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Contents

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Regulators may hold back 60 GHz use

Emerging 60 GHz communications could be a prime example of how a market can be held back by subtle differences in government regulations. These discrepancies could impact the speed at which mobile operators are able to roll out high-bandwidth services, holding back the development of markets that depend on high-speed data.

Besides its use in WiFi networks based on the WiGig standard, 60 GHz also has use as a high data rate 4G-backhaul link, replacing expensive fibre optic cables. Engineers are developing phased-array antennas to focus line-of-sight connections using the highly directional 60 GHz signals. Such antennas let operators dynamically steer the links via software, which eases the job of deploying and upgrading connections.

Since FCC regulations for operation at 60 GHz are based on EIRP (equivalent isotropically radiated power) products, developers in the U.S. are pressing ahead with the development of phased-array based backhaul products. Unfortunately regulators in regions such as Europe may force operators to use existing high gain dish-based solutions for 60 GHz backhaul, which require time-consuming manual setup and maintenance.

The crux of the issue is that U.S. and European regulators have decided to use different definitions of the radiated power they will allow.

U.S. FCC regulation 15.255 for devices operating in the 60 GHz band specifies EIRP up to a maximum average power levels of +40 dBmi. These have also been extended for outdoor use between fixed points to as much as +82 dBmi, depending on antenna gain, as the result of an August 2013 ruling by the FCC.

Europe's CEPT REC(09)01, supplemented by ETSI EN 302 217, has a higher standard power level of +55 dBmi but typically limits maximum conducted power to +10 dBm and the minimum antenna gain to +30 dBi. This approach does not allow the trade-off of antenna gain and power in the way that the more flexible U.S. standard does. Thus equipment will be physically larger, creating aesthetic problems for the design of small cells and increasing installation time due to the need to manually align each link.

In addition, WiGig devices used in small cells outdoors will violate the European standards for minimum antenna gain and maximum conducted power. In addition, European operators who want to deploy point-to-point backhaul links will need to use the combination of high-gain, dish-based antennas and modems that supply less than +10 dBm of transmit power. Meanwhile U.S. operators will have the freedom to use modems that supply up to +27 dBm of transmit power and make use of steerable, but lower-gain phased-array antennas.

The cost implications of this are huge. US mobile operators can deploy backhaul links based on phased-array technology that, given the economies of scale driven by the high volume WiGig market, can by delivered for less than $1,000. Their counterparts in Europe will be obliged to use traditional dish-based solutions with a typical link currently costing between $5,000 and $8,000.

Unless regulators address the discrepancy in standards, manufacturers of end equipment will be forced to develop two or more sets of products. In addition, operators in Europe will experience higher network rollout costs than their counterparts in North America.

If regulators fail to act, this will be a missed opportunity that puts communications legislation at odds with government objectives to build a digital society as they try to extend the reach of the Internet.

By Mark Barrett
Chief Marking Officer at Blu Wireless Technology

Smartphone can now measure particulates in the air

We all know that heavy smog in Beijing or Sao Paulo is an everyday phenomenon. But how does the situation look like in your environment? Researchers from Karlsruhe Institut fuer Technologie (KIT) have developed a sensor that can simply be attached to a standard smartphone. The scientists now hope to create a pollution map, populated by the users through participatory sensing.

The sensor principle for smartphone-based air pollution measurement corresponds to simple optical sensors. Instead of the IR LED used typically in this type of sensor, the smartphone's integrated flash illuminates the critical area within the sensor. If there is smoke or dust in this area, the light is scattered to proportionally to the degree of pollution. The camera of the smartphone serves as the receptor; the dust concentration then is calculated based on the brightness of the pixels, explains Matthias Budde from the KIT Chair of Pervasive Computing who developed the system.

Though the system from Karlsruhe cannot compete against dedicated laboratory instruments in terms of accuracy, they are much more cost-effective and easy to handle. Because these professional instruments are so expensive, in Karlsruhe (a city with 300.000 inhabitants) only two official measurement points exist. Budde intends to compensate for the lack of accuracy at the level of the single instrument by the sheer number of measurement points distributed across the entire area. Measurement results from multiple instruments taken in close local vicinity could be combined to a more exact overall result. In addition, the sensors can be used to calibrate each other mutually, Budde explained. The approach of participatory sensing would enable cities and communities to generate chart air pollution in real time.

Next generation internet will arrive quietly

Someday soon, the world will migrate away from the old, original Internet to a new, next-generation Internet with far better security, greater mobility and many other improved features, but most of us will never know the change has occurred, says computer science researcher Arun Venkataramani of the University of Massachusetts Amherst.

"There will be no flag day, no hour when someone flips a switch to move us all over to the new Internet. Instead, the transition will be gradual, one small group at a time," he explains. "Each new app or piece of software will be adopted safely by ever widening circles of users, until one day the old Internet will just be gone and a new one, more deliberately designed and built than the old one, will be up and running. It will be seamless."

Venkataramani is the lead architect for one of the many research teams funded by the National Science Foundation (NSF) who are now developing and testing next-generation hardware, software and applications to address difficult, systemic shortcomings of the old Internet. He and colleagues at UMass Amherst recently received a two-year, $1.35 million NSF grant for the next phase of the MobilityFirst project.

MobilityFirst researchers, in collaboration with colleagues at seven other partner institutions, will field-test the new architecture through three deployments: a context-aware emergency notification system coordinating with the CASA network of weather radars and the National Weather Service for end users in Texas; a content delivery network of public broadcasting stations and the PennREN network in Pennsylvania, and a wireless service provider, "5Nines," in Madison, Wisconsin.

"The Internet's designers left security out of the design process, and it is nearly impossible now to retrofit its multi-layered protocol stack with security," he adds.

"The same is true of mobility. Neither mobility nor security were pressing concerns in the early days, but both require fundamental changes to Internet architecture. That's what our project, MobilityFirst, is about."

Because researchers cannot run experiments on the real Internet and risk disrupting production networks, online services and end-users, they began creating a national testbed called the Global Environment for Network Innovations (GENI). On it, they can try new routers, servers and apps without disrupting the existing Internet.

Cloud to connect urban traffic

Siemens is developing an integrated, cloud-based mobility platform that enables users to mix-and-match the suitable means of transportation for any destination and at any time of the day. Interconnecting different types of mobility providers such as car sharing, municipal transport services, taxis or even bike bicycle rentals, the platform provides custom answers to users who can access the service through a smartphone app.

The bigger the urban agglomeration, the bigger the challenge. Traffic congestion and lack of parking is pushing urban traffic planners and carmakers to find

ways to increase the mobility in cities without building new, expensive roads and railroad tracks.

In an integrated mobility platform, data from diverse mobility providers are aggregated, homogenised and offered for access in a uniform format. The platform collects customers inquires and assumes the billing for all providers connected. In order to protect privacy relevant data, information that identifies person and route are combined only at the time of calculating the bill.

In a pilot project, Siemens has launched such an integrated mobility platform for Berlin and its surroundings.

CSR opens R&D centre in Bristol to drive wireless

CSR plc has opened a new Research and Development (R&D) facility in Bristol to drive further innovation in wireless connectivity.

The site, which opened in June 2014, will be focused on giving customers the solutions they need to differentiate their products in areas including automotive, wearable devices and audio.

Since the opening of CSR's original R&D site at the Bristol & Bath Science Park in 2012, the size of the team has grown to 33 employees and CSR expects to continue this expansion. The new R&D facility, at Almondsbury in Bristol, will better support the needs of the existing team and enable growth over the coming years. This expansion will create a number of job opportunities in the local area, especially for graduates from South West universities.

Work at the facility will include system engineering, software and digital design and architecture verification.

www.csr.com

Mobile market MEMS hits 14% CAGR

The market for MEMS and sensors for mobile phones and tablet computers is set to grow from $2.85 billion in 2013 to more than $6 billion in 2019, according to market estimation company Yole Developpement (Lyon, France).

This represents a compound annual growth rate over the period of about 14 percent. Over the same period unit shipments will increase from 5.8 billion units to more than 17.5 billion units demonstrating a strong reduction in average selling price.

STMicroelectronics remained the market leader in MEMS for mobile phones and tablets in 2013, according to Yole, but Knowles, Bosch Sensortec and InvenSense all grew in 2013. Knowles had lost market share in MEMS microphones in 2012 due to competition from Analog Devices, AAC Technologies and Goertek but was able to regain market share in 2013 by way of design for two microphones in the iPhone 5C and iPhone 5S.

www.yole.fr

EMC regulations face major shakeup

New EMC regulations are about to come into force with stronger enforcement measures for any electronic product going on sale in Europe.

Directive 2014/30/EU on Electromagnetic Compatibility (EMC) was agreed in April and will come into effect when the first EU member nation enacts legislation in the next few months. The dramatic increase in enforcement is a result of impact assessment which showed that the CE mark was not being enforced. This was highlighted in Germany where 25% of all Luminaire LED lighting products didn't meet EU approvals, says Didier Bozec, business development manager at UK test lab York EMC. The enforcement in Germany is likely to include measures such as random audits of up to 20% of all products on the market, with fines paying for testing, he says. Some of the newer member states are expected to take a hard line on enforcement to show they are serious about the market, he added.

An EU member state will have a responsibility to require the relevant economic operator to correct the non-compliance, agrees German compliance lab TÜV Rheinland., including taking all appropriate measures to restrict or prohibit the apparatus being made available on the market or ensure that it is recalled or withdrawn from the market. The Member States will also have to lay down rules on penalties and shall take all measures necessary to ensure that they are enforced, including criminal penalties for serious infringements, says the lab. This will cover manufacturers, authorized representatives, distributors and importers.

The new directive covers products which are new to the Union market when they are placed on the market and it applies to all forms of supply, including distance selling. It won't apply to custom built evaluation kits destined for professionals to be used for research and development.

www.yorkemc.co.uk
www.tuv.com/en

Anite helps define first 5G channel models

An Anite-led task group within the METIS project has published the world's first channel models for 5G. An essential step towards further development of candidate 5G technologies, the interim channel models were co-authored by eight METIS partners and approved by other key members for publication.

Co-funded by the European Commission, METIS is a consortium of 29 key wireless industry players and the first international and large-scale research activity on 5G. Its main objective is to lay the foundation for 5G, the next generation mobile and wireless communications system.

5G has extremely challenging technical requirements which means that testing the radio channel is even more important compared to previous cellular technologies. 5G will adapt to various radio channel conditions in a more efficient way, utilising all dimensions of the radio channel such as delay, frequency, time, location, elevation and polarization.

One of the METIS project's overall technical goals is to provide a system concept that supports higher mobile data volume per area. Accurate radio channel model development enables higher data transmission volumes, which is why the definition of the radio channel model is seen as a key element in the development of 5G. Anite's extensive experience in this area has helped drive the development of new mobile standards for more than 20 years.

The interim 5G channel models are part of the METIS Deliverable D1.2 and generally available for 5G technology developers worldwide. Anite presented these channel models at the Brooklyn 5G Summit (held in New York).

www.anite.com

Mobile games revenue to hit $29bn by 2016

Juniper Research has revealed that by 2016 total revenues from mobile games will reach $28.9 billion — a growth of over 38% on the 2014 figure of $20.9bn. The report highlights that in an effort to maximize their apps' potential, developers are turning their focus on increasing user lifetime value.

The report, Mobile & Handheld Games: Discover, Monetise, Advertise 2014–2019, found that with the domination of casual gamers playing free-to-play games, developers' approach has shifted from bulk acquisition of unique players. Under the new strategy, which brings mobile analytics to the fore, developers are increasing lifetime value through analysing, (re)engaging and monetising users, allowing for higher overall returns on investment.

The report finds that tablet users will spend more on in-game purchases and generate more revenues per device than smartphone users. It argues that in turn, the enhanced performance and graphical capabilities of tablet games is resulting in accelerated migration from traditional portable gaming devices.

www.juniperresearch.com

Anritsu, Jasper Wireless work global IoT platform

Anritsu A/S has announced that its MasterClaw™ Service Assurance system has been selected by Jasper Wireless to service the M2M market. Anritsu has years of experience within the test and measurement market and the Jasper Wireless contract is Anritsu International's first foray into the M2M market. Jasper will leverage Anritsu's expertise through use of its services and systems designed to support Jasper's high performance cloud-based platform for global IoT.

Jasper Wireless delivers an industry-leading platform that enables enterprise customers and operator partners to deploy and globally scale their M2M services rapidly, giving centralized visibility and control. Jasper Wireless works with 15 mobile operator groups, representing more than 100 mobile network operators.

www.anritsu.com
www.jasperwireless.com

The self-powered Interent of Things is starting up

Matthias Poppel, chief operating officer for EnOcean GmbH, says energy-harvesting with sensors for the Internet of Things is already being deployed for predictive maintenance. The specific characteristics of this technology enable sensors and actuators to work with an unlimited source of energy harvested from the surrounding environment, making them suitable for many IoT applications where flexibility and maintenance-free operation is highly requested.

Strong power sources are temperature differences, for instance. A difference of just 1°C (1K) is sufficient to power a wireless sensor. A temperature difference of more than 10°C allows the operation of more elaborate wireless sensors to monitor and report conditions. The secret behind is an optimized combination of a Peltier element and a DC/DC converter. Standalone Peltier elements only produce very small voltages of about 10 mV per degree Kelvin.

Electronic circuitry connected to this, a sensor module for example, needs a typical supply voltage of 3 V. Therefore, a DC/DC converter is needed to complement the system. An optimized oscillator already starts to resonate upwards of 10 mV input voltage. On 20 mV or more (i.e. about 2K), a useful output voltage of more than 3 V is generated. For a temperature difference of only 7K, approximately 100 microwatts of energy is generated.

This kind of energy-harvesting principle is particularly interesting for predictive maintenance applications in the industrial sector. In production plants, virtually every unit of industrial machinery generates waste heat. Here, we find perfect conditions for the use of thermal-powered sensors. Typically, the temperature difference between the machine's heat and the cooler environment provides enough energy to realize a complete autonomous wireless sensor that measures and sends data twice a day. Some might now ask: only twice a day? Yes, this is sufficient for analyzing oscillation of bearings and for monitoring deviations from the normal status and irregularities of measured values. Such sensor systems achieve highly attractive scaling effects.

The measurement prevents unexpected failures and allows a better planning of changing the bearings. In that way, the maintenance intervals are extended, whereas malfunctions, major damage, and thus production downtimes are avoided. That is an important cost benefit, as only one hour of downtime in a paper plant would cost up to $7,000. In addition, the total cost of ownership (TCO) is reduced as service staff is only required when the sensor reports a necessary servicing or repair.

Self-powered sensors positioned at machines can measure data from many different points where power cables or batteries would prove to be a drawback. Batteries last for only a limited time and must therefore be replaced regularly, which is sometimes impossible if the sensor is placed at a point where a change can only be done by stopping the machine. It is out of the question that this would be opposed to a monitoring system, which is intended to avoid downtime. In addition, the initial installation time is significantly reduced. The self-powered sensors can flexibly be positioned at the machine. An IP gateway, which can be a plug-in receiver for instance, receives the encrypted wireless signal from the sensors and sends it to a monitoring PC – done. Altogether, such a functioning installation can be completed within 15 minutes or less.

Using energy-harvesting wireless technology, an intelligent predictive maintenance can be realized at affordable costs, even in retrofit projects. It enables the connection of a large number of battery-less, maintenance-free sensors into an IP network that processes data for intelligent and safe conditions monitoring and for a better understanding of technical systems. The best thing: This IoT application is already stepping into reality with field trials in real industrial environments.

www.enocean.com

TE Connectivity and Fiber-Span offer public safety DAS

TE Connectivity (TE), in collaboration with Fiber-Span, has developed a code-compliant, single DAS platform that supports the VHF/UHF/700/800/900/TETRA frequency bands used by public safety agencies.

The public safety DAS supports primary public safety and critical first responder frequencies in the VHF/UHF/700/800/900/TETRA bands on a single system and provides high-reliability coverage for public safety communications services for both in-building and outdoor applications.

This DAS platform will offer customers a seamless and world-class commercial and public safety DAS system for any environment.

Peter Wraight, president of TE's Wireless Business Unit, said, "With collaboration from Fiber-Span, TE developed this solution to ensure life safety protection for the public as well as police, firefighters and other first responders."

www.TE.com
www.fiber-span.com

Activity Trackers outsell smartwatches by 4 to 1

ABI Research reports that Activity Trackers dominated sales of wearable devices in Q1 2014, outselling much-hyped smartwatches by 4 to 1, with 2.35 million devices shipped.

Fitbit remains the market leader, with a majority share, but will face more competition in Q2 2014 and over the course of the year, especially with Samsung about to launch the hybrid Samsung Gear Fit.

"Activity Trackers are currently the most viable consumer electronics wearable device category, because they have a clear use case that cannot be matched by smartphones, in contrast to smartwatches," says senior practice director Nick Spencer. "End users have been happy to ditch their watches and use smartphones to tell the time, so extending smartphone functions to the watch is a weak use case and retrograde step.

www.abiresearch.com

Radios give IoT new channels
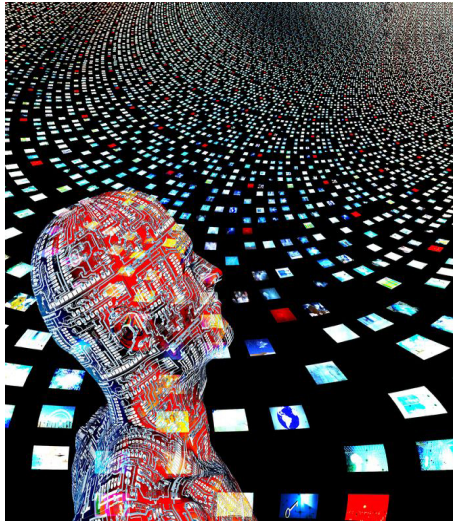
A basketful of new radios for everything from wireless charging to millimeter-wave radar are in the works for the Internet of Things, according to researchers at Imec who described their work on several of them.

The emerging 802.11ah specification for running low-power WiFi over 900 MHz at distances up to a kilometer is one of the most promising new radios. "We believe this new standard is a very strong candidate for IoT applications in smart homes and buildings where a WiFi router is nearby," says Kathleen Philips, who heads an ultra-low-power wireless research program at the Holst Center, a partner with Imec in the Netherlands

Home and building automation has been a fragmented market served by a host of incompatible wireless protocols including EnOcean, 6LowPAN, WirelessHART, ANT, and RF4CE — most requiring their own gateways. "The definition of this WiFi extension can be a major catalyst for these markets, because it will communicate with already available infrastructure, resolving interoperability issues," according to Philips.

Her group is designing an 11ah chip now that aims to send 100 kbit/s distances of up to a kilometer with a peak transmit power consumption of 12 mW and 5 mW for the receiver. "Since this is expected to be one of the new mass markets, vendors will differentiate on cost, battery life, robustness, and distance," she says.

Holst also is researching far-field RF wireless charging over a distance of five to 10 meters as an alternative to inductive approaches that require close alignment of coils. The approach is geared for IoT devices that cannot be easily moved to align with an inductive technique and do not have access to other energy sources.

"With a 3-W EIRP source transmitting at 915 MHz, we can harvest 30 microwatts on a continuous basis from up to five meters away from the source," Phillips says, describing her group's current work.

In other efforts, the Holst team is developing a radio for personal area networks that consumes 5.1 mW, has a -95 dBm sensitivity and supports Bluetooth 4.0, IEEE 802.15.4, and Zigbee protocols. It is also working on a radio for smart buildings that consumes 4 mW in receive mode, has a -120 dBm sensitivity, and supports multiple protocols.

At the high end of the spectrum, Imec is among a growing set of researchers that see many mass-market applications emerging in the millimeter wave spectrum from 60 to 90 GHz, spanning automotive radar to 5G cellular links.

Imec reported earlier this year on its work on a 79 GHz radar transceiver in 28 nm CMOS that has more than 10% efficiency. It is now measuring results of its work, aiming to integrate the transceiver into a cm^2 SoC with a phased array antenna.

Such millimeter wave designs will benefit from emerging work in massive MIMO antennas, says Liesbet Van der Perre, a group science director in wireless research at Imec. She predicts 2020 base stations could use the technique to deliver backhaul connections at 1.17 Gbit/s at power consumption levels of 90 W. That's up from 270 Mbit/s for today's base stations consuming 700 W, she said.

Imec is leading a research collaboration in the European Union that aims to develop core technology for algorithms, DSPs and radios for massive MIMO. "It's not classic MIMO, it's a new scheme and very disruptive," she told us.

Separately, Van der Perre discussed early work on a reconfigurable 10 Gbit/s radio module for 5G, targeting the 16 nm node. It would integrate past work in basebands, transceivers, and frequency-flexible front-end modules.

The group's work is focused on CMOS, which she claims is catching up to the millimeter wave capabilities of silicon germanium at the 20 nm node.

www.imec.be

ADC pushes the boundaries for SDR

At the VLSI circuits symposium 2014 in Honolulu, imec presented a low power pipelined SAR (successive-approximation register) ADC in 28nm digital CMOS with record resolution, speed and power performance.

The ADC targets wireless receivers for next-generation software defined radio, including wireless standards such as LTE-advanced and the emerging generation of Wi-Fi (IEEE802.11ac).

In a software defined radio, the ADC needs high speed, high resolution and high power efficiency in a dynamic solution, supporting high, as well as low bandwidth standards. The pipelined SAR ADC developed by imec and Renesas Electronics achieves an excellent peak SNDR (signal to noise distortion ratio) of 70.7 dB at a speed as high as 200 MS/s while consuming only 2.3 mW at 0.9 V supply voltage. Moreover, the implementation in 28nm digital CMOS not only adds to its area and power efficiency, but also supports digitalization of the radio.

www.imec.be

Bluetooth-enabled smart LED light bulb

Samsung claims to offer the industry's first Bluetooth-enabled Smart LED light bulb at the Lightfair International 2014 exhibition in Las Vegas, Nevada, USA.

The Samsung Bluetooth Smart LED light bulbs require no bridge for connectivity. The bulbs use an industry-first mesh Bluetooth network to connect users' smart devices to their lighting. A plug-and-play solution, the bulbs' modern design represents a sharp break from the traditional look of the A19.

The bulbs' deliver impactful lighting characteristics and also offer control options including dimming and color tunability (2700K warm white to 6500K cool white) as well as preset scenarios for relaxing or waking up and alerts such as different lighting patterns and notifications when a phone is ringing. The mesh network allows for controllability of up to 64 lamps within a range of up to 2000 feet.

www.samsung.com

How Bluetooth Low Energy is driving designs for the Internet of Things

By Josh Mickolio, Product Manager-RF, Digi-Key, www.digikey.com

The latest versions of Bluetooth are pointing to a very intersting evolution of the technology. Bluetooth Low Energy (now called BluetoothSmart) defines very low power modes for wireless links and is gaining traction in the portable market for point-to-point connections, but the latest additions to the specification are providing key advantages in medical, industrial and home markets as part of the Internet of Things (IoT).

With the increasing focus on wearable computing, the current version 4.0 of Bluetooth LE is enabling a wide range of new devices and form factors, from the Fitbit and Nike Fuelband fitness systems even to a 'smart' basketball. The 94Fifty Smart Sensor Basketball from InfoMotion Sports Technologies measures and diagnoses both the frequency and quality of key skills critical to build confidence, versatility, and success on the basketball court using the 4.0 version of Bluetooth Low Energy.

The key to these developments has been having Bluetooth on every almost smartphone, providing a ready-made interface at no extra cost, coupled with the availability of low cost, pre-certifed modules that can be easily integrated into an existing design. Bluetooth 4.1, released in December 2013, takes this a step further, using that interface to control a network rather than just an individual device. This is a fundamental change in the way Bluetooth operates and opens up a wide range of new applications for the Internet of Things.

Powering a device from a small or rechargable battery is key for the wearable market and it is also vital for the Internet of Things. Being able to run an embedded wireless link for several years from one battery is driving the adoption of Bluetooth Smart in IoT as well.

Bluetooth LE uses the same 2.4 GHz ISM band frequencies as the previous Classic Bluetooth but implements a simpler Gaussian frequency shift protocol to reduce the power consumption. It also uses smaller, 2 MHz channels
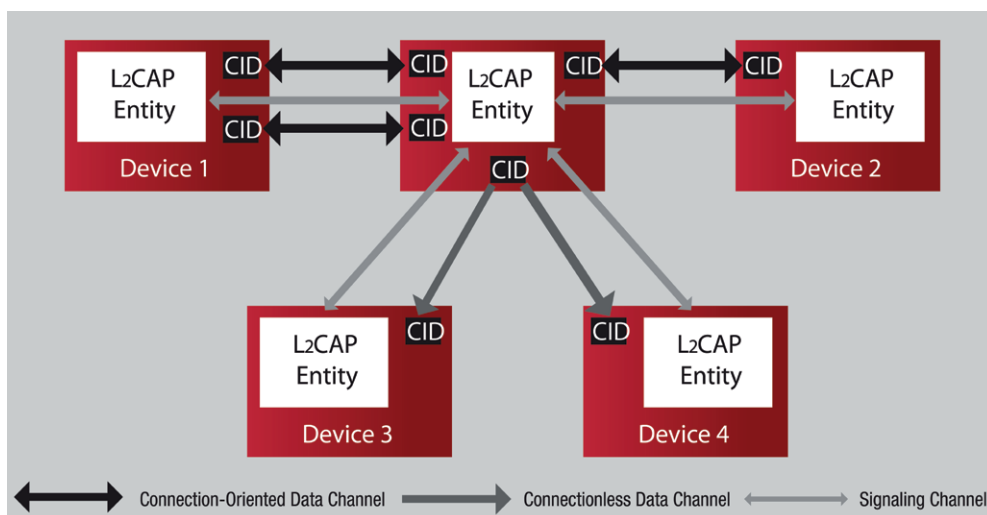

Figure 1: The L2CAP channel architecture for Bluetooth Smart 4.1 enables a network of devices to be controlled, opening up the Internet of Things.

and direct-sequence spread spectrum (DSSS) modulation, giving it lower power and more robust connections. This helps with reducing any interference from other 2.4 GHz networks such s Zigbee or WiFi or cellular data such as 3G and LTE.

The 4.0 and 4.1 specifications use 40 of the 2 MHz channels, giving a link bit rate of 1 Mbit/s and an application throughput of 270 kbit/s. However, this lower bit rate for applications is offset by reducing the latency to 6 ms from the 100 ms of the classic Bluetooth to enable more monitoring applications. The maximum transmit power is also reduced to 10 mW, reducing the range to under 50 m, which is more than sufficient for the short range wearable and home applications.

Version 4.1, allows devices to support multiple roles simultaneously so that a Bluetooth Smart Ready product can act as a hub and a peripheral at the same time. The coexistence with other wireless technologies, notably WiFi on the same 2.4 GHz band, has been improved, and dedicated channels have been added, and it is these that specifically enable IoT applications.

This comes from a Logical Link Control and Adaptation Architecture (L2CAP) that supports the higher-level protocol

multiplexing, packet segmentation and reassembly and quality of service information that is needed for IoT, using 64 Kbyte packets. The architecture is based around channels where each endpoint has a channel identifier (CID). The CID assignment is relative to a particular device and a device can assign CIDs independently from other devices, making it easy to add devices to a network.

There is also more support for the user, as with 4.1, connections are re-established automatically, so when a user enters a room the connection is re-made. Bluetooth 4.1 also supports bulk transfers of data, setting up a link and downloading a larger file rather than having to maintain a constant connection.

All the 4.0 and 4.1 devices will be branded Bluetooth Smart, but there are some distinctions and these tend to be based around the Generic Attribute Profile, or GATT. The profile describes a use case, roles and general behaviors as well as the Bluetooth services that encapsulate the behaviour of part of a device. This also includes hierarchy of services, characteristics and attributes.

"Bluetooth Smart" is for equipment using the Low Energy Core Configuration or Basic Rate and Low Energy Combined Core Configuration, along

with using the GATT-based architecture to enable particular functionality of the product. Typically, Bluetooth Smart branded products are sensor or data collector devices transmitting data to a 'hub' device like a smartphone or tablet.

"Bluetooth Smart Ready" is for equipment using a Basic Rate and Low Energy Combined Core Configuration, along with using the GATT-based architecture to provide a means by which the end user can choose to update that Smart Ready product with the functionality of a Bluetooth Smart product. Typically, these are 'hub' devices such as smartphones, tablets or PCs receiving data from a Bluetooth Smart device and turning it into useful information through the use of an application on the device or in the cloud.

The traditional "Bluetooth" brand is used for equipment that is not using the low energy feature of the core specification and the GATT-based architecture, such as as wireless speakers, headsets or in-vehicle communication devices.

Module makers such as Laird Wireless, BlueGiga and ConnectBlue combine highly integrated transceiver chips with an antenna and interfaces, all in a compact footprint that supports both the Bluetooth Smart and Bluetooth Classic operation These 4.0 modules incorporate all the hardware and firmware required to support development of BLE applications, including UART, SPI, I2C, ADC, and GPIO interfaces, and it is a short step in firmware from 4.0 to 4.1. This allows the expertise that has been developed in the fitness market to be used for cost effective implementations in the Internet of Things.

In addition to carrying FCC modular, IC, CE and MIC approvals, the modules can be fully qualified as a Bluetooth End Products. This enables designers
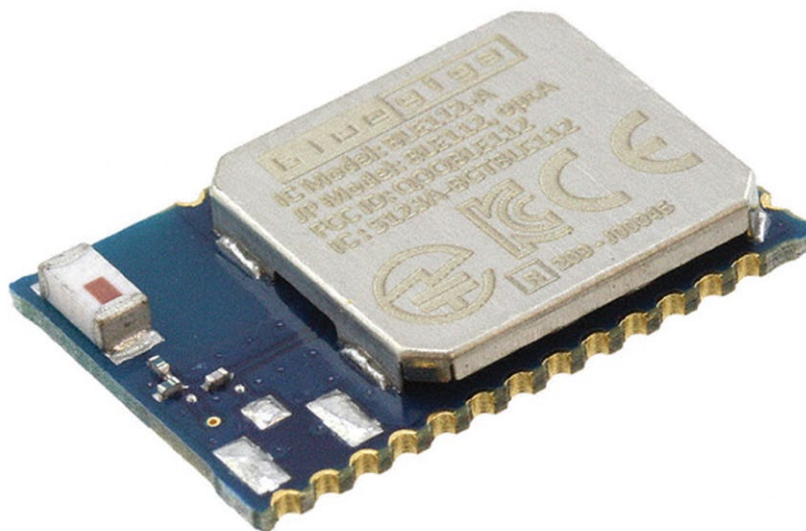
Figure 2: The Bluetooth Low Energy module from BlueGiga is pre-qualified for adding to existing designs.

to integrate the modules in their existing devices without the need for further Bluetooth Qualification, dramatically speeding up developments.

The next step is enhancing the firmware to support version 4.1 and developing a new IoT applications that make use of these new capabilities, and these will take some time to develop and test.

Chip maker CSR provides a complete set of tools for software development, board design and production test around its uEnergy Bluetooth chip to support such developments. This chip sits on a reference module with a USB programming interface and interfaces for breaking out I/O to application-specific sensors and actuators. The fully licensed CSR xIDE software development environment includes example applications for popular Bluetooth Smart profiles

and host applications for both iOS and Android smartphones to simplify the project. The Target board is normally powered from the host USB connection but can also be run standalone from an on-board coin cell to allow real application power measurements to be made.

Bluetooth 4.1 is creating a whole new opportunity for the development of the Internet of Things. With low power and low cost modules that deliver flexible, robust data connections, all kinds of devices can be easily upgraded for connectivity and easily connected up to smartphones and tablets with a wide range of new applications. Pre-qualified modules and development kits to support highly integrated silicon devices help developers add this capability quickly and easily to existing and new designs.

Agilent and China Mobile work on 5G wireless

Agilent Technologies has agreed to collaborate with the China Mobile Communications Co., Ltd., Research Institute (CMRI) on the next–generation 5G wireless communication systems. The two companies signed a memorandum of understanding in Beijing. Agilent will actively support the research and development programs on 5G, led by CMRI, and provide test and measurement solutions for next-generation 5G wireless communication systems.

As the deployment and commercial operation of 4G systems are speeding up, technologists worldwide have begun searching for next-generation wireless solutions to meet the anticipated demands in the 2020 era given the explosive growth of mobile Internet, and this will lead us to the fifth generation 5G.

The 5G research areas of CMRI will focus on the major technical aspects of 5G, including large-scale antenna systems (LSAS), full-duplex radio,

energy efficiency and spectral efficiency co-design, and new signaling/control mechanisms to achieve the main theme of green and soft.

Green and soft defines the interconnected areas of 5G research by CMRI: energy and spectral efficiency co-design; no more cells; rethinking signaling and control; invisible base stations; and full duplex radio.

www.agilent.com

RF SDK enables small cells for backhaul to be built faster

Texas Instruments has added the RF Software Development Kit (RFSDK) to its Base Station SoftwarePac, enabling small cell developers to configure the baseband-to-radio communication and achieve first call or system verification in just one day compared to the weeks or months it took previously.

With the RFSDK, the KeyStone™-based TCI6630K2L small cell System-on-Chip (SoC) and TCI6631K2L backhaul SoC can now seamlessly implement digital radio functions like digital pre-distortion (DPD) and crest factor reduction (CFR), and use a JESD204B interface to communicate with the company's analog front end transceiver, the AFE7500, to maximize performance and system power efficiency. In addition, the RFSDK enables the TCI6630K2L SoC to communicate with analog high speed data converters from TI for industrial applications.

The RFSDK speeds customers' time-to-market by providing a complete integration code that connects to the company's baseband processor and RF ICs. By providing simple APIs and a web-like interface, the RFSDK abstracts hundreds of radio specific parameters into easy to use system level configurations. In deployment, the RFSDK provides OEMs and operators with the ability to field debug by monitoring and measuring the complete radio chain which is critical in SON deployments.

The TCI6631K2L SoC integrates two ARM® processor cores with four TMS320C66x DSP cores with a fully configurable Digital Radio Front End (DRFE) and more than a dozen radio and packet accelerators. This SoC can interface directly with the AFE7500 integrated Analog Front End (AFE) via JESD204B. This two-chip combination can form the basis for multiple radio solutions from 400 MHz to 4 GHz with off-the-shelf SDR implementations for LTE, LTE-U, WiMAX, Wi-FAR as well as proprietary implementations.

Moreover, databases are available today that can implement PAWS and SAS functionality so that underutilized bands can be proactively and efficiently shared among unlicensed users — enabling the effective sharing of under-utilized spectrum.

Shared unlicensed spectrum will potentially have a huge impact on broadband data services around the world and the technology now exists to solve the problem. However, for this to become a reality, global leadership and collaboration as well as a global policy consensus must be put in place.

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AWR and ANSYS partner to bring HFSS into Microwave Office

AWR Corporation and ANSYS have integrated ANSYS HFSS™ into AWR's Microwave Office high frequency circuit design software. This integration unites the industry standard for full-wave EM field simulation and NI AWR Design Environment™/Microwave Office to quickly and accurately simulate microwave circuits, enabling customers to expand their design flows to more efficiently and accurately simulate microwave circuits.

With this design flow, Microwave Office users can readily access HFSS for analysis of EM fields and coupling of 3D structures like passive components, bumps, bond wires, and pins which are essential to successfully designing and realizing microwave circuits like monolithic microwave integrated circuits (MMICs), densely-populated RF circuit boards and multifunction modules.

The link between the two software tools is leveraged from AWR's innovative EM Socket™ open standard interface, which enables AWR users to access a broad range of electromagnetic (EM) tools from within the Microwave Office design environment. The EM Socket architecture also allows AWR Microwave Office users to essentially simulate EM structures with a single mouse click using either AWR's AXIEM 3D planar method of moments solver or Analyst™ 3D finite element method EM software.

In addition to enabling ANSYS HFSS 3D EM simulation capabilities from within the NI/AWR Design Environment, the connection allows the resulting 3D layered format exported from the EM Socket interface to connect to the ANSYS multiphysics portfolio. That suite includes ANSYS SIwave for signal/power integrity analysis and ANSYS Icepak for thermal characterization. The EM Socket architecture also allows AWR users to access third party EM tools from firms like CST and Sonnet.

"Collaborating with third-party firms to expand both the breadth and depth of technology available within the NI AWR Design Environment has been a mainstay of our product offering," said Sherry Hess, vice-president of marketing at AWR.

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Mind the gap: the future for indoor wireless

By Morgan Kurk, Senior Vice President of Wireless, CommScope

Research indicates that 80 percent of mobile connections are made inside buildings. Yet, of the approximately 30 billion square meters of commercial real estate in use today globally, only around two percent are currently covered with a dedicated indoor wireless network.

With the introduction of faster mobile networks such as Long Term Evolution (LTE) and the increased integration of mobile into our daily activities, the amount of data we consume is consistently on the rise. Analyst firm Analysys Mason predicts that the use of mobile data will expand by 6.3 times between 2013 and 2018[i], increasing the pressure on networks. Consumers increasingly expect and depend on a seamless user experience from their service wherever they are, and as such there is a clear mandate for mobile network operators (MNOs) to implement a robust indoor wireless coverage strategy.

Across the globe, many MNOs are rolling out LTE networks. The GSMA predicts some 465 LTE networks will be in operation in 128 countries worldwide by 2017[ii]. But it is not only the wireless spectrum that is shifting – the entire industry is in a high state of change, with consumers demanding more and more from their network providers for less money from every location they visit.

The continued adoption of Bring Your Own Device is putting additional pressure on indoor networks in the workplace. Juniper Research has predicted that there will be more than one billion employee-owned smartphones and tablets in use in the enterprise by 2018[iii]. IT managers are now often tasked with supporting both wired and wireless networks in the enterprise despite having limited training in RF. Whereas once a single operator with a single technology could be deployed, now multi-operator, multi-technology, multi-band systems are needed to meet the variety of demand for wireless access and capacity.

With so much demand from consumers, why are there so few indoor wireless networks? In-building wireless solutions began with a focus on extending coverage using an "outside-in" approach—relying on signals from the macro network—regardless of the type of venue. With the increase in data traffic in many markets, MNOs began to focus on creating additional capacity inside the building, offloading the macro network as part of a new "inside-in" strategy, including the use of distributed antenna systems (DAS). This approach requires greater infrastructure investment, so MNOs began investing in large locations, such as airports and stadiums, with high levels of traffic and therefore a better return on investment. With the increased levels of business data requirements from enterprise buildings, this "inside-in" approach now is being extended to a much larger number of venues. Increasingly, MNOs are looking at smaller sized buildings to ensure good network performance, protect their reputation and satisfying their customers.

So what is the solution to ensure a robust, high quality experience for the user whilst allowing the MNOs to recoup some of their investment in LTE networks?

The industry needs a unified wireless infrastructure platform designed around IT-based structured cabling architecture, making it friendly to both wireless operators and enterprises alike. The flexibility, scalability and simplicity of such a system could resolve the issues associated with rapidly changing indoor coverage and capacity demands. Having a unified wireless network that can scale to building size while being technology and spectrum adaptive is essential. The perfect solution will make DAS simple, supporting both the local area WiFi and wide area cellular networks.

The world lacks people who have the RF design expertise to deploy traditional DAS networks. This limits the deployment of these networks at a time when implementing indoor networks within enterprise buildings is increasingly in demand. The best solution must simplify and optimise installation, empowering IT professionals to deploy these systems easily in enterprise buildings.

The bottom line is that the time has come for a ground-breaking approach to in-building wireless systems, and that change is happening now. Indoor solutions are about putting capacity and coverage where the users are and those users spend the majority of their time indoors. Furthermore, trends in the enterprise market make supporting mobile devices in businesses essential. Organisations that work to integrate, simplify and optimise their wireless networks will have the most to gain as the surge in data consumption continues.

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Wireless broadband to the moon

A team of researchers from the Massachusetts Institute of Technology's (MIT) Lincoln Laboratory, working with NASA last fall, demonstrated for the first time that a data communication technology exists that can provide space dwellers with the connectivity we all enjoy here on Earth, enabling large data transfers and even high-definition video streaming.

This technology could bring high-speed broadband to the moon for future generations that might live on the moon. At CLEO: 2014, the team presented an overview of the on-orbit performance of their record-shattering laser-based communication uplink between the moon and Earth, which beat the previous record transmission speed last fall by a factor of 4,800.

"Communicating at high data rates from Earth to the moon with laser beams is challenging because of the 400,000-kilometer distance spreading out the light beam," says Mark Stevens of MIT Lincoln Laboratory. "It's doubly difficult going through the atmosphere, because turbulence can bend light—causing rapid fading or dropouts of the signal at the receiver."

To outmaneuver problems with fading of the signal over such a distance, the demonstration uses several techniques to achieve error-free performance over a wide range of optically challenging atmospheric conditions in both darkness and bright sunlight. A ground terminal at White Sands, New Mexico, uses four separate telescopes to send the uplink signal to the moon. Each telescope is about 6 inches in diameter and fed by a laser transmitter that sends information coded as pulses of invisible infrared light. The total transmitter power is the sum of the four separate transmitters, which results in 40 W of power.

The reason for the four telescopes is that each one transmits light through a different column of air that experiences different bending effects from the atmosphere, Stevens says. This increases the chance that at least one of the laser beams will interact with the receiver, which is mounted on a satellite orbiting the moon. This receiver uses a slightly narrower telescope to collect the light, which is then focused into an optical fiber similar to fibers used in terrestrial fiber optic networks.

From there, the signal in the fiber is amplified about 30,000 times. A pho-todetector converts the pulses of light into electrical pulses that are in turn converted into data bit patterns that carry the transmitted message. Of the 40-W signals sent by the transmitter, less than a billionth of a watt is received at the satellite—but that's still about 10 times the signal necessary to achieve error-free communication, Stevens says. Further, large margins in received signal level can allow the system to operate through partly transparent thin clouds in the Earth's atmosphere,
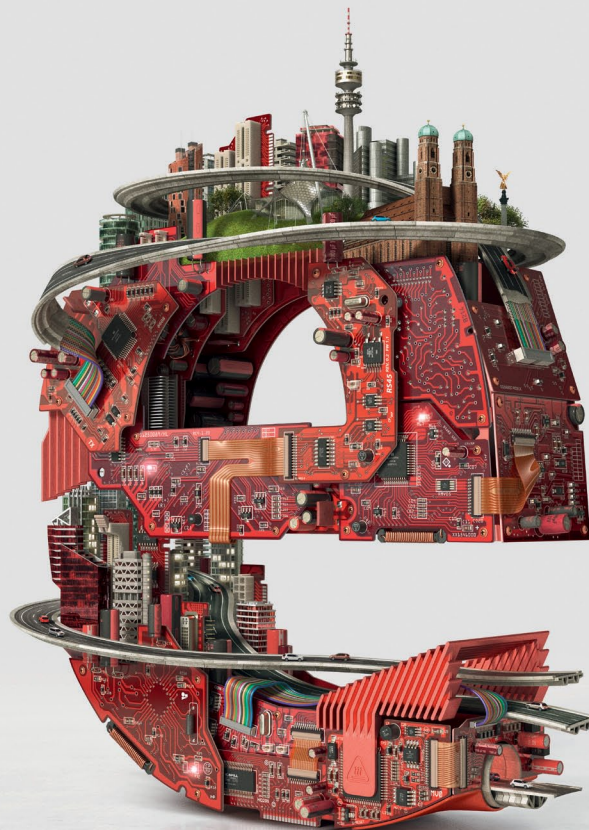
Phase and amplitude controller optimises Doherty power amplifier performance

By Jean-Pierre Joosting

While widely used in the wireless infrastructure industry, Doherty amplifiers require a considerable engineering investment to manually implement and optimize.

The Doherty configuration attempts to amplify the high peak-to-average signal of today's modulation schemes efficiently by splitting the signal into two paths; one amplifier handles the "base" of the signal – effectively, the carrier – while the other is appropriately termed the "peaking" amplifier. Implemented as intended, this can improve power efficiency (RF power added relative to DC power consumed) but the phase and amplitude between the two paths must be matched exactly.

Any mismatch or misalignment in phase and amplitude between the Doherty architecture's carrier and peaking paths can quickly contribute to higher costs and degradation of the system's overall performance. Even after optimizing with discrete components, the system remains inflexible to manufacturing variances from power amplifier assemblies — today, this is a matter of high-cost, low tolerance passive components and manual tuning, with no option to correct the setup as conditions (such as temperature) change, or components age.

MPAC solves this engineering challenge for both asymmetric and symmetric Doherty amplifiers. Through a digital interface, MPAC enables alignment of the phase and amplitude between the Doherty amplifier's carrier and peaking paths. Designed for wireless infrastructure applications, MPAC improves system performance, lowers costs, increases reliability and provides maximum tuning flexibility.

On an UltraCMOS chip, each MPAC product includes: 90-degree hybrid splitter, two phase shifters, two amplitude controllers, and a digital SPI interface.

MPAC delivers improved system performance, lower costs, increased reliability and maximum tuning flexibility for either LDMOS (laterally diffused metal oxide semiconductor) or GaN (gallium

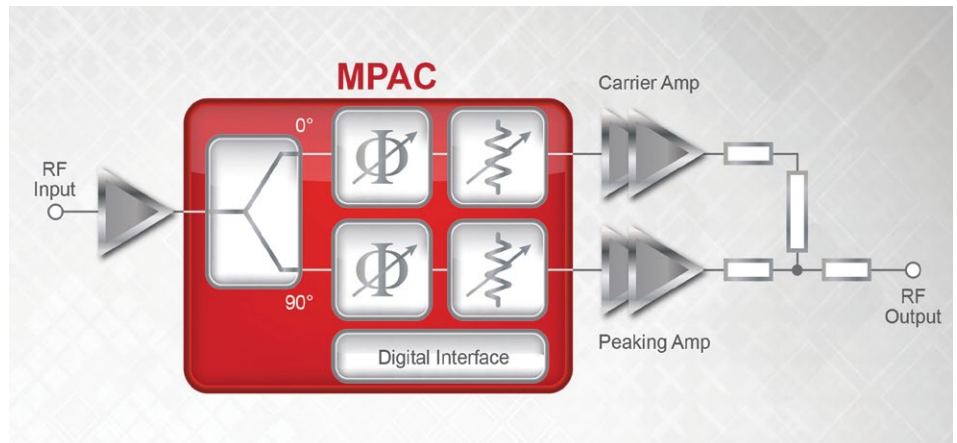nitride) based Doherty power amplifier architectures. MPAC performance advantages include improvements in power added efficiency, linearity across the frequency range, Doherty bandwidth through better matching and effectiveness of the digital pre-distortion (DPD) loop. It also reduces bill of materials (BOM) costs by eliminating the need for external components such as DC blocking capacitors and reducing component count for greater board area. MPAC lowers costs by providing tighter production distributions on expensive power amplifier assemblies. With uniformity and repeatability between transceiver paths, MPAC increases system reliability and increases transceiver yield. Finally, it delivers improved flexibility with adjustable phase and amplitude tuning for each independent path through the SPI digital interface. This flexibility enables real-time adjustments in order to optimize for operational or environmental changes.

With a wide positive and negative phase shift range and a fine step size, MPAC delivers high linearity of 65 dBm IIP3 and extremely low power consumption of 300 µA. It provides performance advantages in power handling and port-to-port isolation. As MPAC is built on an UltraCMOS monolithic chip, RF engineers can rest assured with the most reliable and repeatable solution on the market. UltraCMOS technology enables superior ESD performance of

1 kV, an extended temperature range up to 105-degree Celsius and a wide power supply range from 2.7 to 5.5 V.

The first product in the MPAC family is the PE46120. Currently being sampled to select customers, the PE46120 covers a frequency range of 1.8 to 2.2 GHz. The MPAC product family plans to cover all cellular frequency bands.

Doherty comes of age

The explosive growth of the LTE market has fueled demand for Doherty architectures, and this demand will increase with LTE-A requirements. Both LTE and LTE-A need high peak-to-average ratios (PAR), and the Doherty architecture provides an ideal solution for optimizing amplifier performance. Due to its lower cost, the market has largely adopted asymmetric Doherty amplifiers, which receive the maximum MPAC benefits due to their complex performance optimizations.

"Despite a relatively flat market value in base stations, transceiver shipments will grow by 8 percent annually over the next five years," says Joe Madden, founder and principal analyst at Mobile Experts. "At the same time, several features of LTE and LTE-A are creating a need for tighter control over Doherty amplifier performance. The market needs low-cost solutions that improve phase and amplitude precision."

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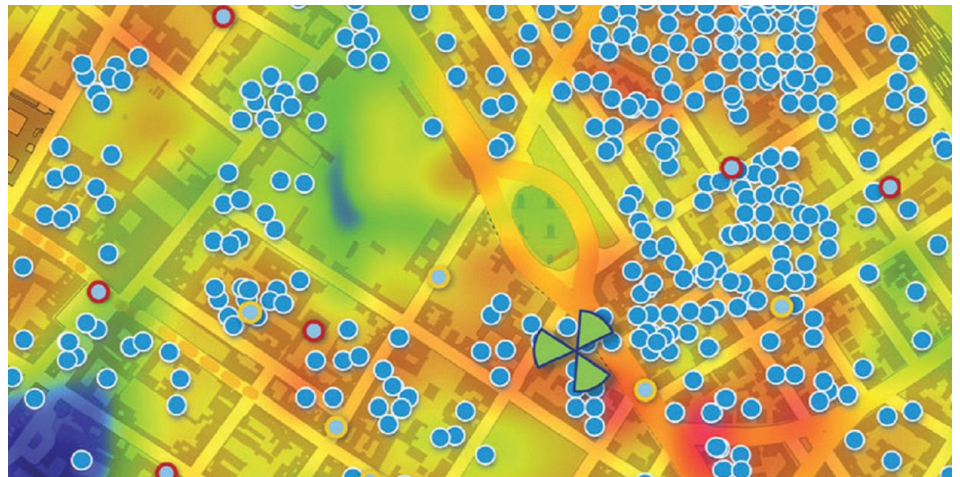
Understanding LTE, inside and out

By Marc Bensadoun, CEO of Newfield Wireless

LTE expansion continues at a rapid pace. Competition is particularly high in markets like the UK, France and Germany where operators are launching commercial 4G services, offering exclusive new devices and more recently turning to VoLTE. Marc Bensadoun, CEO of Newfield Wireless, a Tektronix Communications company, discusses how the shift to 4G services and the resulting growth of new mobile use cases has presented operators with a fresh set of challenges. When it comes to LTE, optimizing the RAN for voice and messaging is no longer enough; traffic patterns are changing and operators need real-time intelligence about what is happening at the network edge. In this article, Bensadoun explains how information collected from the RAN can be used to inform operational and business decisions.

LTE changed the paradigm for mobile network operators and now, 4G is rapidly becoming standardized across the globe. Recent figures published by the Global Mobile Suppliers Association indicate that 288 operators have already launched LTE and it is now available in 104 countries around the world. The move has brought with it a number of new use cases such as video streaming and online gaming, plus the highly anticipated Voice over LTE (VoLTE) which is leading to high-quality voice and video calling services being delivered over mobile networks.

Yet, with this transformation taking place, it is no longer enough for operators to simply maintain their networks for traditional voice, messaging and data. As a result of this paradigm shift in telecommunications, it is now vital that operators develop a much better understanding of the network complexities and the ways subscribers engage with the network. However, this needn't be an expensive or time consuming process, as operators already have access to this information – it's hidden within the mobile network; all that's required are the right keys to uncover it.

Operators that implement end-to-end service assurance and optimization tools covering the entire network from the RAN to the core can unlock this valuable data. RAN management and optimization is vital to delivering on the potential of LTE as it holds the keys to ensuring quality network performance for subscribers. But it comes with its own set of challenges, as historically it has been a very costly exercise for mobile operators. Not only that, but 70 percent of subscriber issues now occur inside the RAN, and at least 10 percent of those problems are not resolvable with existing monitoring workflows. So it comes as no surprise that having a better and more affordable approach to tackling the RAN is now a key technical and financial differentiator for operators, particularly as they're also looking to recoup the considerable investments they've made on LTE network build-outs.

Resolving RAN issues
Because the nature of data fundamentally changed with LTE, network use cases have changed. It is no longer enough to optimize the RAN for voice and messaging alone; operators now require real-time intelligence into what's happening at the network edge, what services and applications subscribers are using, and on which devices. A relatively small concentration of users typically represents a high proportion of data traffic and can occupy all available cell capacity. This means an operator will deliver a satisfying user experience to a minor subset of their overall subscriber base, but a sub-standard experience to the majority. It has become increasingly difficult to ensure a consistent quality of experience. Operators with access to service assurance and monitoring tools have the ability to fight back against customer dissatisfaction and churn, delivering essential insights for carrier operations that will not only help to alleviate network issues but also let them gain a greater understanding of the subscriber experience.

RAN congestion and intensive data users are a major concern for operators today. When a minority of users can impact the Quality of Experience for the majority, a less than stellar experience could lead to widespread churn and loss of revenues – at a time when operators are struggling to recoup network investments. Until now, the standard industry approach for spotting and fixing network problems has been through the use of RAN probes and NEM-based cell trace functionality to glean information from mobile devices used by subscribers. The accepted method is to interrogate the data that comes in, assess the perfor-

mance of individual cells and then react accordingly. In the case of heavy data users, the most commonly deployed tactic is to offload subscribers to small cells and direct traffic away from the congested macro cell.

However, this approach is reactive, not proactive. The very notion of identifying a problem in the network based on handset statistics and cell performance means that a valuable subscriber has already received a poor customer experience. In turn, this means their level of satisfaction has taken a knock. If operators find themselves playing 'catch up' with the user experience at this early stage, it's likely they will only fall further in the eyes of their users once more data starts flowing across their networks as they continue to expand 4G coverage.

Alternatively, operators can access true insights into subscriber behavior and performance with an end-to-end view of the network that takes into account the differences between subscribers. So, to gather the necessary information, operators can apply RAN visualization and a rich depth of geoanalytics, giving them the ability to dynamically pinpoint issues at the subscriber and device level in real time.

Next generation solutions

The success of a next generation mobile network lies with an operator living up to promises made to subscribers. In order to handle network performance more efficiently, operators that pinpoint issues in real time can get a firmer grasp on user experience, and can deliver consistent and reliable mobile connectivity. To keep pace with subscriber expectations, and to improve the overall user experience, operators are adopting new strategies to deal with network issues before they arise. There is a way to make extremely smart use of network data to get beyond a simple spot/fix approach. However, this requires operators to collect information that addresses troubleshooting and empowers better targeting of location-based services, future-proofing through more advanced network planning. This ultimately better informs engineering decisions in a way that's simply not possible with current monitoring workflows – the same ones that can't solve the 10 percent of RAN problems.

The only way to achieve this is to make user and device centric data observations, drilling down into targeted demographics and developing the network model based on deep

insights into the needs, behaviors and usage patterns of subscribers. An end-to-end network view takes into account the differences between users and their individual requirements. Operators automate cell-site analysis with data probes to identify precisely where it would be suitable to hand over to small cells and take on solutions that collect radio interface signaling information to calculate subscribers' geolocation.

By adopting an end-to-end assurance solution that provides comprehensive radio access and core network analytics, operators can unlock a variety of new use cases for real-time subscriber intelligence and network engineering. The benefit is two-fold; on the one hand, this provides the ability to assure the customer experience across the entire mobile network, drilling down to the geolocated device and subscriber level. On the other hand, it provides the enhanced ability to deliver critical network intelligence that can be fed into numerous departments – from operations to customer care, and from the CMO's office to the business development team. Real-time RAN data can play a vital role in reducing the need for costly drive tests, by collecting and analyzing dropped calls and data traffic from network heat maps. These tools can also support RF planning and 4G network optimization.

RF planning and network optimization

When it comes to using RAN data to support network planning, operators pinpoint exactly where network capacity is best employed. Once LTE networks are operational, the operator must then decide which areas of the network need to be prioritized for these capacity infills that can be addressed through small cells, in order to ensure a first-class subscriber experience.

It's also key to consider how network upgrades interact with legacy infrastructure. The deployment and maintenance of an LTE network is a costly business, but big data can help operators optimize their networks in a cost-effective way. Through the use of geoanalytics, operators can generate a range of network performance data in order to make informed decisions.

This is all the more important as LTE becomes widespread and VoLTE deployments grow. Subscribers will undoubtedly experience 'teething troubles' when using these new networks. Network

visualizing tools can help here, too. For example, customer care representatives can use real-time call and data session information to troubleshoot premium and other subscribers' complaints – is it a network problem? A device problem? Customer care can then provide the engineering team with more actionable data to solve the issue, resulting in overall quicker time to resolution. This efficient workflow gives operators more freedom with their operational budget, which means they can limit the need to hire additional resources.

The new network intelligence

Armed with data and full network visualization, operators can dynamically pinpoint issues at the subscriber and device levels in real-time, track those issues across the network and identify new up-sell opportunities based on individual subscriber needs. By having a complete end-to-end view of the network, subscriber data pulled from the RAN can now be used to support a wide range of departments, from customer care to marketing and all the way through to engineering.

Deep network intelligence will form some of the most important operational and business decisions in the immediate future, yet too often the most usual information remains hidden deep within the network. By unlocking the value of subscriber data contained within the RAN, operators will be in a better position to provide a strong Quality of Experience and retain subscribers in the long run. Ultimately, happy networks will lead to happy subscribers.

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A crash course in "the connected car"

By Peter Nicholson, Spirent Communications

As our somewhat cheesy headline suggests, there's plenty of scope for sensationalising automotive connectivity but, for both the automotive and IT industries, there remain serious issues on how to ensure safe, practical solutions both within a vehicle and for external connection, according to Peter Nicholson, Spirent Communications

Figure 1 gives some idea of how the buzz-phrase "connected car" is catching on. It is still rising fast, with Juniper Research predicting that nearly 100 million cars will have Internet access by 2016. Much of the public's interest has focussed on external connection – to the Internet, to intelligent traffic signalling, and between vehicles – but for the automotive industry the term "connected car" also has major implications for connectivity within a vehicle.

Vehicles have always been internally connected with internal linkages and wiring to deliver monitoring, diagnostic and control functions to the dashboard or between systems. In today's connected car, however, these separate functions increasingly converge towards a single network – as has happened elsewhere. Enterprises also experienced a proliferation of electronic networks at the end of the 20th century: a corporate Ethernet LAN, a telephone network, one connecting burglar alarms, one connecting fire alarms, maybe another connecting access security on some doors, another providing environmental monitoring and control – let alone the machine control networks also required on a manufacturing site. But now all these independent networks are converging onto the Ethernet system, and a host of different wiring networks are being replaced by a single IT network that allows all the separate functions to continue as if they still had their own independent wiring system.

The same convergence has been happening in the car. When once there would be separate sets of wires going to the brake lights, fuel gauge, indicators and so on, increasingly these are using different protocols to share a common network.

However, the challenge in any complex system is that it is very difficult to predict exactly how it will behave when new factors are added. The Ethernet packets carrying voice messages on the corporate network have very differ-
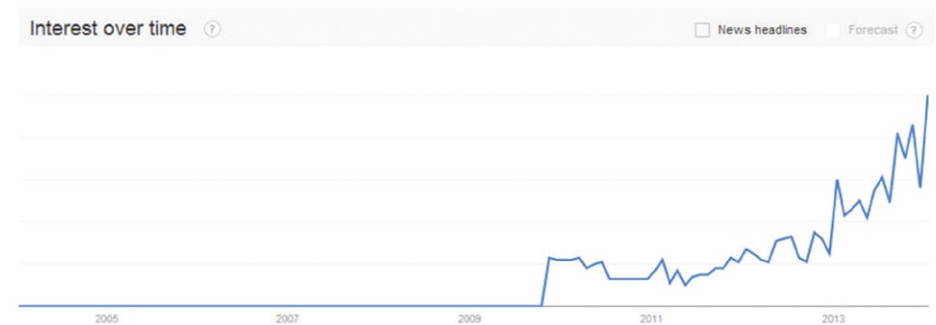

Figure 1: Google search volumes for the term 'connected car' since 2005 (source: Google Trends).

ent needs to the signals carrying a fire alarm, for example; so if the one network is going to serve a host of new services then the only sure way to know that it will continue to work under all circumstances is to test it rigorously under all realistic and extreme operating conditions.

The same will apply as cars become more connected.

The externally connected vehicle

For at least five years it has been possible for fleet operators to buy large trucks with their own connection to headquarters. Automatically feeding back information about the vehicle's position, speed, fuel levels, tyre pressures, engine temperature etc, allows the operator to monitor the driver's behaviour – whether breaking any health and safety regulations by speeding or not taking a break – and provides advance warning if the vehicle needs servicing.

The big manufacturers such as Scania, Volvo and Renault all developed their own proprietary communication technologies to maintain competitive advantage, and these have typically relied on the existing mobile phone networks. As proprietary systems, there is little scope for interconnecting them, so the fleet operator might now have to cope with several different communication systems.

In addition to this one-way flow of information to HQ, there have been

other links towards the vehicle. Global navigation satellite systems (GNSS) and other positioning signals can provide navigation and telematics; Bluetooth can enable hands-free telephone use and media; and RDS can broadcast warnings of weather or traffic information over radio frequencies. For private motorists these "X2Car" communications have become the norm, while "Car2X" services, where the car communicates outwards, or even Car2Car exchanges between vehicles are a relatively new development,

In Europe, for example, an eCall system is being rolled out to automatically contact emergency services in the event of a crash and send event information and location. Similar capabilities exist in North America, with GM's Onstar Service, while Russia's ERA-GLONASS system is said to be fully interoperable with eCall. Meanwhile, a 1,100km Co-operative Intelligent Transport Systems (C-ITS) corridor is being developed between Rotterdam, Frankfurt and Vienna to enable two-way communication between vehicles and the surrounding road infrastructure. This will begin with simple warnings such as road works ahead and anonymised data gathering for road operators, then be extended through sensor fusion to more advanced assisted driving services in coming years.

Of particular interest to the driver is the potential for Internet connection. So far this has mostly been served by routing an Internet connection via a secure Virtual Private Network (VPN) tunnel to the vehicle manufacturer's dedicated data centre. As the technology becomes more mainstream, this would overwhelm available bandwidth, so vehicles will increasingly have their own, direct connection to the Internet – with all the attendant opportunities and security challenges.

The internally connected vehicle

Convergence within the car is starting to replace independent wiring systems with internal networks, using different protocols to deliver key electronic, monitoring and diagnostic functions. This internal connectivity presents immediate challenges for OEMs to successfully launch new vehicles that will be on the roads for the next 10 years – whereas the more radical Car2Car solutions will take longer (market surveys suggest that their true benefits will only be realized after reaching a critical mass of more than 20% of users).

Currently, the CAN (Controller Area Network) bus is most often used as an automotive backbone network, despite its speed and load limitations, while LIN (Local Interconnect Network) provides a low-cost solution for vehicle body applications, MOST (Media Oriented Systems Transport) fibres deliver in-vehicle media, and high-speed FlexRay enables "x-by-wire" capabilities, such as brake-by-wire, along with other functions where speed and reliability are paramount.

For next generation vehicles, however, Ethernet will provide the network backbone, as in the corporate network but also as a means to reduce weight. Vehicle weight is becoming increasingly important, leading to use of lighter materials such as aluminium and carbon fibre while even Ethernet has been pared down to "automotive Ethernet", developed to run on unshielded twisted pair wiring to weigh less than traditional 8-wire Ethernet cable. To create an industry standard, the Open Alliance has adopted the BroadR-Reach (OABR) 2-wire automotive Ethernet as the de-facto physical layer standard, clearing the way for its widespread adoption.

By simplifying a vehicle's wiring loom, with less copper and duplicated network hardware, OABR is significantly lighter than equivalent existing technologies. It also reduces connectivity costs by 80% and improves vehicle

efficiency. It can still deliver 100Mbit/s, and this capacity will be needed as Advanced Driver Assistance Systems (ADAS) and "connected car" functions escalate demands for complexity and bandwidth. BMW has already achieved cabling cost reductions by using BroadR-Reach® Ethernet to deliver vehicles with all-round camera coverage, and expects to make growing use of the technology. ABI Research predicted that Ethernet penetration in new cars worldwide would grow from 1% in 2014 to 40% by 2020.

One downside of the growing complexity made possible in vehicle computing, infotainment and security is that future connected vehicles will require software updates on a regular basis. However, what would be an all day garage task on the current CAN network could be carried out over Ethernet while the owner waits – or even conducted over-the-air with no need to visit a garage.

Automotive Ethernet – what are the challenges?

The application of any new technology – especially where safety is involved as in a moving vehicle – raises the question whether it can be relied upon to work at all times.

Ethernet is already well established in the IT sector and OEMs are able to confidently purchase solutions that have been tested by vendors and debugged through years of extensive use. So little conformance testing is needed during product development phase. But the same cannot be said for automotive networks. OABR automotive Ethernet has just started to be adopted and it would be unwise to rely too heavily upon these new bus systems without thor-

ough testing. Vehicle manufacturers also have greater responsibility for safety and reliability than in the IT industry.

With brand reputation, multi-billion dollar recalls and, ultimately, customers' lives at stake, automotive companies must place even greater importance upon testing at every stage within the supply chain. The system needs to work under all likely environmental conditions – during rain, snow, high and low temperatures and levels of vibration seldom experienced in ordinary IT networks. The car industry is accustomed to recreating that sort of test condition, but Ethernet testing presents a new challenge. As well as being a new technology, it faces a range of hacking and denial of service attacks that have grown up in the IT environment. The risk of cyber-attack brings automotive into the frontline of the world of IT security – a challenge that is probably evolving faster than any other aspect of vehicle development.

Although automotive networks have very specialised requirements, the broad framework for testing automotive Ethernet can be developed from well-established best practice for network testing in the IT industry. Four types of test are needed:

- Conformance testing ensures protocols function correctly and meet approved standards. This will remain important until OABR is so well established that OEMs can leave it to their vendors.
- Negative testing confirms how the system responds when it encounters errors, unexpected or non-standard signals, or no signal at all. This includes "fuzzing" to test every possible permutation close to the expected action – such as a driver missing the correct button and hitting an adjacent one. Exhaustive nega-

tive testing is particularly important in automotive scenarios, where a vehicle must remain safe at all times.
- Performance testing checks how much load the system can bear, and what happens when this limit is exceeded. For example, when faced with a sudden surge in demand for network bandwidth, can a vehicle still identify, prioritise and deliver the most important messages, such as brake function?
- Security testing is becoming increasingly important for the automotive industry. Although CAN and other bus networks can be compromised, the specialised interface restricts the practical threat to an extremely low level. However, the standardised nature of Ethernet means that hacking tools and techniques are widely available and attacks could be made through any external connections.

Conclusion

Connecting vehicles will enable the automotive industry to provide users with new features to improve driving and travelling experiences. Some new features, such as video cameras and other driver assistance systems are already starting to appear in current models, while others, such as fully autonomous driving, will take a lot longer to implement.

To deliver these new features, vehicle manufacturers will need to embrace more new technologies that have been developed in the IT industry. Some, such as Bluetooth, and GPS are already incorporated; but others, like automotive Ethernet and WiFi, will become critical to the development of connected cars. As a vehicle becomes more like a computer network on wheels, ensuring these new features work properly presents a new challenge to the auto industry.

The good news on Ethernet is that the principles behind the underlying technology are already well understood in the IT industry and specialist test tools and techniques have been developed and are available in increasingly simple, easy to use formats. Work has already started on adapting these to OABR and the specialised needs of the automotive industry – for example there is already an interface card available to connect 2-wire OABR to the most sophisticated network test devices, allowing all the above types of test to be customised to match realistic and extreme operating conditions in the vehicle.

www.spirent.com

Agilent, Cascade combine forces on wafer-level measurements

Agilent Technologies and Cascade Microtech have announced a strategic alliance to provide fully configured and validated RF measurement systems that streamline wafer-level semiconductor measurements while delivering guaranteed configuration, installation and support.

Specifying and configuring a wafer-level RF measurement system can be challenging and time-consuming, often requiring equipment to be sourced from multiple suppliers and then configured and verified on-site by the customer. As a result, the time to first measurement can be long, a time frame often measured in months. With wafer-level measurement solutions (WMS) from Agilent and Cascade Microtech, semiconductor customers now have the equipment they need to perform accurate and repeatable DC and RF measurements, device characterization and modeling, all while realizing significant time savings to first measurement.

"Agilent and Cascade Microtech are the worldwide leaders in test and measurement and on-wafer probing, offering both the expertise and products to provide all the building blocks for wafer-level device testing," said Gregg Peters, vice president and general manager of Agilent's Component Test Division.

"Semiconductor process development, modeling and characterization tasks are evolving, time-to-market cycles are shrinking, and the need for greater accuracy is increasing," said Michael Burger, president and chief executive officer of Cascade Microtech. "By working with Agilent to provide guaranteed wafer-level measurement solutions, we can now provide semiconductor engineers the tools they need to perform accurate and fast advanced DC and RF measurements on both components and devices to get their products to market on time."

The latest wafer-level measurement systems combine Cascade Microtech's wafer probe stations, probes and calibration tools with Agilent's test instrumentation and measurement and analysis software. Each system configuration is pre-validated to ensure it meets customers' specific application needs, then validated again—based on previously agreed-upon acceptance criteria—after installation by Cascade Microtech experts. Guaranteed configuration means that any parts missing from the configured system will be provided by either Agilent or Cascade Microtech, free of charge.

Agilent and Cascade Microtech have also collaborated to deliver unique workflow software based on Agilent's WaferPro-XP measurement software. Together with Cascade Microtech's Velox probe station software, customers can now develop complete wafer test suites for a variety of measurement needs (e.g., S-parameters, DC-IV/CV, noise figure, flicker noise, and gain compression). This combination of software provides a coherent environment for test development.

Each wafer-level measurement solution is backed by the offer of a full support package, with access to regional experts who are highly skilled in on-wafer test and measurement. Cascade Microtech acts as the single point of contact to ensure quick problem resolution.

Agilent and Cascade Microtech wafer-level RF measurement systems are now available in a range of configurations, from a fully integrated new solution with either a semi-automated or manual prober, to application-specific hardware upgrades to existing probe stations. The WaferPro-XP measurement software platform for R&D device characterization can also be added to an existing wafer-level measurement system.

www.agilent.com
www.cascademicrotech.com

Start-up distributes IoT starter kit
available through Conrad Business Supplies

Distributor Conrad Business Supplies has announced that it is working exclusively with Berlin based start-up company relayr (iThings4U GmbH) to support the development and launch of the Open Source 'Internet of Things' (IoT) starter kit known as 'WunderBar'.

Start-up company, relayr is focussed on enabling applications using connected devices, and providing the infrastructure that will allows many of the product concepts currently circulating as Internet-of-Things ideas, the get the real world and to function.

Medium- and long-term, relayr's business model is to, in effect, 'commoditise' aspects such as the cloud services that will produce real and useful services from the IoT. The company is considering models similar to the "app" environment with revenue streams coming from small subscriptions or one-time payments, for IoT-based functions and services. It is developing a range of offerings such as its Open Sensor Cloud concept, which will be an environment where data from myriad smart devices can be collated and made useful by an embedded rules engine.

More immediately, relayr believes that there are many would-be IoT "application" developers for whom, "hardware is hard" - for this group, who don't have a problem in coding functions, the practicalities of actually getting sensor measurements connected to a context where they can do "connected-device" operations, is a barrier. Therefore, the company has designed WunderBar.

In March this year, the WunderBar project successfully completed its crowd-funding campaign on the hardware crowd funding platform Dragon Innovations, where it achieved 120% funding.

The WunderBar IoT starter kit together with the relayr Open Sensor Cloud platform allows software application developers to quickly and easily begin working on wireless applications and prototype building based on data gathered from the physical world without needing to learn about hardware. The platform includes software development kits (SDKs) for iOS, Android and Node.js.

www.conrad.biz
http://relayr.io

Platform cuts calibration time for phased-array antennas

As the second product in its recently launched series of modular reference platforms, Agilent has introduced a multi-channel antenna calibration solution that enables engineers to characterise large multi-channel phased-array antennas during manufacturing and integration. The platform includes hardware, software and test expertise.
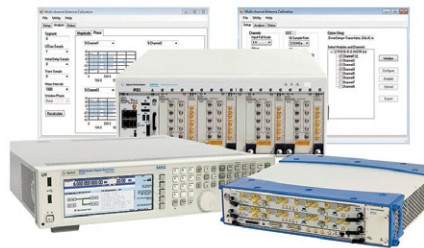
The reference platform at hand provides multiple, phase-coherent channels measured in parallel. Thus it increases the number of antenna measurements per time unit and optimises the amount of data through real-time digital down-conversion (DDC). Phased-array antenna as they are frequently used in AM and FM radio broadcasting, VHF communications and radar applications consist of thousands of individual transmit and receive modules which can make calibration a rather time-consuming with a considerable negative impact on production cost. Plus, the sheer duration of the calibration process can create a bottleneck in production and limit the manufacturer's ability to respond to increasing demand. The reference solution from Agilent greatly reduces measurement time while expanding the test system's flexibility to cover a broader set of applications.

The reference platform provides example software templates including relative magnitude as well as phase measurements, effectively enabling users to reduce the calibration bottleneck and speed up the element-to-element calibra-

tion of large phased array antennas. It is scalable from eight to 40 digitizer channels in a 5-slot chassis (more in a 14-slot chassis). Furthermore, it offers stable, coherent channels with less than one degree phase difference between channels and a high analysis bandwidth flexibility (300 MHz with DDC and 600 MHz without).

www.agilent.com

Low power 6-axis IMU shrinks for wearables
gains design wins

Bosch Sensortec has taken the power consumption of an inertial measurement unit below 1 mA with a view to gaining design wins in wearable equipment. Bosch Sensortec has produced a 6-axis inertial measurement unit (IMU) that consumes less than 1mA and has a packaged size of 2.5 mm by 3.0 mm by 0.8 mm. This compares with Bosch's BMI055 which consumes more than 5 mA and has a package size of 3 mm by 4.5 mm by 0.95 mm.

BMI160 Inertial Measurement Unit (IMU) integrates a 16-bit 3-axis, low-g accelerometer and a 3-axis gyroscope and has been designed for always-on 6-axis and 9-axis applications in smart phones, tablets, wearable devices, remote controls, game controllers, head-mounted devices and toys. It can also serve as an input to 9-axis sensor fusion computation.

The part is available in a 14-pin 2.5 × 3.0 × 0.8 mm^3 LGA package. When the accelerometer and gyroscope are in full operation mode, the typical current consumption is 950 μA, best in class by a factor of two, Bosch claims.

The BMI160 can use an external geo-magnetic sensor to synchronize the inertial accelerometer and gyroscope sensor data for applications requiring exact, low latency 9-axis sensor data fusion.

Additional sensors such as geo-magnetic or pressure sensors can be connected as slaves via a secondary I2C interface. In this configuration, the BMI160 controls data acquisition of the external sensor with all sensor data being stored in the BMI160's built-in FIFO. With the secondary interface configured as a high-speed SPI interface and connected to camera module, BMI160 also supports optical image stabilization.

www.bosch.com

Pre-configured WiFi kit

enbles wireless connectivity to the cloud

Mouser Electronics has the Ayla IoT Design Kit, equipped with a Murata Wireless Wi-Fi connectivity module. This design and development kit allows you to securely connect devices to the cloud from anywhere in the world with an internet connection.

The Ayla Design Kit with Murata WiFi Connectivity allows developers to easily connect their projects to Ayla's cloud service. Wireless connectivity is supported by a Murata Type-YD 2.4 GHz 802.11b/g/n radio module supporting WEP, WPA-PSK, and WPA2-PSK encryption. The Murata Type-YD module includes a TCP/IP stack, security firmware, and other network application features. Murata's Wi-Fi module mounted on Ayla's design kit allows devices to be securely controlled using OAuth-based authentication from anywhere.

Developers can use these technologies to provide interactive control of industrial systems, lighting applications, HVAC, and more, all with minimal modifications to existing systems. Murata also has a certified version of this module; the Type YDDs.

www.mouser.com

SimpleLink WiFi

connects IP with "Internet on a chip"

Ease of use, and low power, are key attributes of SimpleLink Wi-Fi CC3100 and CC3200 devices, which comprise a single-chip, low-power Wi-Fi solution with built-in programmable microcontroller, designed for the IoT

In the move towards a connected-everything environment Texas Instrument sees a trend to re-use of existing infra-structure and specifically, the pervasiveness of WiFi. Also, the company adds, in industrial environments where Ethernet and WiFi are already widely used, new service models and new areas of connectivity are emerging; and WiFi is also being contemplated for applications that might have otherwise been fulfilled with other technologies, such as asset tracking and location-based services.

WiFi has been difficult to use, TI says, and offers the 3100 and 3200 to remedy that. Both contain a complete, integrated, WiFi function with the protocol entirely in ROM: the 3100 has a interface to an off-chip MCU the 3200 has an integrated ARM Cortex-M4 MCU, fully-available for users to add their own code. In either case, you get what amounts to a standard API to the wireless IP connection, with Berkeley interface sockets and following the model that TI has established with SimpleLink. There is also an on-chip cryptography engine to establish secure connections to access points. All of this is in hardware, with very short power-up times (150 ms), enabling short wake-up-to-sleep cycles for low average power.

The devices offer low power consumption for battery operated devices with a low power radio and advanced low power modes.

Current draw while listening to an access point is 37 mA; in shut down the device consumes 120 μA. Stable timing allows it to hold a connection open, despite being ina low-power almost-inactive mode, for up to 2 sec. The air-interface hardware is adaptively adjusted to optimise the connection for the environment it finds itself operating in.

www.ti.com/simplelink

Broadband coaxial switch

normally open multi-throw

The series CCR-38 from Teledyne Coax Switches is a broadband multi-throw, electromechanical coaxial switch designed to switch a microwave signal from a common input to any of 10 outputs.

The CCR-38 normally open switch covers frequencies from DC to 12 GHz and is available with 12, 15, 24 and 28 coil voltages.

The expansion of the CCR-38 series reduce switch count from three switches to achieve a SP10T (1 SPDT to 2 SP5T switches), thus being able to offer smaller, price competitive switching systems.

The characteristic impedance is 50 Ohms. The switches are small using a popular connector spacing on a 1.740-inch diameter circle. Each position has an individual actuator mechanism allowing random position selection. This also gives the minimum switching time.

The CCR-38 measures 3.10 x 3.10 x 2.77 inches and have a maximum weight of 9 oz. (255.2g)

www.teledyne-europe.com

Software-based instrument

packs five bench instruments in one

National Instruments' VirtualBench "reshapes instrumentation" - the software-based, All-In-One device offers five essential instruments in a single unit with an innovative software experience, creating new possibilities for engineers using benchtop test equipment.

VirtualBench is an all-in-one instrument that integrates a mixed-signal oscilloscope, function generator, digital multimeter, programmable DC power supply and digital I/O. Users interact with VirtualBench through software applications that run on PCs or iPads. The device provides the most common functionality affordably and opens up new possibilities for how engineers can use benchtop instruments.

Because VirtualBench uses today's consumer computing platforms, engineers and scientists can take advantage of the

latest technologies such as multitouch displays, multicore processors, wireless connectivity and intuitive interfaces. The simplification and increased capability through software leads to more efficient circuit debugging and validation.

According to NI, VitualBench takes up minimal space on a desktop or benchtop; simplifies instrument configuration through consistent, user-friendly interfaces; offers new capability and convenience with a consolidated view of multiple instruments, visualisation on larger displays and quick functionality to save data and screenshots; and integrates seamlessly with LabVIEW system design software

www.ni.com/virtualbench

Industrial wireless link
closes in on wired reliability

Belden is claiming to be the first supplier to deliver "near wired" reliability for industrial wireless devices using Parallel Redundancy Protocol; its Hirschmann HiLCOS 8.9 firmware significantly improves wireless message transmission dependability, the company says.

Hirschmann HiLCOS 8.9 is the latest version of Belden's WLAN firmware to manage its line of OpenBAT industrial wireless devices. This release is the first industrial wireless application of integrated Parallel Redundancy Protocol (PRP) technology, a new industry standard that allows systems to overcome network failures without affecting data transmission. Wireless technology can be reliably used for mission-critical industrial applications where distances or environments make wired solutions expensive or challenging, Belden says.

The key benefit of PRP inside Hirschmann's BAT products such as wireless access points, clients and bridges is a significant increase in reliability. PRP offers zero failover with two redundant networks. By doubling the packets, there is no data loss if one packet fails, as either the faster packet or the second packet gets through with a functioning second network.

HiLCOS 8.9 firmware includes opportunistic key caching for fast authentication between several access points in a network – known as "fast roaming" - where the access points are under common administrative control.

www.belden.com

Pressurized connectors
meet IP68 to 30 GHz

San-tron has released the pSeries pressurized connectors which provide low-loss, high-stability performance through 30 GHz at ±65 psi. These pressurized connectors, which meet the IP68 standard, feature a simplified, three-piece design – body, center contact, and an innovative dielectric — which eliminates troublesome internal O-rings, gaskets, and silicone greases.

"San-tron's new pSeries pressurized connector design expands the typical operating frequency ranges through 30 GHz, while eliminating failure-prone internal O-rings," noted San-tron Director of Engineering Fred Hull.

Pressurized coaxial connectors are vital where high pressure is maintained for extended periods and in environments needing protection against moisture and other contaminates — such as agriculture, aviation, and marine applications. The pSeries pressurized connectors exhibit low-loss characteristics and meet MIL-STD 202 Method 212, Condition D (+125°C fluorocarbon leak), test conditions. Connector seal integrity exceeds 10^{-5} cm^3/s when tested under 30 psi pressure of alcohol per STI 8.2.4-13. The proprietary insulator also offers five times more thermal stability than standard PTFE insulators found in other pressurized connectors.

The pSeries pressurized connectors are available in a variety of different connector types, including 2.92 mm, 3.5 mm, SMA, TNC, and Type N series.

www.santron.com

Externally biased balanced mixers
cover 50 to 140 GHz

It is always a concern at high millimeter wave band that there is not enough power to drive the mixer, especially full waveguide band. However, the Model FDB-XX-E1 externally biased, balanced mixer series is especially developed for this purpose.

The mixers are offered in 4 waveguide bands to cover frequency spectra from 50 to 140 GHz. These mixers employ high performance GaAs Schottky beamlead diodes and balanced configuration to produce superior performance with a very low LO pumping level.

The mixers are designed for full waveguide band operation with extremely wide IF bandwidth from DC to 18 GHz. The conversion loss measured is 11 to 15 dB for V band through F band with a typical LO power of 0 dBm and +5.0-Vdc/1.0-mA external bias.

These mixers are ideal candidates for test equipment, communication systems and EW receivers where broad band frequency down conversion is required.

www.ducommun.com

Handheld spectrum analysers
come in 3.6 and 6 GHz versions

Two RF spectrum analysers are available in 3.6 GHz and 6.0 GHz versions and maintain a true handheld format whilst offering bench-top level features. Signal input is via an N-type connector.

The PSA3605 and PSA6005 weigh 560 grams and are small enough to fit comfortably into the hand. Their lithium-ion battery provides more than 3 hours of operation from each charge. Despite their compact dimensions, the analysers incorporate a high resolution colour TFT display with touch screen control.

The DANL noise figure is better than -160 dBm/Hz and a minimum full scale reference level of -40 dBm allows signals down to -120 dBm to be observed. RBW and VBW are adjustable from 300 Hz to 10 MHz in 1:3:10 sequence.

Multiple traces can be displayed in contrasting colours, and trace modes include peak hold and multi sweep averaging. Multiple detector modes are selectable. Large internal storage is provided for traces, setups and complete screen images.

Connectivity is provided for USB Flash drives and for direct USB connection to a PC. Internal storage extends to nearly 2 GB, and the internal filing system supports user specified names and time stamping from a real-time clock.

Additional features include automatic measurements of CP, ACPR and OBW, waveform demodulation, complex limit patterns with limits comparator, and triggered logging of up to 25,000 results.

www.aimtti.com

Flexible microwave cable assemblies

match semi-rigid specifications

Able to maintain electrical performance without the limitations of semi-rigid assemblies, these pre-configured flexible microwave cable assemblies combine Molex Temp-Flex coaxial cables and RF connectors in formats that are suited for smaller, lighter devices. They offer excellent electrical properties, and are assembled using a technique that minimises Voltage Standing Wave Ratio and insertion loss.

The company comments that semi-rigid assemblies can suffer performance degradation and a shortened life-span when they are bent to fit into today's smaller modules, and that these assemblies can be installed into virtually any size device, while still providing superior electrical performance and remaining competitively priced.

The assemblies are available in a wide range of standard and custom options and comply with both U.S. and European standards.

The cables come standard with silver-plated conductors, fluoropolymer (FEP) dielectric, double shields and FEP jacket. The solid-core, low-loss version uses proprietary low-loss FEP dielectric with 70% velocity of propagation (VOP) while the air-dielectric ultra-low-loss version use a unique air-enhanced design with up to 87% VOP. The cable impedance of 50 $\pm 1\Omega$ provides consistent electrical performance while the helically wrapped foil covered by a braided shield offers 100 dB or greater shielding effectiveness and protects signals from internal and external interference.

www.molex.com

Hand-held RF Analyser
detects hidden signals

The IDA 2 second-generation interference and direction analyser from Narda Safety Test Solutions is a new hand-held instrument that has been designed to provide communications and security professionals with a means of rapidly detecting, analysing and locating sources of RF interference or unauthorised transmissions.

The instrument incorporates a powerful feature called persistence display, which uses different colours to represent the number of times an amplitude value occurs at a given frequency, thereby enabling intermittent or low-level interference to be clearly distinguished when it might otherwise be hidden within the main

signal. This feature, along with the unit's capability to generate high-resolution spectrograms and time-domain displays, are advanced I/Q analysis functions that would normally be associated with expensive test-lab equipment. Using the IDA 2, signals can therefore be detected and analysed on the spot without the need for external computation.

Operating over the radio spectrum from 9 kHz to 6 GHz, the instrument records signals' in-phase and quadrature components (the I/Q data) in real time at a maximum channel bandwidth of 32 MHz and can store up to 250,000 I/Q data pairs without compression. Computation and analysis can either be performed continuously during the measurement or subsequently from the stored data set.

Since the underlying data remains unchanged in the IDA 2 memory, users can alter display parameters such as the frequency or time resolution afterwards and zoom in on details right down to the original resolution. If required, the I/Q data set can be transferred to a PC via the instrument's Ethernet port.

The IDA 2 features an extremely fast sweep rate of 12 GHz/s, and is supplied with a choice of precision antennas optimised to suit particular frequency bands.

www.narda-sts.com

Waveguide antennas
cover 50 GHz to 70 GHz

Pasternack Enterprises has released a family of high frequency, WR-15 waveguide antennas, which are perfectly designed for high-bandwidth applications including point-to-point links, GigE wireless LAN, millimeter radiometry, uncompressed HD video, FMCW radar, millimeter scintillometry, campus networks, and multi-gigabit wireless communications.

Offered in this release are four high gain WR-15 horn antennas operating between 50 GHz and 70 GHz and are

available in 20 dBi, 24 dBi, 34 dBi and 42 dBi gain models. The company's WR-15 waveguide horn antennas pairs seamlessly with the recently added 60 GHz transmit/receive development system (PEM003-KIT) which enables companies to experiment and develop applications in the globally-unlicensed 60 GHz frequency band. Using two of the company's WR-15 beam antennas rated to 42 dBi gain (PE9881-42), a user is able to transmit and receive a 60 GHz signal at a distance of one kilometer (km), making these antennas ideal for high frequency point-to-point backhaul.

Also available is an omni-directional millimeter wave antenna (PE-W15A001), a vertically polarized WR-15 waveguide connected antenna using a standard UG387/U flange that operates between 58 GHz and 63 GHz. This omni-directional millimeter wave antenna has a 30 degree vertical beam width and a 360 degree horizontal gain variation, making it ideal for short range wireless communications, indoor networks, high frequency applications and 60 GHz development systems. The millimeter wave omni-directional antenna is constructed with a durable brass waveguide input and light-weight aluminum body.

www.pasternack.com

Broadband 20 GHz GaN amplifier
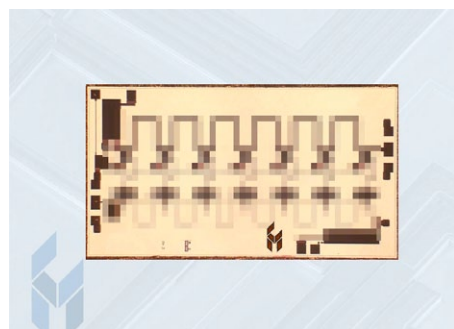
Custom MMIC has announced the CMD184, a broadband 20 GHz GaN power amplifier.

The CMD184 amplifier die offers an ultra-wide bandwidth of 0.5 to 20 GHz, an output 1 dB compression point of greater than +34 dBm, and flat gain of 13 dB. It is the company's first released standard product fabricated on GaN.

The amplifier requires an off-chip bias tee for proper operation. The die offers full passivation for increased reliability and moisture protection.

Typical applications include microwave radio and VSAT, telecom infra-

structure, test instrumentation, and military and space.

www.CustomMMIC.com

OXCO
±0.2ppb frequency stability over temperature

The IQOV-164 series oven controlled crystal oscillator (OCXO) from IQD delivers frequency stability performance at ±0.2 ppb over an operating temperature range of -20 to 70 °C. This ultra high stability model can also be specified to operate over a wider -30 to 75 °C temperature range with only a minor drop in temperature stability performance at ±0.5 ppb.

Available over a frequency range from 10 to 40 MHz, this OCXO consumes a maximum of 7.0 W during warm up time which takes only 3 minutes. Frequencies are available up to 100 MHz with a lower stability of ±10 ppb over -30 to 75 °C. Designed to operate from a 3.3 V supply, the IQOV-164 is housed in an industry standard 5-pin euro package measuring 36 x 27 mm and 13.5 mm high.

Output can be specified as either HCMOS, 15 pF load or Sinewave, into 50 Ohms load. Phase noise performance is typically -158 dBc/Hz at 100 kHz offset and the IQOV-164 can be specified with different frequency pulling options in order to offset the impact of ageing. Typically ageing is ±0.2 ppb per day, ±10 ppb per year depending on the required specification.

www.iqdfrequencyproducts.com

Low PIM coaxial switch
offers linear response and high power capability

Passive Intermodulation (PIM) is critical in today's market where multiple frequencies are transmitted simultaneously in wireless communications and higher data rates.

To address this issue, Teledyne Coax Switches has introduced the Series CCP-47D low PIM coax switch.

The CCP-47D is a broadband TRANSFER, electromechanical coaxial switch designed to switch microwave signals similar to a DPDT switch. The CCP-47D comes standard with 7/16th DIN Connectors designed to achieve IP3 levels of -165 dBc with two carrier signals at +43 dBm.

The CCP-47 Series is ideal for switching high RF power or high sensitivity signals. The company's low PIM CCP-47 Series ensures the most linear response with excellent a galvanically matched contact system. The switch can handle up to 200 W CW at 3 GHz and has superior RF performance such as Isolation of 70 dB minimum at 3 GHz. The company's TRANSFER design claims to offer the most reliable, and insertion loss repeatable switches.

www.teledynecoax.com

Second-generation CMOS pulsed radar chip

Novelda AS (Kviteseid, Norway), has announced the development of a second generation of its XeThru pulsed microwave radar sensor technology.

XeThru is a microwave radar system integrated on a single CMOS chip that can act as ground-probing radar, a sensor for human vital signs monitoring, personal security, environmental monitoring, industrial automation and robotics.
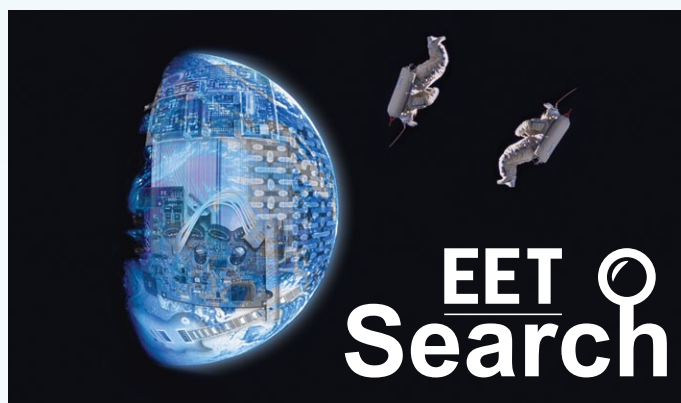
"The core component of the XeThru technology is a high frequency CMOS chip combined with advanced signal processing algorithms. Our second-generation chip X2 (previously called 6201) is now fully tested and in production at TSMC in Taiwan," said Alf-Egil Bogen, CEO of Novelda.

www.novelda.com

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