit boards (PCBs).

2. The BGT24A family of 24-GHz radar sensors are MMIC transceivers with different combinations of transmitters and receivers. *(Courtesy of Infineon Technologies)*

The BGT24ATR11 is a MMIC transceiver with single receive and transmit channels designed for use from 24.00 to 24.25 GHz. It's AEC-Q100 qualified (stress testing that checks for failure mechanisms) for automotive applications, but has also proven its value in many industrial and medical applications. Based on 0.18-μm SiGe:C bipolar technology with an upper-frequency limit of 200 GHz, the MMIC centers around a low-noise, 24-GHz voltage-controlled oscillator (VCO). The VCO's phase noise is typically −85 dBc/Hz offset 100 kHz from the carrier.

The MMIC transceiver contains a switchable prescaler with 1.5-GHz and 23-kHz outputs. It also provides a 24-GHz local-oscillator (LO) output signal at typically 0 dBm to drive additional functionality. The transmit section of the MMIC generates typical power of +9 dBm to an antenna; the output power can be controlled by 3 to 9 dB.

The transmitter features the fast on/off switching needed for radar use, at typically 500 ns, and controls spurious outputs to −30 dBm or less when in off mode. The homodyne-type receiver supports many different 24-GHz ADAS radar system configurations with a wide intermediate-frequency (IF) range of dc to 10 MHz. The 24-GHz radar transceiver is supplied in a compact RoHS-compliant VQFN package and consumes only 500 mW power from a single +3.3-V dc supply.

With one transmit and three single-ended receiver channels each with its own variable-gain amplifier (VGA), the STRADA431 from STMicroelectronics is an AEC-Q100-qualified 24-GHz ADAS transceiver also built around a low-noise 24-GHz VCO. Typical phase noise is −75 dBc/Hz offset 100 kHz from the carrier. Supplied in a 6- × 6-mm QFN package, it runs on a +3.3-V dc supply and is controlled with a four-pin SPI interface. The MMIC has on-board power and temperature sensors, and its single-channel transceiver provides +13-dBm differential output power at 24 GHz. It features switchable/selectable IF filters and is capable of as much as 60-dB receiver conversion gain.

Long-time IC supplier Analog Devices provides 24-GHz ICs for commercial and industrial security systems that also function for ADAS radars. As with many semiconductor suppliers, the company offers evaluation boards to simplify initial testing of the radar chips, too.

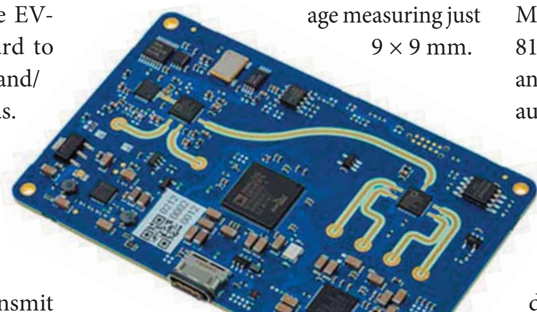
The ADF5901 24-GHz transmit IC and ADF5904 24-GHz receive IC along with the ADF4159 phase-locked-loop (PLL) IC are mounted on the EV-TINYRAD24G radar evaluation module and the EV-RADAR-MMIC2 evaluation board to explore how the ICs work together and/or with different mmWave antennas. The evaluation module *(Fig. 3)* is equipped with a phased-array antenna in a multiple-input, multiple-output (MIMO) configuration that allows antenna radiation patterns to be formed for transmit and receive functions using multiple small antenna elements in an array pattern.

These highly integrated devices achieve effective radar functions within small 5- × 5-mm LFCSF packages. The ADF5901, for example, provides dual 24-GHz radar transmit channels by means of an on-board power amplifier and 24-GHz VCO. The VCO also provides an LO signal for additional receiver functions. The IC contains an assortment of digital circuitry, such as an auxiliary analog-to-digital converter (ADC), as well as a temperature sensor and power-control circuitry for each transmit channel. A simple four-wire interface controls all of the on-chip registers.

Higher in Frequency

Because the available ISM bandwidth at 24 GHz is currently limited to 250 MHz, many circuit and system developers find the greater available bandwidth around 77 GHz (and the high resolution of the smaller wavelengths) attractive for ADAS radars. Many semiconductor processes used for 24-GHz ADAS radar chips support 77-GHz devices with similar transmitter, receiver, and transceiver architectures.

For example, STMicroelectronics fabricates its dual-band, 76- to 77-GHz and 77- to 81-GHz STRADA770M ADAS radar transceiver on SiGe BiCMOS. The tiny transceiver integrates four single-ended, 50-Ω receiver channels—each with high-resolution ADCs—with three single-ended, 50-Ω transmitter channels. The transmitter channels include chirp modulator and chirp sequencer, and the assortment of functions is contained within a single wafer-level BGA package measuring just 9 × 9 mm.



3. For ease of evaluation, separate 24-GHz transmit and receive ICs are mounted on a compact model EV-TINYRAD24G PCB. *(Courtesy of Analog Devices)*

The STRADA770M radar transceiver includes an integrated low-phase-noise oscillator designed for use with 40- or 50-MHz crystal references. The typical phase noise is –95 dBc/Hz offset 1 MHz from a 77-GHz carrier. The transceiver provides transmit power of typically +13 dBm from 76 to 77 GHz and +10 dBm from 77 to 81 GHz. It achieves as much as 75-dB receiver conversion gain, adjustable over a 30-dB range in 10 3-dB steps. The densely packed IC features an on-board chirp sequencer and FMCW chirp modulator as well as a digital slave interface that can be set for SPI or I^2C operation. The MMIC runs on a single +3.3-V dc supply.

The TEF8102 ADAS radar transceiver MMIC *(Fig. 4)* from NXP Semiconductors is fabricated on the firm's 20-nm RF CMOS process. The packaged MMIC contains three transmit channels with binary control and output level stabilization as well as four receive channels; each receive channel has a dedicated 12-bit ADC. The on-board waveform generator achieves typical transmit power of +12 dBm from 76 to 78 GHz and +13 dBm from 78 to 81 GHz. The FMCW transceiver's four receive channels, which provide serialized output data, benefit from the low noise of the waveform generator. Typical phase noise is –86 dBc/Hz or better when offset 1 MHz from any frequency from 76 to 81 GHz.

The radar transceiver supports SRR, MRR, and LRR applications from 76 to 81 GHz with chirp bandwidths of 0.5, 1.0, and 2.0 MHz/µs, respectively. It's suited for autonomous emergency braking (AEB), adaptive cruise control (ACC), front cross-traffic alert (FCTA), rear cross-traffic alert (RCTA), parking assist (PA), and blind-spot detection (BSD). The transceiver provides the 4D radar data required for ADAS vehicles.

Four of the TEF8102 radar transceiver MMICs can provide enough data for full 360-deg. coverage. The device fits within a 7.5- × 7.5-mm embedded wafer-level ball-grid-array (eWLB) package and can be supplied on a test board (model TEF8102 evaluation board) for ease of system development.

The AWR1243 single-chip FMCW radar transceiver from Texas Instruments features three single-ended transmit and four single-ended receive channels covering 76 to 81 GHz. The firm offers two versions of the device: For model AWR1243, two of the three transmit channels can be operated simultaneously, and for model AWR1243P, all three transmit channels can be used simultaneously.

The radar MMIC is fabricated with a 45-nm RF CMOS process with low power consumption and the AEC-Q100-qualified transceiver can accommodate both +3.3- and +1.8-V dc supplies. The foundation of the MMIC is an on-board fractional-N PLL frequency synthesizer that commands precise chirp generation and synchronization.

The AWR1243's waveform generator exhibits low typical phase noise of –95 dBc/Hz when offset 1 MHz from 76- to 77-GHz carriers, and –93 dBc/Hz when offset 1 MHz from 77- to 81-GHz carriers. The typical transmit output power is +12 dBm while the typical receiver conversion gain is 48 dB, with a 24-dB control range that's adjustable in 2-dB steps.

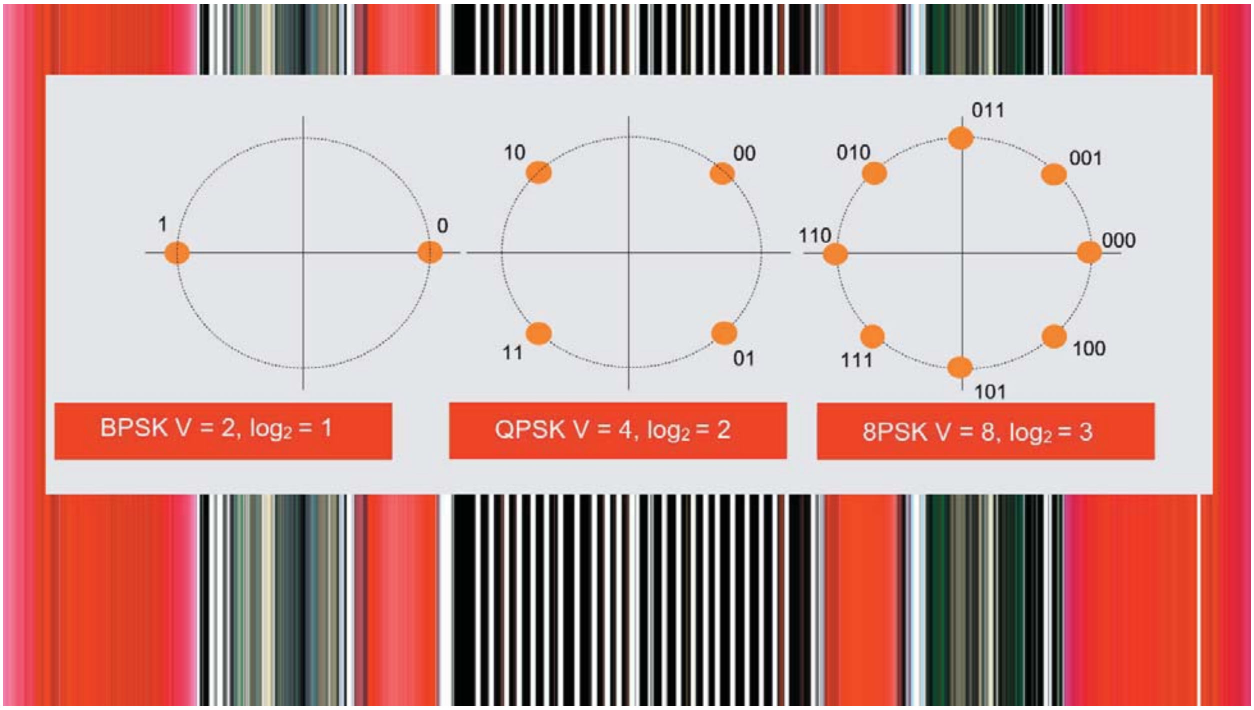
The 77-GHz radar transceiver is designed for use with an external 40-MHz clock source. It features built-in temperature and power monitoring as well as built-in self-calibration across frequency and temperature. The transceiver comes in a flip-chip ball-grid-array (BGA) type package measuring 10.4 × 10.4 mm. By performing simple programming changes, the transceiver can be used for all three types of main automotive application types (SRR, MRR, and LRR) at frequencies from 76 to 81 GHz.

Some of the 24-GHz FMCW radar MMIC suppliers are also developing radar MMICs for 77-GHz ADAS applications, such as Analog Devices and Infineon. For example, as with its 24-GHz devices, Infineon fabricates its 77-GHz devices on a SiGe process. While still in preproduction, these radar MMICs are slated for the company's RASIC product line. They include the RXS816xPL transceiver with three transmit and four receive channels and the RXS8156PLA transceiver with two transmit and four receive channels. Both 77-GHz radar MMICs will be available in eWLB packages. mw

4. The TEF8102 MMIC is a radar transceiver with three transmit channels and four receive channels scanning 76 to 81 GHz. *(Courtesy of NXP Semiconductors)*

Some of the 24-GHz FMCW radar MMIC suppliers are also developing radar MMICs for 77-GHz ADAS applications, such as Analog Devices and Infineon.

JAMES MAZZEI | Chief Operating Officer, Gaye Mazzei, LLC



A REMINDER: Pay Attention to Harry Nyquist and Claude Shannon

Many CIOs, CTOs, and architects tend to forget this telecommunications throughput issue.

It's a very easy and normal thing to focus on the principal characteristics of the principal components of a communications system or link, and regard other items and issues as peripheral and not so important. That it has happened a surprising amount with satellite communications links, especially remote mobile ones, is the reason for this missive.

Here's a hypothetical situation. You are a soldier. You're deployed in a mountainous area of the Middle East, carrying an older Intelsat satellite terminal for immediate access back to headquarters, and the headquarters has leased a 72-MHz transponder for your exclusive use.

A nice, safe place to be is in a cave, so you string a communications cable to the satellite terminal at the cave's entrance and sit back to check in with your workstation that's connected to the terminal with a quadrature phase-shift keying (QPSK) modem. Checking in is fine, but the comm is lousy. The satellite company guarantees you 72 Mb/s (1 bit per Hz), but you're barely getting less than 35 Mb/s. Should you have gotten a newer terminal? Should you be using another system?

Nyquist Maximum Data Rates

The actual answer is what Harry Nyquist and Claude Shannon said about maximum data rates over every channel, including that communications cable. Harry Nyquist noted, as has been thoroughly documented[1], the maximum number of bits you can get through a channel (noise not considered) is:

$$\text{Max } R = 2\,H\,\text{Log}_2 V$$

where H is the channel bandwidth and V is the number of discrete symbols (binary phase-shift keying, or BPSK, is 2, QPSK is 4, etc.).

If you're not familiar with $\log_2$, it's not difficult once you get used to it. The $\log_2 V$ is simply the exponent to which 2 must be raised to equal V. So, if V is BPSK (2), then the expression $\log_2 V$ is simply 1, since 2^1 is actually 2; and if V is QPSK (4), then the expression $\log_2 V$ is 2 since 2^2 is actually 4, and so on.

If you're using a 10-MHz Cat 3 cable, then the maximum data rate INTO the satellite terminal is BPSK 20 Mb/s, QPSK 40 Mb/s, and 8PSK 30 Mb/s, as a function of the $\log_2$ relationships. *Figure 1* shows the number of states and their log to the base 2 equivalent. Therefore, the Nyquist limit, using the QPSK modem, is 40 Mb/s.

Shannon Maximum Data Rates

Well, Harry Nyquist was working the issue of maximum data rates without considering noise while Claude Shannon was working it strictly as a function of noise. His equation[2] says:

$$\text{Max } R = H \log_2 (1 + \text{SNR})$$

where H is again the channel bandwidth and the SNR is the signal power divided by the noise power, generally given in dB. Let's assume that the SNR on that same Cat 3 cable is around 30 dB or 1,000 in raw numbers (the SNR must be reconverted to its rational value to calculate an exponential). Since we've been running up the scale of 2's exponentials, we can just continue to do that. *Figure 2* shows that progression.

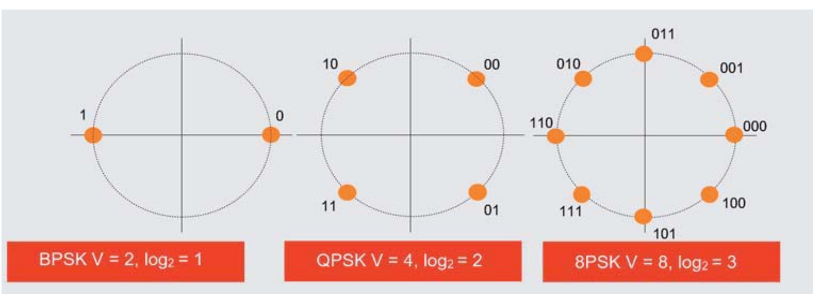
If we round off a bit for simplicity's sake, 1,001 is closer to 1,024 than any other increment and 2 raised to the 10th power gives you a value far closer than any other exponent. Sitting back in your cave with a 10-MHz bandwidth Cat 3 cable, Claude Shannon says you should get a data rate of $10 \times 10^6 (10) = 100$ Mb/s.

If Claude Shannon says you can get a maximum data rate into the satellite communications terminal of 100 Mb/s and Harry Nyquist says you can only get 40 Mb/s to and from your QPSK-equipped workstation, who is right?

Let's look at another analogy. The University of Notre Dame has an academically constrained but relatively good football team. On the other hand, it has a great marching band because outstanding musicians are frequently outstanding high-school students. To get onto the field, the band must march through two archways, one allowing 15 members abreast and one allowing 10. How many members abreast does the band form up? Well, in the same way, Nyquist and Shannon aren't competing. They're just two different gates with two different constraints.

If Claude Shannon says you can get a maximum data rate into the satellite communications terminal of 100 Mb/s and Harry Nyquist says you can only get 40 Mb/s to and from your QPSK-equipped workstation, who is right?

It's not just the major system. It's the goes-intas and the goes-outas all the way to the hands typing on the keyboard. And the original papers published by physicist Nyquist[3] and mathematician/engineer Shannon[4] still have something to say to us. mw



1. BPSK, having two states, has a $\log_2$ value of 1; QPSK, having four states, has a $\log_2$ value of 2; and so on.

2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}
2	4	8	16	32	64	128	256	512	1024

2. A number, shown on the top line, has an exponential value, shown on the bottom line, and demonstrates the significance of the system's noise temperature as it relates to a channel throughput.

REFERENCES

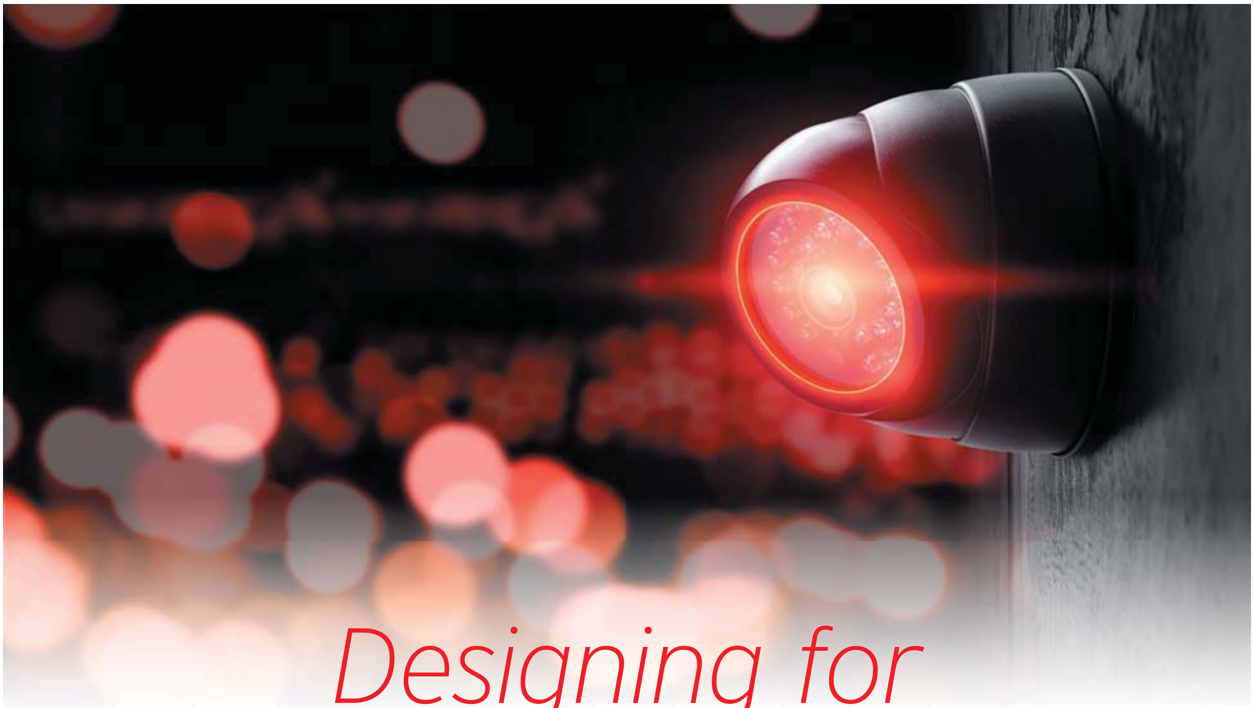
1. An example of the equation can be found in any edition of *Data and Computer Communications* by William Stallings listed under Nyquist Bandwidth. Note: Different authors use different letters to designate data rate, bandwidth, etc.

2. As with Nyquist the equation being found in any edition of *Data and Computer Communications* by William Stallings, this one is listed under Shannon Capacity Formula. Note: Different authors use different letters to designate data rate, bandwidth, etc.

3. Certain topics in telegraph transmission theory (which implied the limit) were presented at the Winter Convention of the AIEE, New York, N.Y., February 13-17, 1928. It was republished as a "Classic Paper" in the Proceedings of the IEEE in February 2002.

4. "Communications in the Presence of Noise" was published in the *Proceedings of the IRE* in January 1949, nine years after it was written.

RICKARD BARREFELT and CHRISTIAN KOEHLER | TE Connectivity



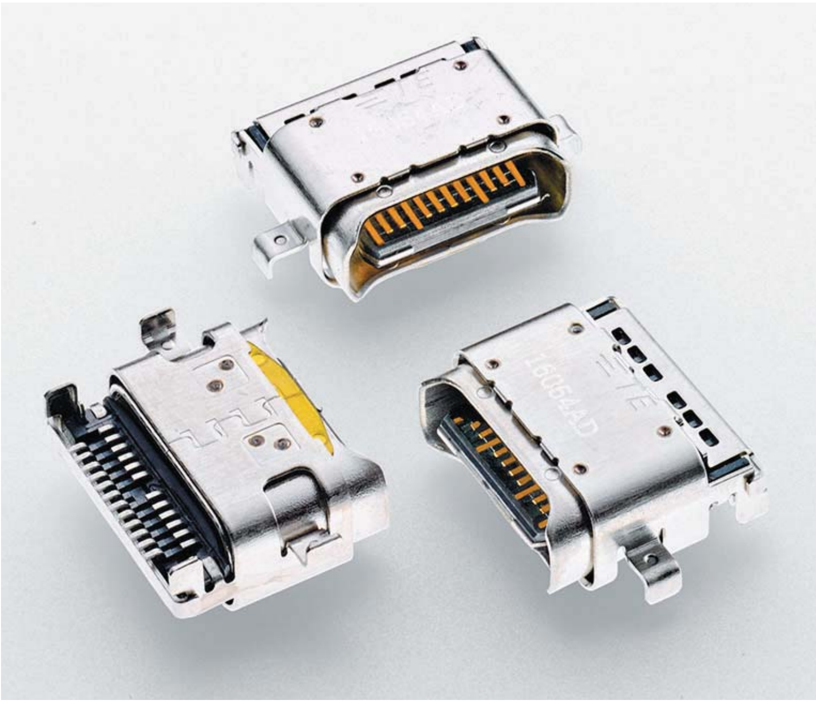
Designing for OUTDOOR SURVEILLANCE in Smart Cities

What are the key considerations and solutions for EEs involved in designing outdoor surveillance systems and other IoT devices for smart cities?

A smart city ecosystem effectively integrates physical, digital, and human systems to help drive a sustainable, prosperous, and inclusive future for all who live and work there. A networked infrastructure commonly serves as a foundation to improve economic and political efficiency and helps enable social, cultural, and urban development, as well as help foster social and environmental sustainability.

Technology designers and manufacturers commonly have key roles in helping to create long-term growth in this ecosystem. Increases in government initiatives, urban population numbers, and demand for public safety seem to be driving this growing trend. And even though the COVID-19 pandemic seems to be pushing some people at least temporarily away from cities, the pandemic is also helping accelerate smart city trends.

As smart cities evolve, surveillance can play a powerful role in improving quality of life and the safety of our societies. Technologies such as real-time video surveillance, facial recognition, and license-plate reading are becoming widely used to help ensure public safety. In this article, we will



Rugged USB Type-C connectors with IPX8 waterproof ratings are a useful choice for outdoor surveillance devices.

explore some of the demands and trends in smart surveillance technology within the smart city ecosystem and review what many engineers may need to consider when designing smart surveillance products and components.

Market Drivers

5G: As 5G rollouts grow globally and in emerging markets, offering faster data transmission and the ability to connect significantly more devices at once, more cities will probably dive deeper into the smart city trend. 5G capabilities can make smarter technology more accessible and open new market opportunities for Internet of Things (IoT) solutions, such as in outdoor surveillance, physical security, government, and transportation/traffic control.

Public safety: Crime normally plays a large role in quality of living, real-estate value, and more in urban areas, and citizens seem to be getting more comfortable with the idea of surveillance playing a role in crime prevention.

Aging infrastructure: In 2017, the U.S. received a D+ on its infrastructure report card from the American Society of Civil Engineers. That meant deteriorating roads and bridges across most U.S. cities were not only dangerous, but likely "impeding our ability to compete" in the global economy and spurring job and GDP losses by the millions and trillions, respectively.

At CES 2020, a panel of experts discussed how infusing new technology into these crumbling infrastructures can offer renewable solutions. Smart city technology, as well as and often in conjunction with other existing digital technology, can reduce infrastructure project costs in some regions by as much as 45%. Smart streetlights, connected cars, automated traffic programs, surveillance programs, etc., can help create communities that are resilient and sustainable through the creation of the right public-private partnerships to defuse some of the costs.

Sustainability: Sustainability is a long-term trend that should also be considered in that holistic view. Urbanized areas account for a major portion of global energy consumption, releasing up to an estimated 80% of greenhouse gases (GHG). Smart city solutions can reduce GHG emissions by at least 10% to 15%.

Cybersecurity and privacy: While many people are becoming more comfortable with smart city technology and surveillance in their cities, privacy issues remain and should be considered along with cybersecurity as trends to be aware of when designing for the smart city market.

Keys to Efficient Designs

Outdoor smart surveillance tools, devices, and systems can present several challenges for design engineers. The following includes important considerations for designing certain outdoor smart surveillance devices.

Durability: Most outdoor surveillance devices may need to be durable enough to withstand harsh weather, temperatures, and ultraviolet (UV) light, as well as, in some cases, wildlife contact and vandals. Ruggedized components and sealed connectors should be used where possible in devices that are commonly exposed to these harsh elements.

- Flat flexible cable (FFC) connectors are just one example of a versatile interconnection solution that can enable flexibility and durability in high-performance applications.
- Rugged USB Type-C connectors with IPX8 waterproof ratings are a useful choice for outdoor surveillance devices. These connectors can support a variety of different protocols and transfer data at speeds up to 10 Gb/s, and can be useful with outdoor USB Type-C cables for maximum robustness and performance in rugged environments.

Data rates and bandwidth: Consider the current and potential future bandwidth needs for each device or system, as it may vary depending on the purpose and the network it will be sending data on. For example, traffic-control devices may require more bandwidth than parking control to accommodate the data and speeds often needed for the functionality.

Anything with video or facial recognition normally needs even higher bandwidth capabilities to capture and deliver clear images. As more data throughput is required, better antennas may be needed—consider multiple antennas or MIMO antennas to optimize data speed. USB Type-C connectors and high-speed board-to-board connectors can offer reliable signal integrity and excellent signal speed, transferring data at up to 10-Gb/s data speeds and beyond.

Miniaturization: Outdoor surveillance devices often need to be small so as not to stand out in their environment. In addition, the need may arise for quite a bit of functionality to be designed into that small space, so miniaturized components can be key. Some design considerations may include small centerline or pitch spacing, lower profile heights, and lighter interconnect solutions.

Many of these components, of course, normally must also be ruggedized and/or sealed to function optimally in extreme weather, temperatures, and humidity. Many miniaturized components are designed for tight spaces, high data speeds, and harsh environments, including:

- SMA/SSMA and micro coax cables and connectors
- AMP CT, AMP Mini CT, and AMP Micro CT interconnects
- FPC connectors
- 0.5-, 0.6-, .8-, and 1-mm free height connectors
- Mobile battery connectors
- USB Type-C connectors

Signal integrity: Especially in most smart surveillance devices used for crime detection and prevention, throughput and signal integrity are often critical factors. Poor throughput can reduce bandwidth and compromises data and video output, potentially creating blurry images in video or facial recognition.

Spring fingers help prevent EMI noise and static, can provide a highly reliable connection and a cost-effective solution for antenna feeds, as well as allow versatility in design because of the limited space they occupy. Board-level shielding can be used to isolate board-level components, which could help reduce EMI susceptibility and minimize crosstalk without impacting system speed. One- and two-piece board-level shields can be useful for thinner devices with multiple antennas, higher data rates, and increased operating frequencies.

Micro coax cables and connectors support applications where miniaturization is important.

> **Outdoor surveillance devices often need to be small so as not to stand out in their environment.**

Wireless connectivity: Wireless connectivity outdoors has often presented certain challenges with multiple sources of potential interference and signal blocking. Tall buildings, landmarks, and weather, for example, can all influence connectivity and integrity of the network. As engineers across industries design in more wireless communications technologies for advanced functionality, the complexity of the communications environment and the likelihood of radio interference normally increases.

With its speed, reliability, and device density connection capability, 5G technology can be the cornerstone of the smart device ecosystem since it can provide interoperability and capability for end-to-end solutions like never before. Preventing interference from outdoor elements and other device components may be key, which also means the choice of antenna often is critical to a device's reliability and function.

Modularity: Today's engineering designs typically require high performance, signal integrity, electromagnetic compatibility (EMC) compliance, and high-speed data transfer with power and signal connections. Connectors commonly have smaller profiles to use less space, are lighter in weight, and often have to withstand varying environmental conditions. The right interconnects can help design engineers adapt and be flexible to continually push the boundaries of design, allowing engineers to address tough design specs without compromising on connection reliability.

Low-profile flexible-printed-circuit (FPC) connectors can give designers flexibility and space-saving capability to include more technology into smaller spaces. Lightweight FPC connectors can be useful where small centerline spacing makes larger wire-to-board interconnects impractical. In addition, many applications require connectors that provide reliability, such as latching features, along with gold plating for more precision and accuracy.

As smart city deployments grow and outdoor surveillance applications grow with them, design engineers will be challenged to create devices that meet the efficiency and performance requirements outlined above. Fortunately, the marketplace offers many choices in components for successful designs. mw

Dual Directional Coupler Channels 1 to 40 GHz

Mini-Circuits' model ZDDC20-K0144+ is a dc-pass, dual directional coupler with broad bandwidth of 1 to 40 GHz. It maintains 20-dB coupling with ±0.6-dB coupling flatness across the full bandwidth. The mainline loss is typically 0.6 dB or less from 1 to 18 GHz and 1.2 dB or less from 18 to 40 GHz while return loss is typically 21 dB from 1 to 40 GHz. Directivity is typically 33 dB from 1 to 8 GHz, 26 dB from 8 to 18 GHz, and 21 dB or better from 18 to 40 GHz. Ideal for power monitoring and test applications, the 50-Ω RoHS-compliant coupler can handle as much as 20 W input power and pass as much as 0.63 A dc current. It measures 3.07 × 0.94 × 0.50 in. (78.0 × 24.0 × 12.7 mm) and is equipped with 2.92-mm female coaxial connectors. The coupler has an operating temperature range of -55 to +100°C.

MINI-CIRCUITS, https://www.minicircuits.com/WebStore/dashboard.html?model=ZDDC20-K0144%2B

Low-Pass Filter's Passband Covers 38 to 64 GHz

Spacek Labs' new model LPF1-U-15C low-pass filter has a passband from 38 to 64 GHz in a WR-19 waveguide with 1.85-mm coaxial connectors (waveguide I/O available). The filter is 1.3 in. long and has an insertion loss of 1.5 dB typical and 2.5 dB max. The rejection at 84 GHz is 30 dB minimum. This proprietary filter design rejects frequencies from 85 to 170 GHz by greater than 40 dB. If the user's needs differ from standard models, this series of Spacek Labs filters can be customized to your required frequency and bandwidth from 18 to 110 GHz and can be designed with a sharp cutoff as close as 5% of the band edge frequency.

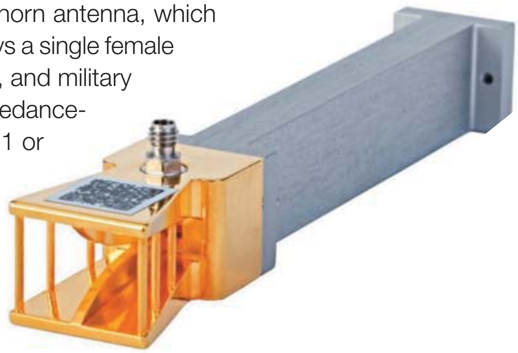
SPACEK LABS, www.spaceklabs.com

Parabolic Antennas Go Rugged for MIMO LAN Applications

KP Performance Antennas recently unveiled a new line of rugged parabolic antennas designed for wireless MIMO LAN, IEEE 802.11b/g/n/ax, point-to-multipoint, 3.5-GHz CBRS, and mobile WiMAX wireless IP applications. The 3.5-GHz parabolic antenna line offers a pair of new models that outperform flat-panel or similar-sized antennas in terms of lower side-lobe levels and gain. The 1-ft. KP-35PD1-N antennas also deliver 20 dBi of gain, while the 2-ft. KP-35PD2-N antennas provide 24 dBi, respectively. The antennas offer a rugged design, featuring a heavy-duty bracket and a polyester-based powder coating to resist corrosion and mitigate ice and water build-up, making them ideal for industrial and outdoor applications. They also feature low side-lobes, high front-to-back, and compact shipping size.

KP PERFORMANCE ANTENNAS, https://www.kpperformance.com/search?Category=Antennas&Rfpsan99design=Parabolic&view_type=grid

Horn Antenna Covers 14- to 110-GHz Bandwidth



Impulse Technologies has introduced its Model DRH110 waveguide horn antenna, which operates over a frequency range of 14 to 110 GHz. The antenna employs a single female coaxial connector and is designed for commercial, industrial, medical, and military systems, including communications and test applications. It's also impedance-matched for use in 50-Ω systems and provides a low VSWR of 2.10:1 or better to minimize signal reflections for both transmission and reflection. The waveguide horn antenna features high radiation efficiency to conserve power and offers a power-handling capability of 4 W with CW signals and 8 W with pulsed signals, including those in millimeter-wave radar applications.

IMPULSE TECHNOLOGIES, https://www.impulse-tech.com/index.php?ID=22&IID=226

COMe Module Packs Serious RAM for Industrial Uses

Kontron's COMe-m4AL10 (E2) module is intended for industrial IoT and Industry 4.0 applications, medical imaging, autonomous vehicles, surveillance and security devices. The module is available with five different Intel Atom, Pentium, and Celeron dual-core/quad-core processors, with up to 16 GB of LPDDR4 RAM. It can also handle two independent displays, with one utilizing DP++ (DP/HDMI/DVI) (4096 x 2160 @ 60Hz) and another sporting single-channel LVDS with DP-to-LVDS (3840 x 2160 @ 30 Hz). The COMe-m4AL10 (E2) comes with storage options for a pair of SATA II 300-Mb/s interfaces and features two serial ports, two USB 3.0 interfaces, and up to eight USB 2.0 ports. There's also Gigabit Ethernet, as well as four PCIe Gen2 lanes for additional expansion options.

KONTRON, https://www.kontron.com/products/boards-and-standard-form-factors/com-express/com-express-mini/come-mal10.html

Impedance-Matching and Protection IC Simplifies Portable GNSS Receivers

STMicroelectronics' BPF8089-01SC6 RF front-end IC for Global Navigation Satellite System (GNSS) receivers simplifies design and saves real estate by integrating the impedance-matching and electrostatic-discharge (ESD) protection circuitry typically implemented using discrete components. The BPF8089-01SC6 provides a 50-Ω matched interface between the receiver's antenna and low-noise amplifier (LNA) and is ready to plug-and-play with ST's STA8089 and STA8090 LNAs. This compact, integrated device typically replaces a matching network containing up to five capacitors, resistors, and inductors, as well as two discrete protection devices, resulting in a much smaller footprint. The device is housed in a SOT23-6L package that's compatible with automatic optical inspection. The device is in production now, priced from $0.198 for orders of 1000 pieces.

STMICROELECTRONICS, www.st.com/bpf8089-for-gnss

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