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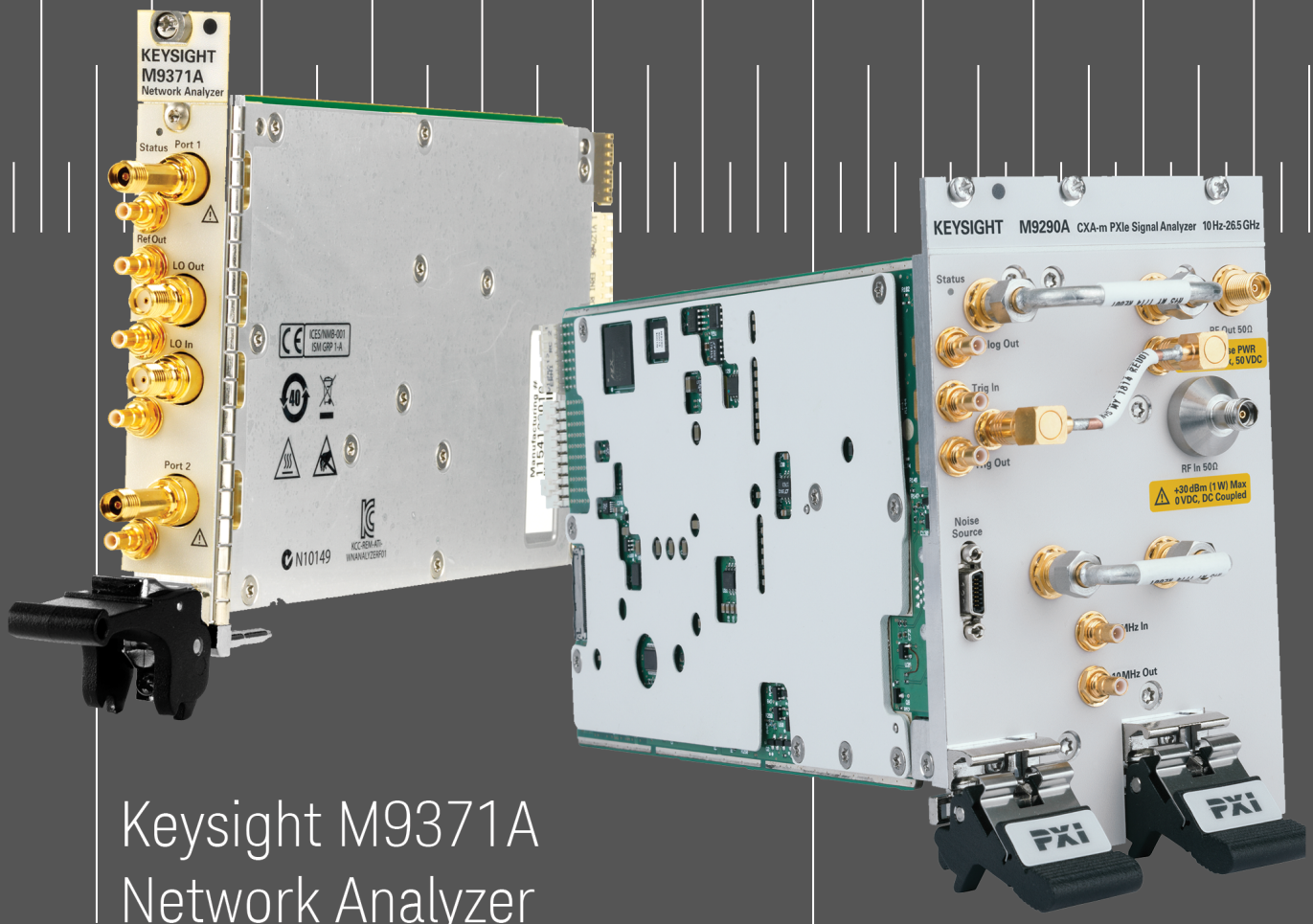
MICROWAVE engineering europe



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The European journal for the microwave and wireless design engineer

www.mwee.com

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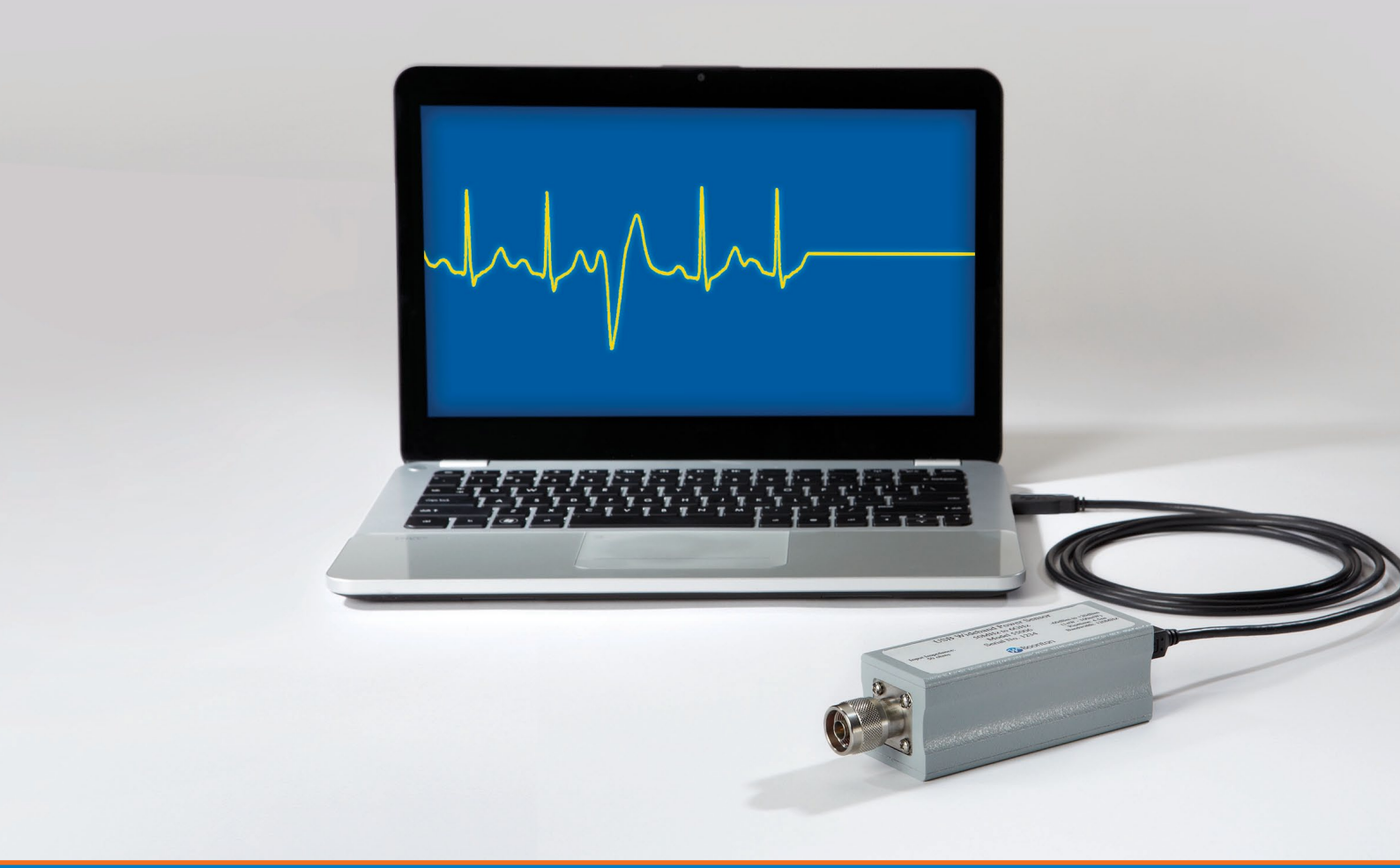

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IoT and wearable devices to drive market for many trillions of sensors in 15 years

As we discuss the IoT and wearable devices, we tend to gloss over the proliferation of sensors that such devices require. Smartphones have driven the sensor market over the last few years from 10 million units in 2007 (iPhone introduction) to almost 10 billion devices in 2013.

At a recent Trillion Sensor Summit that took place in Munich, the driving theme was inspired by "Abundance" defined as a world without hunger, a clean environment and energy and medical care to all, to be enabled in one generation through technological innovations by so called exponential technologies producing goods and services faster than global demand. All this requires networked sensors, capable of collecting data and exchanging information.

Beyond technology, the roll-out of ubiquitous sensor applications will destroy industries — and create new ones.

According to a Fraunhofer EMFT press release, networked sensors are one of the exponential technologies with forecasted demand up to 45 trillion sensors in 20 years. The biggest global economic tides, such as Digital Health and Internet of Everything (forecasted by Cisco to grow the global economy by $19 trillion by 2020, to represent over 20% of global GDP) are positioned to make Abundance a reality. The Abundance concept was introduced in the bestselling 2012 book by Peter Diamandis and Steve Kotler of the same title.

Is this realistic? We have predicted Utopia many times in human history only to find that things do not usually work as planned. Trillions of sensors are probably going to happen, but, they will help us manage, conserve and use scarce resources more efficiently.

More to the point, as we see the use of sensors explode in smartphones, this can be expected to continue in wearable devices, which will essentially be add-on sensor systems for the smartphone. It would be reasonable to see the smartphone become the universal controller of everything much like the PC became the centre of the computing world. These trends where smartphones are used to control and monitor are already seen in healthcare, medicine and home automation to mention a few.

To illustrate the breadth of this point, Dartmouth researchers and their colleagues recently built the first smartphone app that automatically reveals students' mental health, academic performance and behavioral trends. In other words, your smartphone knows your state of mind — even if you don't — and how that affects you.

The StudentLife app, which compares students' happiness, stress, depression and loneliness to their academic performance, also may be used in the general population – for example, to monitor mental health, trigger intervention and improve productivity in workplace employees.

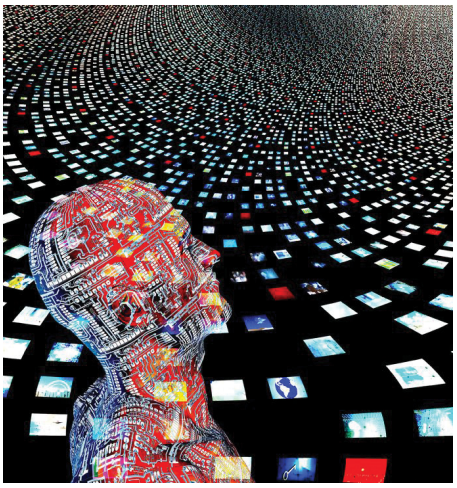
"The StudentLife app is able to continuously make mental health assessment 24/7, opening the way for a new form of assessment," says computer science Professor Andrew Campbell, the study's senior author.

The mobile industry is in the first stages of a revolution driven by apps, and sensors will provide the data inputs to drive whatever application a particular app is written for. Potentially, the possibilities are only limited by human ingenuity.

The IoT will extend the Internet to devices and machines at home in the office or out in industry. Eventually everything will be connected, but here sensors are needed to know the status and where all these devices are. Machines can notify their users when they need maintenance and repair. Retail can track and monitor everything, a true 'cradle to grave philosophy'.

The Trillion Sensor Summit offered a snapshot of this exploding universe. Janusz Bryzek, originator and chairman of the Trillion Sensor Summit initiative and co-chair of the Munich meeting, gave an impression of the economic potential of the mobile sensor market today and in the future.

Between 2007 and 2014, this market has grown from $2 billion to $13 billion annually. At the same time, the complexity of these sensors exploded from 1000 to 1 million transistors per sensor. And this expansion wont stop by no means in the overseeable future, Bryzek said. While the number of sensors in operation around the globe today is in the range of some ten billions, this number will make another breath-taking hike. Within the next 15 years, the world will see it rise to



a number somewhere in the double-digit trillion range, Bryzek predicted.

Enablers for this giant market are breakthroughs in the fields of biotechnology, medicine, nanomaterials, networking, computational systems and robotics. A particular important role will play the availability of 3D printing systems at a large scale, Bryzek said. MEMS and MEMS-based systems will play a major role in sensor development, he added.

Challenges in the trillion sensor summit roadmap include slow cycle times for commercialisation and standardisation. At the technology level, the algorithms enabling the derivation of useful information have yet to be developed in a way that suits large numbers of distributed sensors. And if many sensors throw their data to some kind of collection point, bandwidth issues are almost certain to arise. Last but not least, user adoption is vital to the propagation of the IoT.

Further it is likely that this won't be a self-propelling model: Sensors - and the machines equipped with them - will kill jobs. In the US alone, 50 percent of the currently existing workforce will be displaced by robots within the decade ahead, Bryzek predicted. And if this would not be enough, 40% of the current Fortune 500 companies will give way to new companies we did not hear about yet. But no reason to become desperate: The IoT will create a total of 172 million jobs, mostly for knowledge workers, by 2020, Bryzek quoted a Cisco forecast.

By Jean-Pierre Joosting and Christoph Hammerschmidt

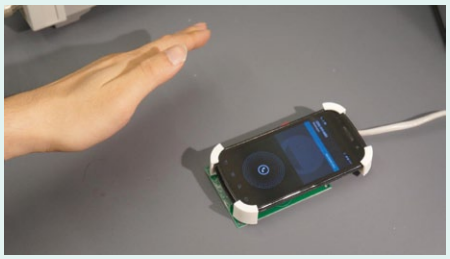
Reflections of smartphone transmissions enable gesture control

Phone manufacturers have been looking at going beyond touchscreens in smartphones with the ability to interact with our smartphone through gestures in the space around the phone. Some smartphones are starting to incorporate 3-D gesture sensing based on cameras, for example, but cameras consume significant battery power and require a clear view of the user's hands.

University of Washington (UW) engineers have developed a new form of low-power wireless sensing technology that could soon contribute to this growing field by letting users "train" their smartphones to recognize and respond to specific hand gestures near the phone.

The technology – developed in the labs of Matt Reynolds and Shwetak Patel, UW associate professors of electrical engineering and of computer science and engineering — uses the phone's wireless transmissions to sense nearby gestures, so it works when a device is out of sight in a pocket or bag and could easily be built into future smartphones and tablets.

When a person makes a call or an app exchanges data with the Internet, a phone transmits radio signals on a 2G, 3G or 4G cellular network to communicate with a cellular base station. When a user's hand moves through space near the phone, the user's body reflects some of the transmitted signal back toward the phone.



The SideSwipe system uses the phone's transmissions to sense nearby gestures. Credit: University of Washington.

The new system uses multiple small antennas to capture the changes in the reflected signal and classify the changes to detect the type of gesture performed. In this way, tapping, hovering and sliding gestures could correspond to various commands for the phone, such as silencing a ring, changing which song is playing or muting the speakerphone. Because the phone's wireless transmissions pass easily through the fabric of clothing or a handbag, the system works even when the phone is stowed away.

A group of 10 study participants tested the technology by performing 14 different hand gestures – including hovering, sliding and tapping – in various positions around a smartphone. The team found the smartphone recognized gestures with about 87 percent accuracy.

www.uwnews.org

Low profile antenna cuts OpEx for Wi-Fi-equipped aircraft

Panasonic Avionics Corporation (Panasonic) and Boeing Network and Space Systems (N&SS) have announced that, subject to terms, N&SS and Panasonic will develop a ground breaking broadband electronically steered phased array antenna for commercial airliners.

This jointly developed lightweight antenna, which will deliver Panasonic's eXConnect broadband in-flight Wi-Fi service, reduces fuel burn and emissions through a 65 percent reduction in operational weight and drag without compromising connection speed, offering airlines the best of both worlds.

The antenna will be available to the commercial aircraft market in 2016. In addition, Panasonic plans to offer the electronically steered antenna for a much broader range of narrow- and wide-body aircraft.

www.panasonic.aero
www.boeing.com/bds

RFMD and TriQuint merger yields new company Qorvo

RF Micro Devices and TriQuint Semiconductor have revealed that the holding company under which the companies will combine in a merger of equals will be named Qorvo™, Inc. The companies also unveiled the Qorvo logo and stock trading symbol, which they will begin using immediately upon closing of the merger.

"We believe that our new name reflects our company's commitment to keep customers at the center of all that we do," said Bob Bruggeworth, RFMD president and CEO, who will serve as Qorvo's CEO following closing of the merger. "As a new leader in RF solutions, Qorvo will offer the agility, innovation and precision customers need for success in mobile, infrastructure, and defense markets."

Shareholders of both TriQuint and RFMD voted to approve the merger on September 5, 2014, and the transaction is expected to close in the second half of 2014, following other required regulatory approvals and satisfaction of customary closing conditions

www.triquint.com
www.rfmd.com

Alcatel-Lucent pushes small cells

Alcatel-Lucent has announced that it will introduce its breakthrough Enterprise Small Cell device at the beginning of 2015 for office and home applications. The latest 9962 Multi-Standard Enterprise Cell, developed in a collaboration between Alcatel-Lucent and Qualcomm Technologies, is the first small cell of its type to support both 3G and 4G LTE connectivity through a single chipset with key features like carrier aggregation. It allows operators to meet their existing business customer needs to deliver in-building wireless services to support continued growth in data traffic and VoLTE service. The Qualcomm chipset on which the 9962 is based — the FSM9955 — also provides the ability to migrate the radio access technologies from 3G to 4G.

www.alcatel-lucent.com

Data analytics platform targets wearable healthcare

Vivametrica has introduced a first-of-its-kind wearable analytics platform for consumers, enterprises and healthcare providers based on years of clinical research linking activity and health risks, authored by its executive management team.

According to the company, wearable sports and activity trackers will become a $1.4 billion industry in less than two years, producing a massive amount of user activity data along the way. A huge opportunity exists for leveraging this data to create meaningful healthcare decisions.

Vivametrica's device-agnostic platform delivers a standardized approach to data collection and management, bridging the gap between wearable fitness applications and actionable health data by improving personal wellness metrics. To do this the company's approach delivers accurate, credible and personalized assessments that can be used to determine individual risk for chronic conditions such as heart disease, diabetes and back pain. Additionally, the platform provides personalized health targets and goals based on objective data collection.

Further, platform caters for research-based analytics. Created by physicians and researchers, Vivametrica's analysis is based on years of comprehensive clinical findings in the fields of physical activity, rehabilitation and medicine.

www.vivametrica.com

Canadian startup mutualizes iBeacon deployment costs

Bluetooth Smart-enabled applications crop up everyday, from personalized remote sensors to proximity detection for home automation, to in-shop consumer notifications. While the sensor-type Bluetooth Smart devices can indoubtedly answer specific needs, consumers will certainly be less receptive to iBeacon-type in-store messaging and micro-geo-localized marketing. The invasiveness of Bluetooth Smart beacons may be felt even more strongly if shoppers are asked to download the app of every shop they visit.

This is the pitch of Canadian startup, Reteneo, who designed its 'Puck' as a stripped-down iOS and Android-compatible beacon platform to allow multiple retailers and merchants to offer beacon-based services to consumers via a single 'Reteneo Life' app instead of having to download a separate app for each beacon.

For as low as $15 per month, retailers will be able to ping their visitors, without collecting their personal info nor asking them to register, all the set-up, programming and maintenance being centralized and performed remotely by Reteneo.

Included in the subscription fee, the company will also replace defective any

beacon with failing batteries (on two watch batteries, those will run for an average of two years in continuous operation, claims the manufacturer).

"We can foresee a day where every retailer or merchant has beacons, but we cannot foresee a day where consumers are willing to have hundreds of different beacon-compatible apps on their smartphones," explains Cesar Rego, CEO of Reteneo in a joint statement with Nordic Semiconductor, provider of the nRF51822 radio SoC.

"It's never going to happen given that people are already complaining that they have too many apps on their smartphones as it is."

www.reteneo.com
www.estimote.com
www.nordicsemi.com

Xilinx and China Mobile collaborate on 5G

Xilinx has said it is collaborating with China Mobile Research Institute for the development of virtualized 5G wireless networks. As 4G wireless networks are being deployed around the world, Xilinx and China Mobile, are working together on virtualization advancements for next generation 5G systems to address challenges faced by wireless operators.

Xilinx's unique All Programmable devices, design tools and methodologies are key enablers for virtualization technology. In particular, the company's innovations in partial reconfiguration (PR) allow equipment designers to create designs that can be altered in-system without interrupting the equipment operation. For example, new air interface waveforms can be switched in and out at speed to provide a cost effective alternative to building support for all air interface standards, saving power, cost and increasing system performance.

www.xilinx.com

Next generation mobile network for IoT devices

A finalist at CTIA's Super Mobility Week Startup Showcase, Open Garden has announced a new generation mobile network for IoT devices. The Open Garden Network makes it easy for devices to seamlessly access other devices and the Internet via secure peer-to-peer connections. Devices automatically detect nearby enabled smartphones or tablets via Bluetooth LE and can pass data through them securely until the proper destination or recipient are reached. No pairing or configuration are required on the device owner's part. To enable access to the network, device manufacturers use a simple digital access key, available from Open Garden and its partners.

TrackR is the first device to leverage this new technology. TrackR is a small, coin-sized device that attaches to valuable items such as keys, wallet, luggage, bike, and more. Using the TrackR app for iPhone and Android, one can locate lost items in seconds. With the 250,000 devices in the market, TrackR is one of the most successful IoT devices to date.

www.opengarden.com/IoT

Active DAS challenges small cells on the way to 5G

There is fierce competition between Distributed Antenna Systems (DAS) and small cells vendors for coverage and capacity in the $US8.5 billion enterprise in-building wireless systems market with each vendor having distinct strengths and weaknesses, according to ABI Research.

Modern DAS systems challenge small cells by building on their inherent advantages of neutral host, and macrocell parity and adding features such as traffic steering and multiple network convergence (for example Wi-Fi or public safety) on the same in-building backhaul. They also challenge small cells by tackling one of the main drawbacks: cost per square foot of installation and OPEX needed for system cooling and operation.

However, small cells do not immediately provide a neutral host capability and are complex to configure and virtualize since the baseband, unlike DAS, is distributed in each small cell which must coordinate with its neighbor to mitigate interference.

Hybrid systems are a recent development where the best of DAS and small cells merge. "These systems centralize the baseband function like DAS but use Cloud RAN (CRAN) techniques to distribute signals over dedicated fiber to remote radio heads in the building," says Nick Marshall, research director, networks. "ABI Research believes that it is innovations such as these that are laying the groundwork for in-building 5G."

www.abiresearch.com

EU project takes mm-waves beyond WiGig

Launched at the beginning of 2014 for a duration of three years, the "MiWaveS" (Millimeter-Wave Small Cell Access and Backhauling) European collaborative project aims to develop millimeter-wave (mmW) radio technologies to enable multi-Gbps capable 5th Generation cellular mobile networks.

Taping both into the unlicensed 60 GHz and light-licensed 71-86 GHz E-band, the research project is looking at expanding mobile user access points with the development of small backhaul cells with data transmission capacities up to 10 Gbps for backhaul and 5 Gbps for mobile users.

A heterogeneous network integrating small backhaul cells within larger base station cells could offload data from the macro cells to the small cells while improving user data rate near these more densely installed access points The research will take existing 60 GHz SiGe or CMOS technologies (such as that developed for WiGig or for automotive radars) and push them further by exploring different radio protocols and multi-module implementations with different antenna designs to shrink further existing backhaul cells and mobile-terminal radio transceivers.

In theory, the benefits for such an approach include a more flexible deployment in dense urban areas with a reduced transmit power (both from the terminals and from the base stations). But as well as defining new radio and antenna technologies, the MiWaveS project will have to tackle significant challenges on the system architecture, networking functions and algorithms, according to Dr. Laurent Dussopt, MiWaveS project manager and a research engineer at CEA-Leti.

www.miwaves.eu

Smartphone app for vehicle diagnostics

The golo onboard adapter from repair workshop equipment vendor Launch Europe (Kerpen, Germany) establishes the connection between the On-Board Diagnostics (OBD2) plug and a smartphone. Golo is more than just a plug - the smartphone app that comes with the hardware device turns it into a remote diagnosis system for the car. The adapter is simply plugged to the ODB2 connector; the link to the smartphone is established via Bluetooth. Once connected, the app accesses several ECUs and displays basic information related to the vehicle such as the GPS coordinates, remaining amount of fuel or vehicle protocols.

The app can conduct an analysis of the car's electronic systems, for example of the ECUs controlling engine, ABS, and airbags. The data are sent to a cloud server for analysis. If there is a serious problem, the driver gets immediate feedback and a warning in cases where it would be advisable to contact the nearest workshop.

For the time being, golo supports 59 vehicle types. The app is available for the Android and iOS operating systems.

www.launch-europde.de

Huber+Suhner provide antennas for NYC subway

HUBER+SUHNER has been chosen to supply Thales with a range of trackside and on-board antennas and cables to support the CBTC (Communications Based Train Control) system of New York City Subway. CBTC enables a continuous, high capacity, two-way digital communication between each train and control centre. The control system benefits from enhanced information such as train performance data and continuous determination of train location and speed.

Under a contract with Thales Canada Transportation Solutions, SENCITY® SPOT-M Yagi antennas and rolling stock SPOT-S antennas, together with RF cable assemblies from HUBER+SUHNER will be used to provide the train-to-track radio network for trackside and rolling stock on the New York City Transit Flushing Line 7.

www.hubersuhner.com

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Fundamentals of cable/antenna test tools for base station deployment, upkeep and improvement

By Alain Mignot, Livingston FR

It is recognised that one of the main issues pertaining to the overall performance of a modern mobile communication network will stem from the numerous base stations on which the network is reliant. If these base stations have not been correctly constructed or there has been a failure for timely maintenance to be carried out, then the level of service that a network operator provides to its subscribers might be put in jeopardy and significant revenue may be lost. To prevent this from happening in-depth analysis needs to be done regularly. The following article will look at the various parameters that must be considered when sourcing an antenna/cable analyser so that the best suited model is eventually decided upon.

Antenna/cable analysers are an essential piece of kit for today's field test engineers. By using these items of instrumentation it is possible to obtain detailed information on how well the component parts which make up a base station's transmission system all integrate together and whether the harsh outdoor environment in which they are situated has had any detrimental influence. By compiling all the information acquired, the operational effectiveness of each base station within a network can be determined. Any problems that have arisen can be identified and dealt with rapidly.

There are a broad choice of analysers now on the market, offered by a number of different highly reputable test equipment manufacturers. Each one of these analysers has attributes that can potentially be of value to a test engineer under the right circumstances, so it is important to recognise which are most relevant for the specific test set you have in mind and base your selection on these.

Key measurement criteria

Regardless of which one is finally specified, for any antenna/cable analyser the ability to take certain measurements will be effectively mandatory. As a result

the analyser will have functional modes built in that provision for the following measurements:

1. Voltage Standing Wave Ratio (VSWR) — This is used to express the power that is reflected from the base station antenna. It relates directly to the reflection coefficient (r) via the following straightforward equation:

   $VSWR = (1 + r)/(1 - r)$

   The VSWR can be employed in order to give an accurate assessment of how closely the antenna is impedance matched with the transmission line that it has been connected to. For an antenna that is not adequately matched then a standing wave will form upon the transmission line and the severity of losses will be greater. If the VSWR figure is low then the degree of matching will be better and the power being delivered to the antenna will be higher.

2. Return Loss (RL) — Measured in dB, this is the loss of signal power that results from a reflection occurring because there is some kind of discontinuity or impedance mismatch on the transmission line. It relates directly to the incident power (P_I) that reaches a specified point and the reflected power (P_R) that comes back from it. The equation describing this relationship is:

   $RL = 10\text{Log}_{10}(P_I/P_R)$

   RL basically gives a measure of how well devices or transmission lines are matched and safeguards against interconnects that have been poorly implemented (so that the connection turns out to be lose, for instance) or kinks within the cabling. When the matching is of a high standard then the RL value will be high. The greater the RL the lower insertion loss will be. The impact of RL was not that large in the past, so it was judged to be of little concern to test engineering professionals. With the emergence of ever higher speed, next generation communications protocols, such as LTE and HSDPA, this is all starting to chance though.

3. Cable Loss — This signifies the amount of energy that is dissipated across the transmission line, and all of its associated component parts (the cabling, interconnects and protection devices), as the signal passes down it. Caused by the resistance present in the transmission line, this corresponds directly to the total insertion loss (over a given frequency band). The higher the frequency of the signal, the smaller the diameter of the transmission line and the longer the transmission line is, the greater the subsequent loss will be. The size of the losses is of increasing

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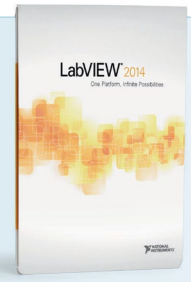

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importance to network operators as they now have to meet stringent legislative guidelines in terms of energy efficiency.

4. Distance to Fault (DTF) — This can be of great assistance in locating the positions of discontinuities and shorts in the base station antenna/cabling that have led to VSWR or return loss issues occurring. Normally complex Fast Fourier Transform (FFT) algorithms are employed by the analyser to translate acquired frequency data into the time domain data, so that signal aberrations can be ascertained in relation to distance.

Other important factors

As well as supporting all the previously mentioned measurement modes there are a wide variety of different features and functionality that are offered by antenna/cable analyser models currently on the market which may prove to be beneficial. Here are just a few major ones.

Obviously, since these instruments are being used in the field and need to be carried up antenna masts, etc., a lightweight, portable format is highly advantageous. Normally an overall weight below 3kg and dimensions of around 200mm x 280mm x 150mm would be expected. Other characteristics like long battery life and robust construction are also elementary.

To make the examining of acquired data as simple as possible to execute, a unit with a relatively large (+7" diagonal), high resolution colour display should be sought. Inclusion of a touch screen has almost become ubiquitous now – this leads to a more intuitive user interface which is easy to operate, however it is worth pointing out that potentially there can be drawbacks associated with touch screen operation. If an engineer is up an antenna mast and is wearing gloves, then a touch-enabled user interface can become difficult to manipulate.

Another feature, which is available from some manufacturers, is the ability for engineers to write their own test procedures for controlling the instrument. This allows a company to guarantee that every one of its field engineers is following exactly the same procedure when testing a specific base station. This reduces the possibility of errors occurring – such as selecting the wrong the frequency when testing.

It is likely that two port transmission measurement will prove itself to be useful, as it will lead to results that are more accurate than those from single port measurements. 3G/4G base stations today use diplexers and duplexers to increase cell coverage. Via two port transmission measurement it is possible to carry out gain, isolation and insertion loss measurements to deal with this. Furthermore if the analyser has a split screen facility, the user can examine two different measurements (such as DTF and VSWR) at the same time.

Access to superior accessories to accompany these analysers is also important. For example, low loss cables and probes with mean that more accurate test data can be acquired. Furthermore by utilising precision calibration kits, that need to be maintained in good order and regularly recalibrated themselves, it can be ensured that the instrumentation fully complies with all the relevant standards throughout its operational life. There is thus a direct correlation between the quality of the measurements taken and the quality of the calibration kits.

So that more can be done with just a single item of equipment, additional functions may be integrated into unit. Spectrum measurement, for example, can be of use as it allows sources of interference to be determined. As a result more advanced models will often incorporate a spectrum analyser. Increasingly network operators will expect field engineers to accurately log the position where testing was undertaken, so GPS is becoming an important supplementary feature. Furthermore, passive inter-modulation (PIM) is now regarded as one of the critical phenomena that needs addressing when base station infrastructure is being deployed. Some analysers now also have the capacity to provide a basic indication of the presence of PIM, though utilisation of a separate dedicated PIM tester will be needed to scrutinise it properly. The detailed mapping out an interference profile, using a directional antenna, can be beneficial to the field engineer, so units that provide this facility are likely to be very attractive.

In many cases analysers are only required for short periods of time. This means that it may not be economically viable to purchase such items of equipment. Instead, in many cases, it will be more attractive, both technically and financially speaking, to partner with an equipment rental firm. Among the products in test sourcing specialist Livingston's portfolio that are widely used in antenna/cable analysis are Anritsu' Site Master, JDSU CellAdvisor and the ZVH from Rohde & Schwarz. These are offered with a full range of accessories, plus a comprehensive calibration management service. The flexibility that this sort of engagement permits means that as well as having complete control of how long the analyser is kept in use (so that the monetary investment matches well with the revenue generated), different analysers options can be tried out. If one analyser model proves to not be as suitable as first expected, then an alternative can quickly be sought without any cost penalties being accrued.

www.livingston.co.uk
www.livingston.fr

Modular instruments from Keysight ensure measurement integrity and code compatibility across form factor and product lifecycle

By Allison Douglas – Market Development Manager, Keysight EMEA

In the Test & Measurement (T&M) industry today, there is a debate between T&M experts, equipment manufacturers and end-users: What is the best instrument form factor to achieve this test? As of today, this question spans across three form factors: benchtop, modular and handheld. Some related questions are also very often asked: What is the future of the T&M industry? Will everything go modular, or will benchtop instruments remain largely dominant as they are today? Contrary to what some T&M companies may tell you, "one size fits all" is a limiting value proposition.

Why? The answer lives inside your product lifecycle: test needs evolve from unbounded in R&D to just enough in manufacturing. Different situations benefit from best-fit platforms—hardware and software—that provide meaningful choices. There is no simple rule for choosing the best form factor to answer all customer situations. Each test system has its own requirements.

Keysight Technologies has taken the approach of providing a range of solutions across benchtop, modular, and handheld to meet the needs of all end-users, no matter what part of the product lifecycle you are in. All of these form factors utilize the same measurement science, resulting in measurement integrity across multiple platforms.

Your team can benefit from this approach by gaining confidence across the lifecycle, because Keysight's ongoing investment in measurement science ensures fully specified performance. This enhances your ability to optimize test in ways the support your technical and business objectives. The whole organization benefits: It becomes more efficient when successive groups see consistent measurement results throughout the lifecycle, from early R&D to manufacturing. The foundation of this is Keysight's commitment to measurement integrity.

Figure 1: Adding two-port PXI VNA modules to an existing test station enables powerful device characterization without expanding system height or footprint.

There are two new products that have been recently introduced to enhance Keysight Technologies' modular portfolio. Both leverage the measurement science from Keysight's existing benchtop portfolio to ensure measurement integrity and code compatibility across form factor and product lifecycle.

The first new modular series that has been introduced are one-slot PXI vector network analyzers that cover 300 kHz up to 26.5 GHz. The new M9370A series offer the best PXI VNA performance on key specifications such as speed, trace noise, stability and dynamic range. This enables the PXI VNAs to perform fast, accurate measurements and reduce the cost-of-test by enabling simultaneous characterization of many devices – two-port or multi-port – using a single PXI chassis.

As devices become increasingly complex, there is a need to easily characterize a full set of S-parameters on a large number of ports—8, 16, 24, or more. On the production line or in a wafer fab, there is a growing need to test multiple devices or multiple wafer sites at a single test station. Examples include cell phone handsets, military radios and increasingly dense silicon wafers. In these situations, one of the key needs is reducing the overall size of the test solution. When space is at a premium, full two-port VNA capability with S-parameters can be added to an existing system that has just one open slot. To address applications such as high-volume device testing and highly complex on-wafer testing, a single chassis can be loaded with up to sixteen PXI VNA modules for use as either multiple two-port VNAs, a single 32-port VNA, or any combination in between (Figure 1).

The PXI VNA uses the measurement science and calibration technology from the popular Keysight PNA vector network analyzers. The PXI models also provide a graphical user interface

that shares the familiar look-and-feel of the PNA family and eases the transition to PXI.

The second new introduction is industry's first signal analyzer to provide swept and FFT-based capabilities in the PXI form factor. The Keysight M9290A CXA-m PXIe signal analyzer delivers fully specified performance up to 26.5 GHz and provides best-in-class specifications in key areas such as sensitivity and dynamic range.

The CXA-m supports testing of components, boards and systems in a variety of applications, including military maintenance operations at the intermediate and depot levels. Example devices-under-test include radios such as those used in the military, public safety, avionics, radar, electronic warfare and satellites. The rich set of built-in measurement capabilities, including swept and FFT modes in the same instrument, accelerates tasks such as the identification of spurious signals and harmonics.

The CXA-m also reduces time and effort in system deployment. For example, it ensures seamless transitions between R&D, manufacturing and maintenance by providing 100-percent compatibility with code written for Keysight's X-Series signal analyzers and ESA spectrum analyzers. Ready-to-use drivers and SCPI commands simplify evaluation and programming.

To help ease the transition from benchtop to modular, the CXA-m has the same user interface as the X-Series signal analyzers. In addition, code developed on a benchtop MXA or PXA signal analyzer in R&D or design verification can be used with a PXI-based system that includes the CXA-m, and the code typically runs without modifications (Figure 2).

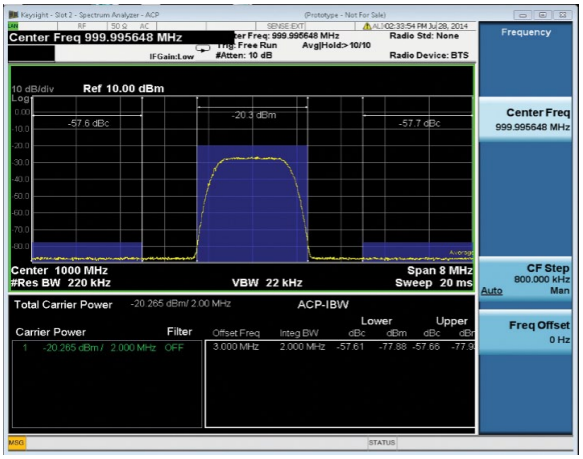

Figure 2. Power suite CXA screenshot.

With both of these new products, Keysight continues our commitment to bring you the best measurement science and integrity, across a range of form factors. By offering both benchtop and modular instruments, Keysight is proposing a consultative approach with its customers to find the best solution to meet their individual needs. By ensuring consistent answers across diverse platforms, we put you in the strongest position to first focus on what's needed and then optimize how to get there.

www.keysight.com

Wireless test set expands functional test capabilities and adds LTE-A category 7 support

Keysight Technologies has announced functionality enhancements to the E7515A UXM wireless test set including support for LTE-A category 7 data throughput, expanded functional test capabilities, and in-depth RF performance verification using the industry standard X-Series measurement applications. The UXM is an industry-leading wireless test set with a breakthrough system architecture and versatile touch screen. It is a highly integrated signaling test set created for functional and RF design validation in the 4G era and beyond.

The test set delivers uplink carrier aggregation support, enabling sustained bidirectional 300 Mbps/100 Mbps end-to-end IP data throughput, and boasts expanded functional test capability with support for VoLTE (including semi-persistent scheduling, multi-DRB and TTI bundling), handovers (including CSFB and SRVCC), connected mode DRX (for battery drain analysis), and in-depth protocol logging with new Wireshark-based logging software. Further, the UXM provides integrated X-Series measurement applications for RF design performance verification. The X-Series applications deliver trusted measurement science, a consistent user interface with the ability to troubleshoot and analyze issues using the X-Series' flexible measurement control.

Joe DePond, general manager of Keysight's Mobile Broadband Operation comments, "Coupled with the UXM's current downlink carrier aggregation, integrated fading and flexible receiver test capabilities, this new functionality demonstrates the UXM's ability to handle the challenging 4G test requirements of next-generation handsets and devices."

To keep pace with evolving wireless device designs, the UXM's future-ready architecture is built to handle the next advancements in antenna techniques, component carriers and data rates. With the industry-leading combination of two independent 100-MHz RF transceivers, the UXM enables multiple cells, carrier aggregation, MIMO up to 4x2, and integrated fading. It also provides built-in servers for extensive functional test applications. As device technologies change, the UXM can evolve as well: Its extensible architecture includes upgradable processors, multiple expansion slots, and high-speed interconnects.

Users can get up and running quickly with a versatile touch screen that features a new-yet-familiar interface based on popular Agilent instruments. Test teams can leverage their current libraries of test cases with backward-compatible SCPI commands.

www.keysight.com

Arveni offers free, open wireless protocol

Founded in 2007 as an engineering company developing micro energy harvesting solutions for building automation, French startup Arveni claims several patents on the assembly of very efficient piezoelectric-based battery-less switches.

Strong from the experience gathered with building automation partners as a consultant and R&D engineering company, Arveni is now launching a line of battery-less wall switches, able to remotely control a relay and timer receiver unit through a very low power radio link whose protocol it is making open source.

Dubbed SARAH for "SmArt RAdio by Harvesters for building automation", the open-source and collaborative radio protocol operates in the 868.3 MHz ISM band, relying on frequency modulation to deliver a communication range of 20 to 100 meters indoor. Drawing less than 0.3-W, SARAH is particularly light to operate but rugged enough to reliably send the short switch identifiers and on/off status messages to paired relays.

"When discussing with building automation system engineers, either coming from large groups such as Bouygues Construction, or from small and medium enterprises, all would beg for interoperability and access to the source code", recalls Martin from the days Arveni operated as a design office for equipment manufacturers.

"While there are already many radio protocols available for building control and automation systems, such as KNX, Z-Wave, EnOcean or ZigBee, all implemented under various product brands, the lack of interoperability between the different brands often locks building automation system installers into one brand, for the sake of simplicity", explains Martin.

"So when we looked at implementing light radio links for our own battery-less switches, after trying out many of the existing protocols on the market and figuring out all the incompatibility and cost issues, we decided to develop our own. The big difference is that we make SARAH free to use and open-source", says Martin. "We wanted to break free from monopolistic radio protocols that don't let you mix and choose the best parts from different vendors". With this approach, manufacturers can have full access to the source code and even tweak the radio protocol and run a different version for a specific need, as long as they keep it open and release their patched version back to Arveni.

In return, Arveni will manage a repository of all existing versions and their typical use cases, checking the new patches for interoperability while updating public code libraries for engineers to implement SARAH on any low cost and low-power radio chip from the likes of Atmel, STmicro, or TI to name a few examples.

Supporting data rates of 125 kbps, SARAH is a dynamic protocol with the data payload tuneable from 0 to 255 bytes. So the frame size can be increased in order to achieve sensor data communication, bidirectional communication and data encryption for example.

This length is indicated in the data frame before the actual payload so the relay listening to the message knows what to expect. A byte is also reserved for the manufacturer's ID. 80 µWs is needed for the first frame, then only 50 µWs for the following frames, and the messages are repeated 3 to 5 times for ruggedness.

Currently, Arveni offers a short- and a long-message version, together these implementations should cover about 70 to 80% of all applications according to the company.

pico Technology

PicoScope®

9341 20 GHz bandwidth, 4 channels in a compact USB instrument

European Microwave Week. Rome, Italy
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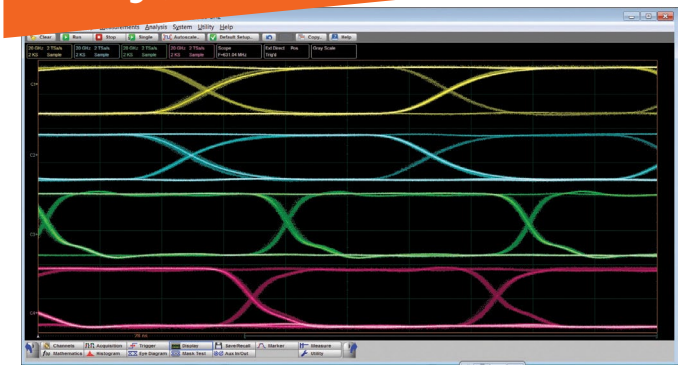

The PicoScope 9341 sampling oscilloscope offers 20 GHz bandwidth on four channels for engineers who need to characterise performance of multi-lane gigabit transmission systems, and check for channel-to-channel interference and compatibility.

In common with other 9300 series instruments the 9341 can perform eye-diagram analysis such as eye-width, eye-height, rise and fall-time, and jitter measurements. In addition pattern lock triggering, derived from bit rate, pattern length, and trigger divide ratio, can build up an eye pattern from a specified group of bits in a sequence which helps to isolate data dependent errors and sources of cross-channel crosstalk.

Eye Line mode uses the pattern lock feature to establish a pattern sync trigger, and then uses that trigger to walk through each bit of the data pattern which can be averaged for a precision view of specific bit trajectories. This allows pattern dependent effects to be investigated. For example, the trace leading to a mask violation can be captured and displayed.

20 GHz bandwidth

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• 11.3 Gb/s clock recovery
• Optical input 9 GHz typical

Integral signal generator: Pulse, PRBS NRZ/RZ, 500 MHz clock, Eye diagram, eye line, histograms and mask testing

www.picotech.com/RF339

How a monolithic RF controller facilitates Doherty amplifier use in more RF applications

By Naveen Yanduru, Ph.D. and Kinana Hussain, Peregrine Semiconductor

The best inventions open the door to unforeseen opportunities. In 1947, three AT&T researchers developed the transistor as a replacement for the problematic and unreliable vacuum tube. Little did they know that their work would be the foundation for modern electronics and would lead to the integrated circuit. Like the transistor, the internet arose for a particular application and has evolved. The internet was created during the Cold War to serve as a network of node-to-node communication in case radios and telephones were down. Fast forward to the modern day and imagine the world without the internet.

In 1936, William H. Doherty of Bell Telephone Technologies published a paper titled "A New High-Efficiency Power Amplifier for Modulated Waves." His paper detailed a clever solution for improving the efficiency of RF power amplifiers—a solution now known as the Doherty power amplifier. While the Doherty amplifier was created for use in broadband radio transmitters, it—as is the case in many great inventions—took off in an unforeseen arena.

Doherty could never have foreseen that his amplifier would rapidly increase in popularity with the introduction of WCDMA and LTE networks. Over the last few years, the Doherty amplifier has clearly dominated the wireless infrastructure equipment market, largely due to the architecture's ability to accommodate a high peak-to average ratio (PAR). With the advent of amplitude modulation in wireless and the worldwide rollout of LTE, the PAR can be around 9 dB. A Doherty configuration uses load modulation to allow for very high efficiencies to be achieved under back-off conditions. The back-off efficiencies are the key to keeping the overall system efficiency of the PA module high for LTE signals. Most wireless base stations implement a Doherty architecture as a way to improve PA efficiencies, especially when amplitude modulations are involved.

While the Doherty power amplifier is now widely used in the wireless infrastructure market, other markets and applications have avoided use of the Doherty configuration. This is largely due to the difficulties faced in Doherty amplifier optimization. Aware of the Doherty optimization challenges, Peregrine Semiconductor introduced a solution—a monolithic RF controller that enables alignment of the phase and the amplitude through a digital interface. This monolithic RF controller, UltraCMOS® MPAC (monolithic phase & amplitude controller), reduces the difficulties in Doherty amplifier optimization and makes the Doherty amplifier more simple and easy to use. In fact, MPAC (Figure 1) makes Doherty so simple and easy to use that the Doherty amplifier can potentially extend beyond the wireless infrastructure market and into more RF applications.

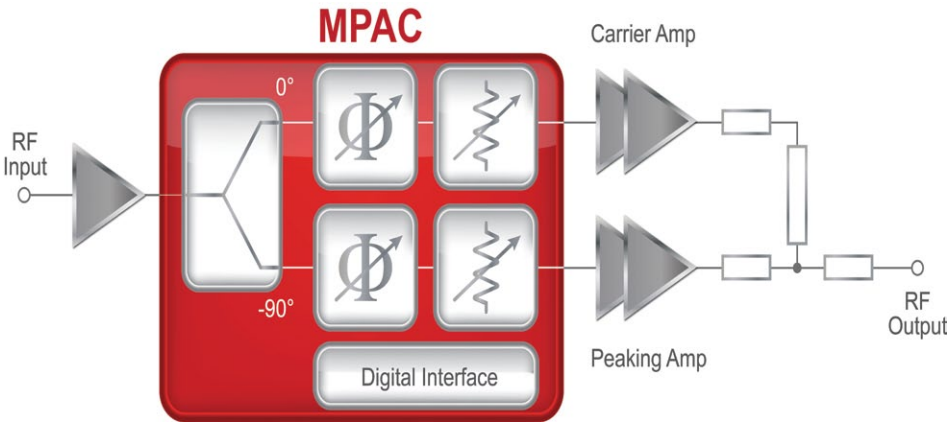

Figure 1: UltraCMOS® MPAC (monolithic phase & amplitude controller) enables alignment of the phase and amplitude between the Doherty amplifier's carrier and peaking paths through a digital interface.

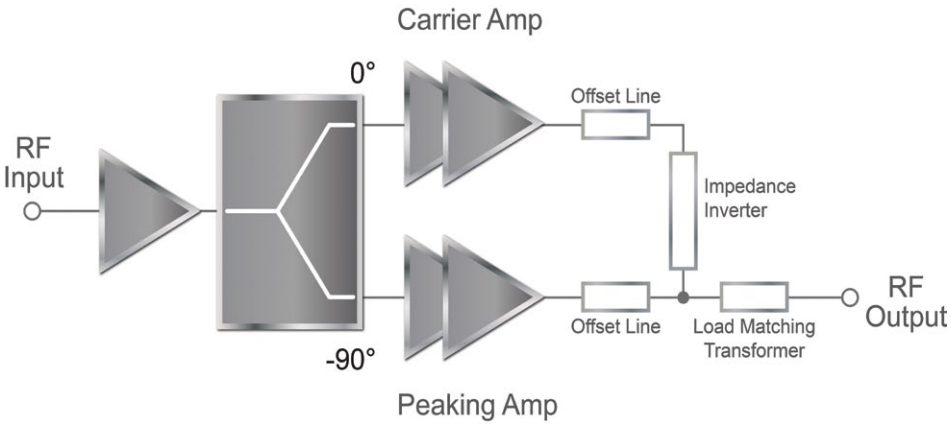

Figure 2: A Doherty power amplifier has a dual-path architecture that consists of a class AB carrier amplifier and a class C peaking amplifier.

The Doherty amplifier configuration

Before diving into Doherty optimization challenges and Peregrine's MPAC product, let's examine the Doherty amplifier's clever design. The Doherty amplifier has a dual-path architecture that consists of two amplifiers—a carrier amplifier and a peaking amplifier, as shown in Figure 2. The Doherty's two amplifier paths enable a significant

efficiency gain over traditional architectures. The carrier amplifier is a class AB amplifier designed for carrier signals. The peaking amplifier is a class C amplifier optimized for high peaks in the signal. Signals enter through a main RF input and are then split into zero- and 90-degree phases before they pass through the carrier and peaking paths within the amplifier. At the end, the signals are combined to form the output signal, essentially managing the phase and the amplitude into enabling a higher efficiency.

The architecture has an output-combining network, allowing for the carrier amplifier to see a higher impedance and thus experience higher voltage swings under back-off conditions. By showing a higher impedance to the carrier amplifier under these conditions, the carrier amplifier uses the available voltage headroom and works closer to saturation. A Doherty amplifier also keeps the class C peaking amplifier turned off under back-off conditions. As the power starts moving towards the peak power, the peaking amplifier turns on and the output Doherty network experiences load modulation. The carrier amplifier then sees a lower impedance than the high impedance it was presented in back-off conditions.

In a Doherty configuration, there are multiple components that make the amplifier both frequency and manufacturing sensitive. The output load-matching transformer is a quarter wave transmission line section with 35-Ohm characteristic impedance. The impedance inverter between the carrier and peaking amplifier is another quarter wave transmission line section with 50-Ohm characteristic impedance. Both of these transformers are frequency sensitive, along with the output matching networks of the peaking and carrier amplifier. Additionally, the offset lines, which are used to optimize the impedance at the output of each amplifier, are also frequency sensitive.

When the Doherty is designed for high PARs such as 9 dB, asymmetric configuration is used. In such configurations the peaking amplifier is larger than the carrier. The input drive strength control and phase balance become especially critical to realize the optimized asymmetric Doherty implementation.

Doherty amplifier optimization challenges

Anyone who's been tasked with implementing a Doherty power amplifier (PA) for a wireless base-station transmitter can attest to the challenges that lie in Doherty amplifier optimization. There are the manufacturing and frequency sensitivities, the manual tweaking of each module, the discrete components and their own variances, not to mention the lack of flexibility after optimization. For an engineer, it is a time-consuming challenge—time that is also an investment cost for the company.

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 overall performance. If the carrier and

peaking amplifier are not in sync, then the final output will not reach the output performance as designed. Today, most macrocell RF engineers manage this complexity using discrete components to tune the phase and amplitude for each one of the carrier and peaking paths. But discrete components come with their own set of manufacturing variances. For example, O4O2 or O6O3 surface mount components can easily vary, especially on the lower values of capacitance. Even if the engineer is using some kind of transmission line-based matching network, capacitance values can vary by up to 20-percent. The same is true with any micro-strip layers. As the engineer optimizes the amplifier for higher bandwidths, these variations eat into the margins and make the Doherty even more susceptible to manufacturing variations, given its propensity to be frequency sensitive already.

Using discrete components is a proven methodology, and it keeps the bill of materials (BOM) low because discrete components are cheap. On the other hand, the methodology requires substantial engineering time and expertise because optimization is both manual and laborious. Engineers must determine what the discrete component values are and how they need to be put on the board. Furthermore, once the discrete components are on the board, there is no flexibility to make changes for unexpected power-transistor variances. The RF engineer is left with no way to optimize the phase and amplitude.

Peregrine's monolithic RF controller—UltraCMOS MPAC

In June 2014, Peregrine introduced MPAC as the industry's first monolithic RF solution to optimize Doherty power amplifier performance. Built on Peregrine's UltraCMOS technology, MPAC independently adjusts the phase and the amplitude on the carrier and peaking paths. The single-chip system integrates a digital serial peripheral interface (SPI), two phase shifters, two digital step attenuators and a 90-degree splitter, that otherwise would have been a discrete component. For each one of the different paths, MPAC offers engineers maximum flexibility in adjusting the phase and the amplitude, allowing them to tune the carrier and peaking paths through the SPI.

MPAC eliminates the need for multiple discrete components and enables wireless-infrastructure vendors to improve system performance, lower cost, improve the overall product reliability and deliver maximum tuning flexibility for either LDMOS (laterally diffused metal oxide semiconductor) or GaN (gallium nitride) based Doherty power amplifiers.

With a wide phase shift range of 87.2° and a fine step size of 2.8° per path, MPAC delivers high linearity of 65 dBm IIP3 and extremely low power consumption of 300 µA. In addition, it can support 31dBm of peak input RF power and has high port-to-port isolation of 30 dB. With a 5-bit phase code sweep at 2.8° LSB (least significant bit), MPAC's single path relative phase has good accuracy and maintains monotonicity across the entire RF frequency range, as shown in Figure 3.

As MPAC is built on an UltraCMOS monolithic die, RF engineers can confidently trust the uniformity and manufacturing reliability of the UltraCMOS process. Only UltraCMOS technology enables intelligent integration—something GaAs technology can never achieve. If an MPAC-like solution were built on any other technology, such as GaAs, the result would be a multi-chip module held together by a myriad of bond wires. Additionally, 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 5.5V.

The first product in the MPAC family is the PE46120 (Figure 4). 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.

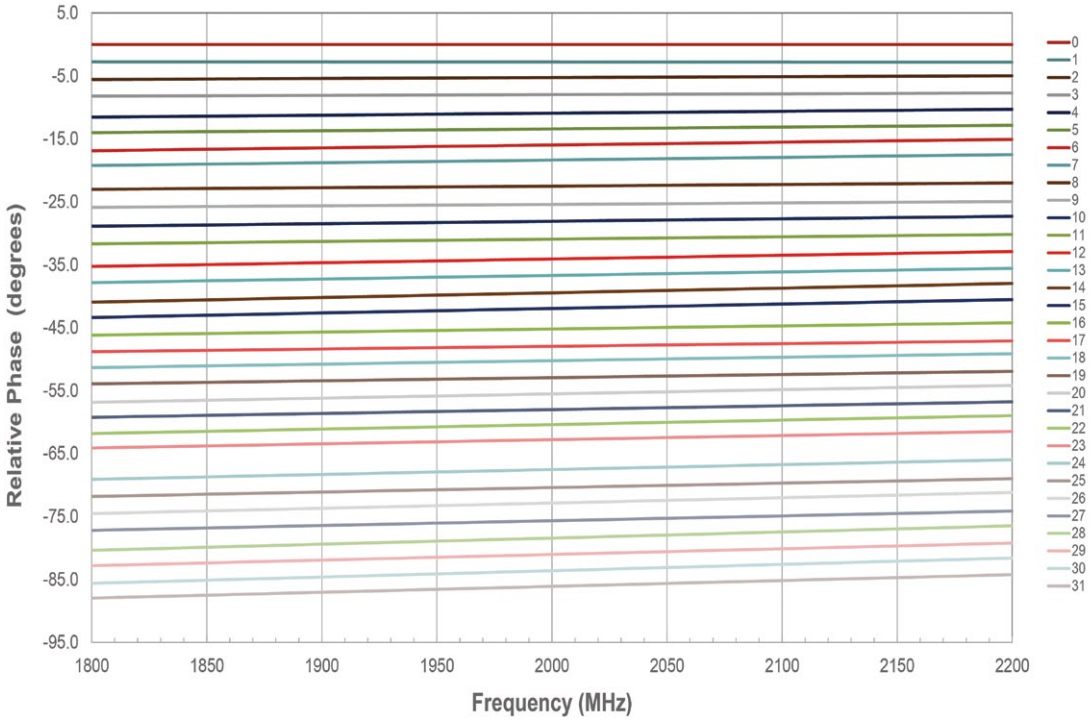

Figure 3: MPAC's single path relative phase maintains monotonicity across the entire RF frequency range.

Conclusion

While this paper has focused extensively on using MPAC for Doherty amplifiers, it is worth noting that MPAC can be used in optimizing performance for other dual path, dynamically load modulated amplifier architectures, such as LINC and Chireix amplifiers. Additionally, MPAC can be utilized for vector generation purposes in feed forward amplifiers, beamforming networks and dual polarized alignment/generation applications.

In conclusion, Peregrine's UltraCMOS MPAC effectively solves the challenges that engineers regularly face with Doherty power amplifier optimization. With MPAC, engineers no longer have to manually tweak each module, work with multiple discrete components and deal with inflexibility. MPAC

facilitates a simple and easy-to-use Doherty amplifier—an amplifier that can go beyond the wireless infrastructure market into other unforeseen markets and opportunities.

The authors

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Kinana Hussain is the senior marketing manager at Peregrine Semiconductor. He previously held multiple positions in engineering and management at Vitesse Semiconductor. Kinana earned an MBA from UCLA Anderson School of Management and a bachelor of science in electrical engineering from Cal State University, Northridge.

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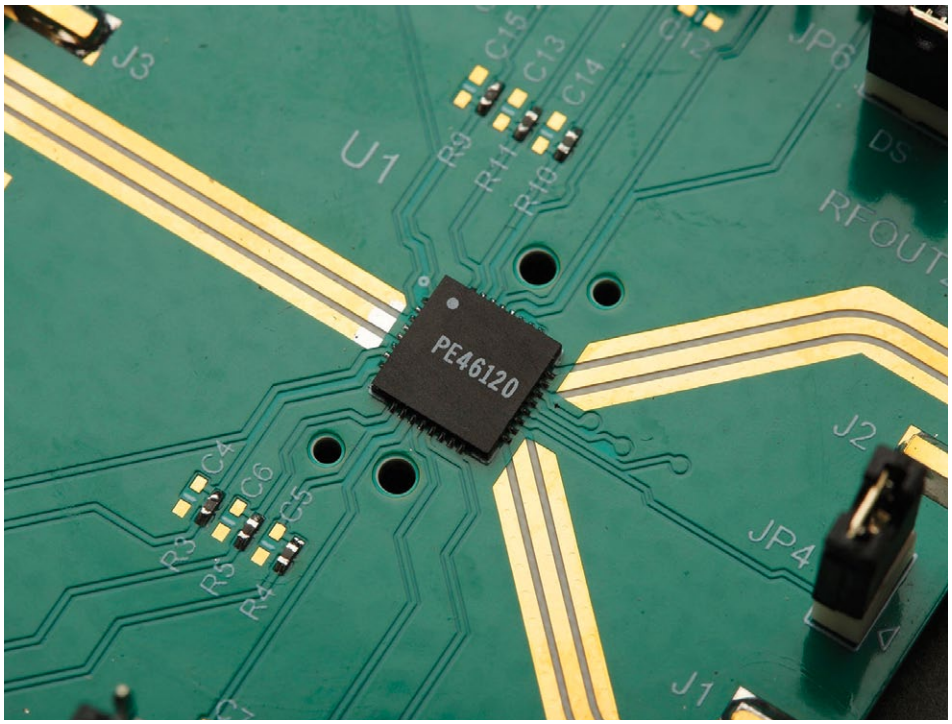

Figure 4: Currently being sampled to select customers, the PE46120 is the first product in the MPAC family.

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The right path — A look at path loss calculations for modules using the 2.4 GHz band

By Pradeep Shamanna, Microchip, www.microchip.com

The 2.4 GHz band has become a popular choice for short-range radio applications in homes, offices and factories. Usually, 2.4 GHz channels are part of unlicensed Industrial Scientific Medical (ISM) frequency bands. Many protocols such as ZigBee (IEEE 802.15.4), Bluetooth (IEEE 802.15.1), Wi-Fi (IEEE 802.11 b/g/n), Wireless Universal Serial Bus (WUSB), proprietary protocols (such as MiWi) and few cordless phones occupy this space. However, operation in the 2.4 GHz ISM band induces the radios to interfere with other protocols using the same spectrum.

It is important therefore to evaluate the range and performance of wireless transmission to create models for estimating the path loss for short range modules in indoor and outdoor environments to give designers an initial estimate on a wireless communications system's performance. The performance parameters include range, path loss, receiver sensitivity, bit error rate (BER) and packet error rate (PER), which are critical in any communications system.

To do this, consider three modules with varied specifications related to power and type of antenna – Microchip's MRF24J40MA, MRF24J40MB and MRF24J40MC. The MRF24J40MA is a certified 2.4 GHz IEEE 802.15.4 radio transceiver module with integrated PCB antenna and is suitable for wireless sensor networks, home automation, building automation and consumer applications. The MRF24J40MB is similar but better suited to longer range applications such as automatic meter reading. The MRF24J40MC has an external antenna (shown in Figure 1) and also suits longer range applications. All three connect to microcontrollers through a four-wired SPI interface and have various regulatory and modularly certified on board.

Path loss models

Large-scale models predict behaviour averaged over distances. The large-scale model is a function of distance and significant environmental features that are roughly frequency independent. This model exorbitantly breaks down as the distance decreases but is useful for modelling the range of a radio system and rough capacity planning. Small-scale (fading) models describe signal variability on a scale of one to one. They have dominating multi-path effects (phase cancellation). The path attenuation is considered constant but is mostly dependent on the frequency and bandwidth.

However, usually the initial focus is on small scale modelling with rapid change in the signal over a short distance or length of time. If the estimated received power is sufficiently large (typically relative to the receiver sensitivity), which may be dependent on the communications protocol in use, the link becomes useful for sending data. The amount by which the received power exceeds receiver sensitivity is called the link margin.

The link or fade margin is defined as the power (margin) required above the receiver sensitivity level to ensure a reliable radio link between the transmitter and receiver. In favourable conditions (antennas are perfectly aligned, no multi-path or reflections exist, and there are no losses), the necessary link margin would be 0 dB. The exact fade margin required depends on the desired reliability of the link, but a good rule of thumb is to maintain 22 to 28 dB of fade margin at any time. Having a fade margin of not less than 15 dB in good weather conditions provides a high degree of assurance that the RF system continues to operate effectively in harsh conditions due to weather, solar and RF interference.

The path loss due to propagation between the reception and transmission antennas is normally written in dimensionless form by normalising the distance to the wavelength. However,

Figure 1: MRF24J40MC modules with daughter board and external antenna.

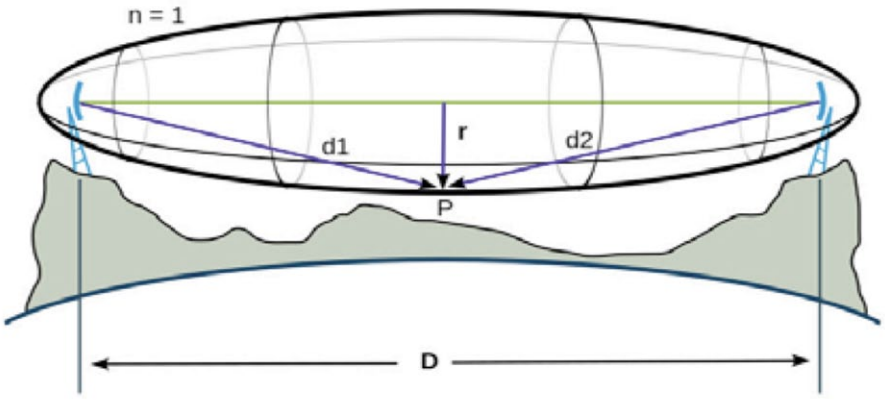

Figure 2: Fresnel Zone.

it is sometimes convenient to consider the loss due to distance and wavelength separately. In this case, it is important to track the units being used, since each choice involves a differing constant offset.

As an example, estimate the feasibility of a 1 km link (range) with RF nodes one and two of MRF24J40MB modules with 20 dBm output power. Node one is connected to an omnidirectional PCB antenna with 1 dBi gain, while node two is also connected to a similar PCB antenna with 1 dBi gain. The transmitting power of node one is 100 mW (or 20 dBm) and its sensitivity is -102 dBm. The transmitting power of node two is 100 mW (or 20 dBm) with a similar sensitivity as node one. The cables are short and are approximated with a loss of 1 dB on each side. Then add all the gains and subtract all the losses from the node one to node two link considering only the free space loss for a path loss of a 1 km link.

Since -60 dB is greater than the minimum receive sensitivity of node two (-102 dBm), the signal level is just enough for node two to communicate with node one. There is a 42 dB margin (102 dB - 60 dB), which is suitable for good transmission under good weather conditions, but may not be enough to protect against harsh weather conditions.

The path loss is the same on the return path. Therefore, the received signal level on the node one side is -60 dB. Since the receive sensitivity of node one is -102 dBm, this leaves a fade margin of 42 dB (102 dB - 60 dB). Additionally, there are losses due to environment (fading) even at LoS (line of sight) and could further reduce by 20 dB, which is within the requirement for communications without any additional gain.

Now let's substitute node two with an MRF24J40MA module with 0 dB gain (output power). Since the receive sensitivity of node one is -95 dBm, this leaves a fade margin of 35 dBm (95 dB - 60 dB). Additionally, there are losses due to environment (fading) even at LoS and can further reduce by 20 dB, which communicates only with some additional gain of 15 to 20 dB.

Fresnel Zone

The Fresnel Zone is the area around the visual LoS that radio waves spread out after they leave the antenna, as shown in Figure 2. It is good have the LoS to maintain strength, especially for 2.4 GHz wireless systems. This is because the 2.4 GHz waves are absorbed by water. The rule of thumb is that 60% of the Fresnel Zone must be clear of obstacles. Typically, 20% Fresnel Zone blockage introduces little signal loss to the link, and beyond 40% blockage the signal loss becomes significant.

It is important to enumerate the extent to which the Fresnel Zone can be blocked. Typically, 20 to 40% Fresnel Zone obstruction introduces little to no interference into the communications link. It is better to have an inaccuracy up to more than 20% blockage of the Fresnel Zone.

The propagation losses for indoors can be significantly higher in buildings because of obstructions such as walls and ceilings. This occurs because of a combination of attenuation by walls and ceilings, and blockage due to equipment, furniture and human intervention.

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Trees attenuate around 8 to 18 dB of loss per tree in the direct path. This attenuation depends on the size, shape and type of tree. A dry wood wall on both sides can result in about 6 dB loss per wall. Comparatively older buildings may have greater internal losses than new buildings due to materials and LoS issues. Concrete walls account to 10 to 15 dB depending on the size and shape of the construction. Floors in buildings account for 12 to 27 dB of loss. Concrete and steel floors attenuate more than wooden floors. Mirrored walls have very high loss because the reflective coating is conductive.

The Fresnel Zone is sometimes a good indication of an indoor environment range measurement. Generally, the LoS propagation is valid only for about the first 3 m. Beyond 3 m, the indoor propagation losses can go up to 30 dB per 30 m in dense office environments. Conservatively, it overstates the path loss in most cases. Actual propagation losses may vary significantly depending on the building construction, structure and layout.

Some of the possible reasons for propagation losses through the Fresnel Zone are collisions with other transmitters, weak error vector magnitude (EVM) from the transmitter generally in the range of 20 to 24% rms, and reflections from moving objects or people.

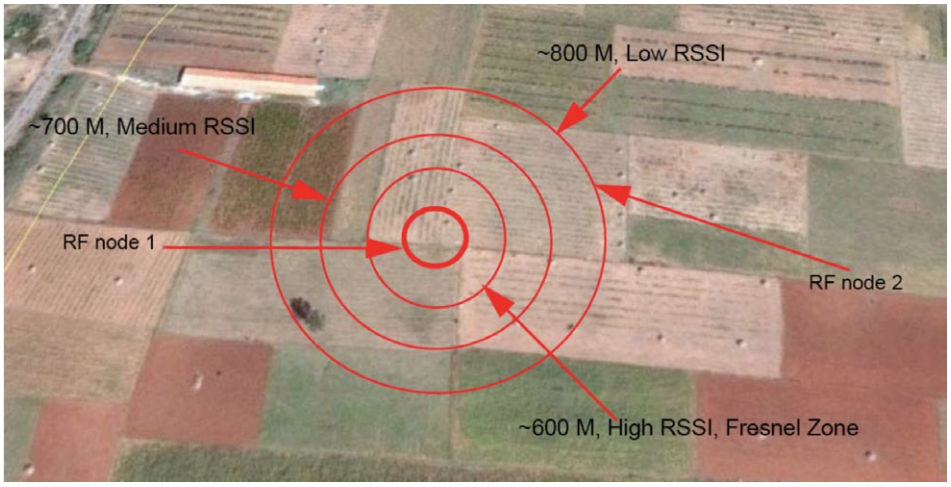


Figure 3: Location and distance in an LoS environment.

Figure 3 shows the received signal strength information (RSSI) in an LoS environment.

Conclusion

Take care when choosing the path loss model for predicting the RF system performance. Serious errors can occur by using the free space path loss (FSPL) model for most cases except few restricted cases. A more realistic model to use for urban environments is the ITU indoor propagation model.

For urban environments, the use of 10 to 12 dB is a good rule of thumb for predicting the required increase in the link budget to double the transmission distance. Receiver sensitivity is the first variable in a system that must be taken care of and optimised to increase the transmission distance. Other variables in any wireless system also affect distance but must be changed by a greater percentage to equal the effects presented by changing the receiver sensitivity.

Fading due to multi-path can result in a signal attenuation of more than 30 to 40 dB, and it is highly recommended that sufficient link margin is factored into the link budget to overcome this loss while designing a wireless system.

Mobile broadband operators scramble for VoLTE

Everybody wants LTE, and as the first wave of LTE deployments achieve coverage, VoLTE is the next big thing. VoLTE runs on IMS, and according to ABI Research, the market will total over $US30 billion through 2019 as it becomes widespread.

Leading infrastructure vendors such as Ericsson and Nokia are fully committed to VoLTE and IMS space and equip customers with this next wave in mobile broadband. Similarly, other vendors such as Alcatel-Lucent, Huawei, and Cisco recognize the impact VoLTE and IMS will have on the market. These vendors are active in the VoLTE space by offering credible solutions in order to attract and retain customers.

North American operators lead the way with VoLTE driven IMS deployments, closely followed by Western European operators. IMS deployments are on a rise and will be widely deployed over the coming years.

"4G LTE and VoLTE are the primary drivers for IMS on mobile broadband. ABI Research expects robust growth of VoLTE and IMS services over the next few years," comments research analyst Sabir Rafiq.

Apple's embrace of VoLTE with the iPhone 6 raises the bar and points the way for all device manufacturers to follow. "IMS mobile core revenue corresponds directly with the popularity of VoLTE," adds Rafiq.

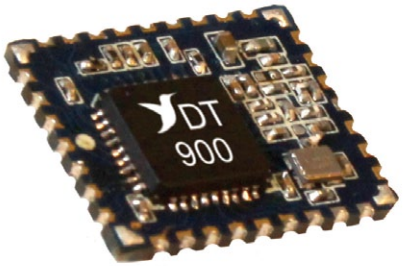
The deployment of LTE is fast-tracking and is the fastest growing mobile technology ever. Operators are focusing on LTE as part of their business strategy to lower the cost of operation and increase revenues with mobile broadband. With the availability of VoLTE smartphones, operators realize benefits with improving quality in voice service, and also top-line growth with value adding services.

This leads to increasing VoLTE services in smartphones, with Apple and high-end Android devices leading the way. VoLTE will become extremely important in the future and ABI Research believes competitive positioning will lead operators to VoLTE/IMS.

www.abiresearch.com

Wireless UART data transceiver

module combines low cost with frequency agility



Linx Technologies has released the HumDT™ series transceiver, designed with cost in mind from the start to appeal to OEMs who have a limited budget to incorporate RF for simple wireless data transfer.

At below $9 in volume, the Hummingbird platform claims to be the lowest cost complete wideband transceiver with microcontroller module on the market today. The HumDT™ is built on this platform and is designed for reliable wireless digital data transfer. It includes a frequency agile protocol and supports versions at 2.4 GHz and 900 MHz with a common footprint and pin out.

The frequency agile protocol repeats the packet on up to 4 channels, gaining some of the noise immunity of frequency hopping without the synchronization, timing delays and other overhead associated with FHSS solutions. The number of channels is configurable as well as which channels are used. The module automatically handles all of the over-the-air transactions, so no overhead is required by the user.

Like its namesake, the Hummingbird modules are tiny. At 11.5 mm by 14.0 mm, the HumDT™ uses advanced system on chip (SoC) technology to minimize the footprint and the number of components. It is designed for large-scale volume production, leading to a price that is nearly half that of similar modules, and making it cost competitive with discrete designs.

The HumDT™ transceiver has built-in networking with encryption. Each module can act as one of three components in the wireless network, either the Access Point that controls a network, a Range Extender to repeat messages and expand the range of the network, or an End Device. Each Access Point can be joined to up to 50 Range Extenders and End Devices. The Access Point also supports routing so that End Devices can talk to each other through the Access Point. All routing and network maintenance functions are automatically handled by the transceiver.

www.linxtechnologies.com

Broadband 18 GHz UltraCMOS® RF switches

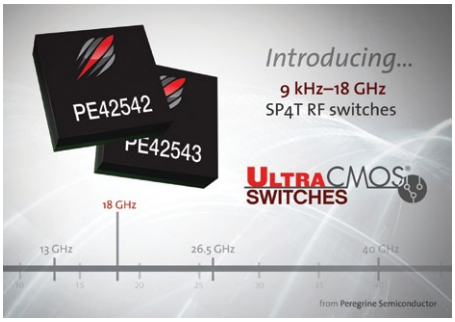
deliver better performance than GaAs

Peregrine Semiconductor has introduced the UltraCMOS® PE42542 and PE42543 18 GHz SP4T broadband RF switches — an expansion of the company's high-frequency portfolio launched in 2013 with the PE42520 and PE42521 SPDT 13 GHz switches. These latest devices represent the first RF SOI switches to deliver a high-performance alternative to incumbent gallium arsenide (GaAs) technology.

The company's latest switches uniquely offer test-and-measurement, wireless backhaul and military systems designers additional features, such as broad bandwidth, low-frequency power handling, high ESD protection and a fast settling time.

The UltraCMOS PE42542 and PE42543 18 GHz RF switches offer standard 1.8 V and 3.3 V input logic control and consistent performance across a wide, 2.3 V to 5.5 V supply range. For special RF requirements, PE42543 sports a fast switching time of 500 ns.

The PE42542 and PE42543 are single-pole four throw (SP4T) RF switches accommodating a frequency range between 9 kHz and 18 GHz and offering low-frequency power handling of 10 dBm at 9 kHz. The switches also offer consistent performance across a wide supply range with no drift in insertion loss and phase. Both switches feature 120-µA power-supply-current consumption, which is a fraction of what is required by competing GaAs switches.



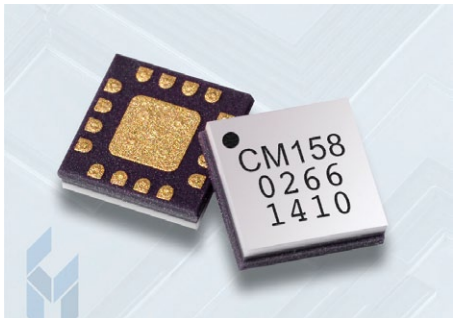
The PE42542 has a high linearity of 58 dBm IIP3 and 118 dBm IIP2, a fast switching time of 3 µs and a high ESD rating of 3.5 kV HBM, 150V MM and 500V CDM on all pins. Its fast settling time of 7 µs eliminates gate lag in test-and-measurement equipment.

The PE42543 has a high linearity of 59 dBm IIP3 and 113 dBm IIP2, a fast switching time of 500 ns, a fast settling time of 2 µs and a high ESD rating of 2.5 kV HBM, 150V MM and 250V CDM on all pins.

www.psemi.com

6 to 16 GHz driver amplifier

delivers 21 dB of gain



The CMD158C4 delivers 21 dB of gain across its bandwidth, while providing +21 dBm of saturated output power at a PAE of 24%. It operates from a single positive supply voltage of +5.0 V at 95 mA.

The amplifier is housed in a Pb-free, RoHs-compliant, ceramic 4 x 4-mm QFN surface-mount package. No external components are required for operation except the usual bypass capacitors on the VDD line.

Ideal applications for the CMD158C4 include point-to-point and point-to-multipoint radios, VSAT, LO driver amplifiers, and military applications.

www.CustomMMIC.com

Multi-octave spiral antenna

covers 1 to 18 GHz

A UK based designer and manufacturer of high specification microwave antennas, Steatite Q-par Antennas has released an ultra-small multi-octave wideband 1 to 18 GHz left and right hand circularly polarised spiral antenna suitable for applications where space and gain requirements are at a premium.

At a diameter of 78 mm, the QSP-RC-1-18-S-SG-R antenna provides excellent return loss, gain and axial ratio over the full 1 to 18 GHz operational band and is ideal for satisfying challenging applications which includes ELINT and

COMINT systems, radar warning receivers systems, and spectrum management antenna arrays.

Based on an SMA connector, the antenna handles 2-W power (c.w.) with a gain of 0 to 7 dBiC. Tyipical VSWR is <2.5:1. Maximum VSWR is 3.2:1. The antenna's 3-dB beamwidth is 20 to 112 degrees, while the 10 dB beamwidth is 111 to 181 degrees.

www.steatiteqpar-antennas.co.uk

Compact 100 W low PIM terminations

Enabling better networks and performance, MECA's latest compact 100 W low PIM terminations feature industry leading PIM performance of -165 dBc typical all while handling full rated power to +85°C.

All of the terminations cover 0.698 to 2.700 GHz frequency bands in 7/16 DIN, Type N and 4.1/9.5 (mini-DIN) connectors. Typical VSWR is 1.10:1, while minimum VSWR is1.20:1. The devices come in a compact package measuring 8.5 x 3.0 inches (21.6- x 7.6-cm).

www.e-MECA.com

CW amplifier operates 200-/250-W TWTs up to 18 GHz

The Model 200, CW TWT amplifier from Applied Systems Engineering has been designed to operate 200-/250-W traveling wave tubes up to 18 GHz. All power supplies are regulated, phase shifted resonant mode DC to DC converter designs operating at 50 KHz.

The TWT power supplies feature full load efficiency greater than 90%, and fast regulation loop response which provides minimal output variations at any PRF including non-periodic and burst PRF. Power supply and power line related spurious signals are below -50 dBc. The 4-line vacuum florescence display provides TWT amplifier status, operating and heater time, TWT cathode and collector voltages and helix and beam current. All parameters available at the front panel display are also available on the remote interface.

www.applsys.com

Qualcomm claims mobile industry's first LTE broadcast SDK

Qualcomm Technologies has announced the general availability of the LTE Broadcast Software Development Kit (SDK) through the Qualcomm Developer Network.

The LTE Broadcast SDK is designed to empower software developers to create applications that harness the unique benefits of LTE Broadcast connectivity and content delivery on LTE Broadcast capable devices featuring Qualcomm Snapdragon processors. Developers will be able to access a common application protocol interface (API) that can be used in all regions

around the world that are trialing, testing or deploying LTE Broadcast. The LTE Broadcast SDK claims to be the first development tool for LTE Broadcast in the mobile industry published for general availability and has been tested with multiple operators, OEMs, and application developers worldwide.

To support LTE Broadcast functionality on smart devices, Qualcomm Technologies offers a comprehensive LTE Broadcast solution for the evolved Multimedia Broadcast Multicast Service (eMBMS), which includes a Snapdragon processor, Qualcomm RaptorQ forward error correction technology, broadcast middleware, multimedia services and a proven interface for LTE Broadcast application development.

The LTE Broadcast SDK is designed, optimized and integrated for Snapdragon LTE capable processors. The SDK provides libraries, tools and documentation for the development and testing of software applications intended for mobile devices capable of delivering LTE Broadcast services. The open API set included in the LTE Broadcast SDK can be used by application developers for multiple OEMs and operators.

www.qualcomm.com

PXI reference system

for full characterization of next-generation PA modules

Keysight Technologies has announced a PXI Reference Solution for RF power amplifier (PA) characterization and test. The Reference Solution, which performs S-parameter, harmonic distortion, power and demodulation measurements, enables rapid, full characterization of next-generation power amplifier modules, such as a power amplifier-duplexer (PAD). It is optimized for high throughput and highly accurate measurement quality. The company claims this is the only small footprint, full characterization system for design validation and product test of the RF power amplifier, as well as all of the passive devices surrounding the power amplifier, such as filters and duplexers.

The robust digital pre-distortion (DPD) algorithms in the Reference Solution are built on years of close cooperation with wireless manufacturing customers and insights gained from Keysight's SystemVue simulation and N7614B Signal Studio for Power Amplifier Test software applications. This makes it capable of providing consistent measurements, from simulation to manufacturing, for next-generation power amplifier modules.

The proven DPD algorithms, with lookup table (LUT) and memory polynomial capability, complement the system's envelope tracking (ET) test capability. The Reference Solution includes fast waveform download, tight synchronization and automated calibration, critical for ET test. It supports multiple vendors, such as the Signadyne SD AOU-H3353 single-slot, high-speed PXIe AWG and enables the fastest envelope generation in the industry while reducing the test footprint.

The M937xA PXIe vector network analyzer and the M9393A PXIe performance VSA, enable the full characterization that customers need, including key high-density, high-speed S-parameter measurements and high-speed harmonics distortion testing up to 27 GHz.

www.keysight.com

Module combines WiFi, Bluetooth and NFC

For wireless in-vehicle applications such as rear-seat entertainment or internet connectivity for passengers, Berlin-based Lesswire AG has developed an automotive-grade radio module. The WiBear 11ac supports WiFi (802.11ac), Bluetooth 4.0 and NFC.

With PHY data rates up to 433 Mbps, the WiBear 11ac is suited to support HD video streaming to rear-seat entertainment screens. It provides a complete wireless modem solution that can be integrated into third-party vendors applications. For connectivity to a host processor, it is equipped with SDIO, high-speed UART and TWSI interfaces.

The SMD module is radio approved for Europe (CE) and the USA (FCC). Since the company also plans to sell it into industrial applications, an Industry Canada (IC) certification is pending. Other features include 64- and 128-bit AES hardware encryption engine for hardware-encrypted WAPI, as well as PCM and I2S interfaces for audio data.Automotive climatic, mechanical and operating life tests qualification according according to VW 80000 and ISO 16750-4 have been approved

www.lesswire.com

Smart Home radio chip

for remote controls

GreenPeak Technologies has launched the GP565 Smart Home radio chip for remote controls, that supports voice control, motion sensing and the latest ZRC 2.0 protocol.

Next generation remotes use RF instead of infrared (IR) and will be able to control all the home's Smart Home features — all from a single remote. The ZigBee ZRC 2.0 protocol enables a single remote control to control all the home's connected devices. Other ZRC 2.0 features include the 'Find My Remote' feature, which enables a remote control to start beeping and/or flashing when it is lost and making it much easier to find. It can be activated by a physical Find My Remote button on the home's entertainment system or Smart Home devices.The amplifier is housed in a Pb-free, RoHs-compliant, ceramic 4 x 4-mm QFN surface-mount package. No external components are required for operation except the usual bypass capacitors on the VDD line.

The GP565 is optimized for advanced yet low cost ZigBee RF4CE remote controls. It is available in two versions with 120k or 248k Flash (and 8k or 16k RAM) memory. The 40-pin footprint can support a keyboard scanner interface or other IO interfaces required for remote control implementations. Also the GP565 silicon provides reduced current consumption in combination with improved receiver sensitivity and output power. The company's patented Antenna Diversity technology enables superior range and WiFi/Bluetooth interference rejection.

www.greenpeak.com

Elevate Test Framework breaks the "Box" model of wireless testing

Spirent Communications has launched its Elevate Test Framework, a revolutionary advance in testing wireless and machine-to-machine (M2M) devices and services.

Elevate is a powerful network of resources designed to address the increasingly complex testing challenges and scale demands of the wireless industry. Providing a unique open test architecture, Elevate disrupts the status quo in test and measurement and delivers a higher level of testing that enables faster time-to-market and improved user experience.

With the rollout of complex wireless services and the surge in the number of smartphone and M2M devices, legacy test solutions are not able to support the increased complexity and time to market requirements. Services such as VoLTE (Voice-over-LTE) and RCS (Rich Communication Services) are exposing entirely new interoperability issues with commercial devices on live networks.

Spirent Elevate breaks the "box" testing model by separating hardware from software, making use of virtualization and organizing test elements and resources into an open architecture. The framework encompasses instrumentation, emulated and live services, an open API, automated and interactive testing, analytics that cross all phases of wireless device development, and shareable test results for comprehensive collaboration.

www.spirent.com

Network tester adds WLAN 802.11ac support

Aeroflex Limited has announced that the Aeroflex TM500 family of network test systems now supports the offload of live data calls between LTE and WLAN 802.11ac as well as 802.11a/b/g/n.

"Wi-Fi offload is becoming an essential way for mobile operators to balance the load on their networks and to proactively manage the increasing demands on network capacity for optimum user experience," said Evan Gray, product and marketing director of Aeroflex Limited. "The TM500 family is the industry-standard handset simulator used by leading operators and infrastructure vendors for performance benchmarking, and has developed a reputation for staying ahead with tracking the LTE ecosystem roadmap to provide advanced test capability ahead of market need."

The complete Wi-Fi offload test system comprises an Aeroflex E500 LTE Capacity Test System, including a real data service generator, Evolved Packet Core (EPC) for LTE/Wi-Fi, and Wi-Fi STA (station) systems.

www.aeroflex.com

Vector network analyzer

provides cost-efficient uni- and bidirectional measurements

Enabling users in RF component production to maintain high throughput while carrying out S parameter measurements on antennas and filters, the ZND from Rohde & Schwarz is an attractively priced vector network analyzer that is easy to operate.

The vector network analyzer features two test ports, and the base unit is designed for unidirectional measurements from 100 kHz to 4.5 GHz. Its easy-to-use options provide for flexible upgrades. The frequency range can be extended to 8.5 GHz, plus the instrument can be equipped for bidirectional measurements up to 4.5 GHz or 8.5 GHz. These functions can be locally activated.

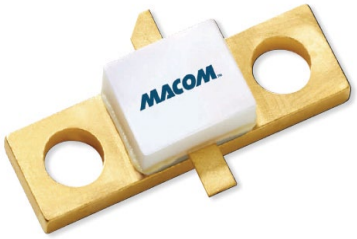
The ZND is perfect for production line measurements such as characterization of passive mobile phone components. The analyzer enables users to easily measure S-parameters such as S11 on antennas or S21 on filters.

The analyzer's large 30 cm (12.1") touchscreen and intuitive user interface make it especially easy to configure measurements and analyze results.

www.rohde-schwarz.com

15 W GaN on SiC pulsed power transistor

targets radar applications



Ideal for civilian and military radar pulsed applications, the MAGX-000035-015000 and MAGX-000035-01500S are gold-metalized unmatched GaN on Silicon Carbide RF power transistors optimized for a variety of RF power amplifier applications. The devices provide a typical 17 W of peak output power with 15.5 dB of power gain and 63% efficiency.

The transistors make an ideal driver stage for the company's higher power GaN transistors for L-Band and S-Band pulsed radar applications.

Operating between the DC-3.5 GHz frequency range, the devices are highly robust transistors with high voltage breakdowns and boast a mean time to failure (MTTF) of 600 years. The product is offered in both an enhanced flanged (Cu/W) and flangeless (Cu) ceramic package.

www.macom.com

Latching multi-throw coaxial switch

Teledyne Coax Switches introduces the CCS-19, a broadband multi-throw, electromechanical coaxial switch designed to switch a microwave signal from a common input to any 3, 4, 5, or 6 outputs. The CCS-19 is available in Commercial and Elite models which have temperatures ranges of -40° to +65°C and -55°C to +85°C respectively. The CCS-19 series will help reduce switch count for customers who are interested in latching multi-port systems.

www.teledyne-europe.com

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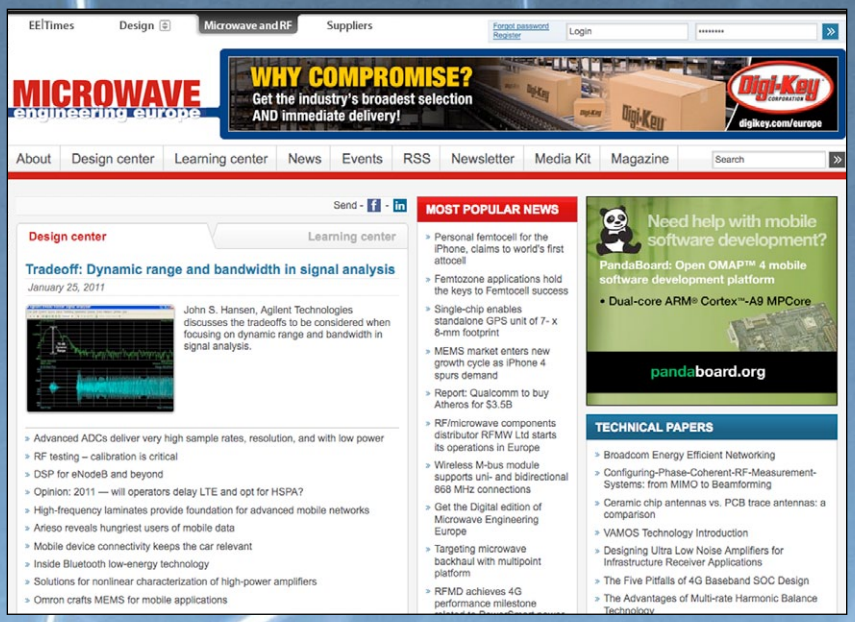

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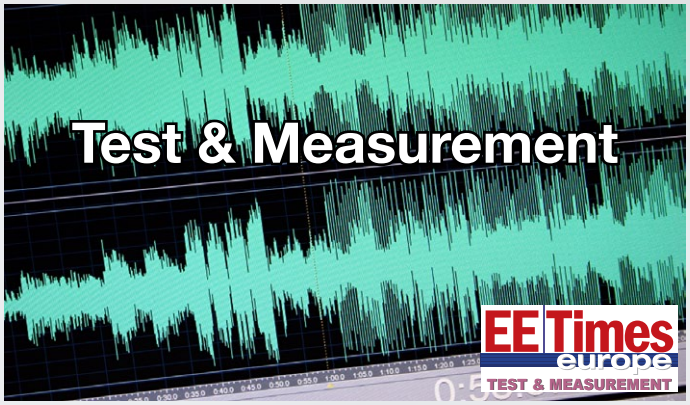

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