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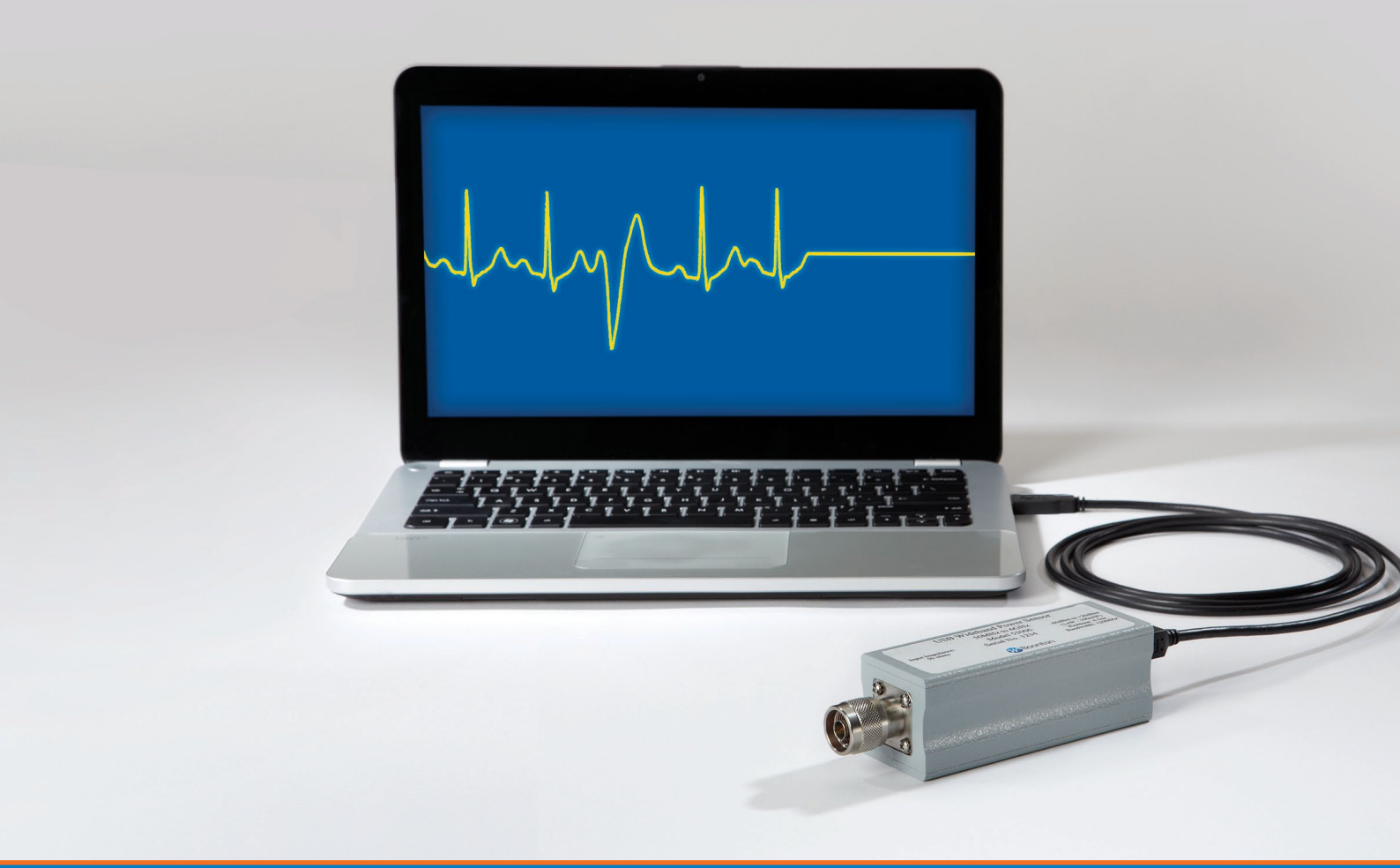

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Wireless set to change the face of Medicine

Wireless and smartphones are to change the face of medicine as we know it today, especially in monitoring and the way healthcare could be delivered. Some inroads have already been made and early example are emerging.

The sports and fitness market has benefited from a boom in wearable devices primarily designed to monitor physical parameters as well as some vital signs of the human body. As this area is not regulated, it has been free to develop products rapidly. However, this experiment is already leading researchers and designers to apply some of these principles to medicine.

By leveraging the smartphone, a relatively inexpensive and powerful computing device is available for processing and communicating data over global networks. Further, such devices are intuitive and can be used by anyone. The key here is to develop robust and reliable sensors that can deliver the patients data to the smartphone. Some major advantages of such an approach include the possibility of continuous monitoring, much lower costs than traditional purpose-built equipment, a global network that reaches into the patients home and can deliver data anywhere and anytime, and the ability to implant devices without invasive wires.

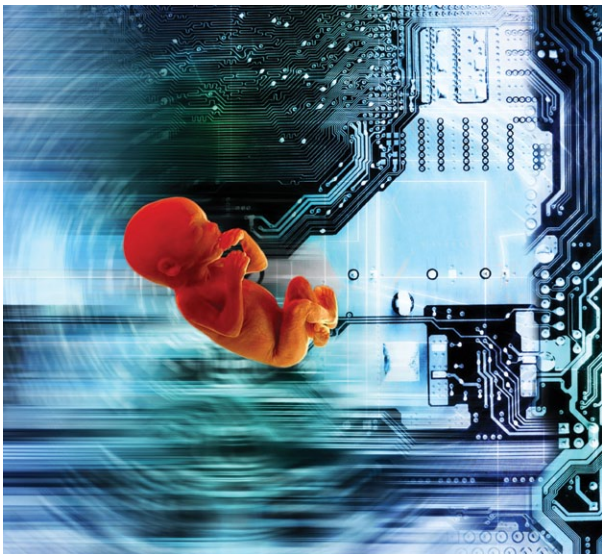
Could healthcare costs be kept in control by keeping as many patients out of hospital as possible? Two examples cited below show how progress is advancing even in the conservative and highly regulated hospital environment. Further as costs come down, high quality medical care taken for granted in developed countries will benefit more people in less developed countries.

Wireless pacemaker

One area that has already benefitted from wireless technology is that of hearing aids. However, the advantages offered to devices such as pacemakers are even more alluring.

Although traditional pacemakers pose minimal risk, patients are still vulnerable to some complications. These can stem from the pulse generator implanted under the skin of the chest, where infections or skin breakdown can occur, and particularly from the leads, or wires, that run from the generator through a vein to the heart. Leads can break, dislodge or contribute to a vein blockage.

To help address these issues, a small, wireless self-contained pacemaker made by Nanostim Inc., appears safe and feasible for use in patients, according to a small study in the American Heart Association journal Circulation. The pacemaker has no leads, its pulse generator lies within the unit in the heart, and is placed without the need for surgery.



At 6 millimeters in diameter and about 42 millimeters long, the wireless device is smaller than a triple-A battery. It's faster and easier to implant than traditional pacemakers, and it's programmed and monitored similarly, according to Vivek Y. Reddy, M.D., lead author of the study and director of the Cardiac Arrhythmia Service at Mount Sinai Hospital in New York City.

"While a much larger study is required to prove this, one may expect the leadless pacemaker to be associated with less chance of infection and lead-related problems such as lead fracture," Reddy said. "Overall, the self-contained pacemaker is a paradigm shift in cardiac pacing."

The device is a self-modulating pacer guided into place using a catheter inserted in the femoral vein and is affixed to the heart in the right ventricle, the same place a standard lead would be located. The device is for patients who require single-chamber pacing, or roughly 20 percent to 30 percent of U.S. and European patients who need pacemakers.

Smartphone app oximeter

LionsGate Technologies (LGTmedical), a Vancouver-based social enterprise, has secured its first major financial backers to scale up development of the Phone Oximeter™, an app and medical sensor that turns a non-specialist, community-level health worker's smartphone, tablet computer or laptop into an affordable and simple but sophisticated medical-grade diagnostic tool typically available in the developing world only in some hospitals.

The Phone Oximeter offers hope of preventing thousands of deaths and improving the health of expectant mothers, newborns and children throughout the developing world.

Developed by scientists Drs. Mark Ansermino, Guy Dumont and Peter von Dadelszen of the University of British Columbia, the device measures blood oxygen levels through a light sensor attached to a person's fingertip. This technique is known as pulse oximetry.

The Phone Oximeter™, using a predictive score, can accurately identify an estimated 80% of cases of pregnant women at risk of life-threatening complications due to high blood pressure. The condition, pre-eclampsia, is one of three leading causes of maternal mortality. Each year, about 76,000 of an estimated 10 million pregnant women worldwide who develop pre-eclampsia die from it and related complications.

The number of fetus and infant deaths due to these disorders is estimated at more than 500,000. "That equates to over 1,600 deaths of pregnant young women and babies every day - an unacceptable burden - and more than 99% of these deaths occur in developing countries - an issue of social justice," said Dr. von Dadelszen.

The Phone Oximeter™ can also reveal dangerously low oxygen levels in patients with pneumonia, which kills more than 1 million children annually.

The $40 target price will make it 80% less costly than any other device capable today of meeting high-level medical standards.

By Jean-Pierre Joosting
Editor: Microwave Engineering Europe

Stretchable antenna developed for wearable health monitoring

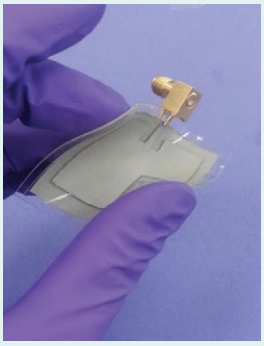
North Carolina State University researchers have developed a stretchable antenna that can be incorporated into wearable technologies, such as health monitoring devices.

One of the key requirements of the project was to develop an antenna that could be stretched, rolled or twisted and always return to its original shape, because wearable systems can be subject to a variety of stresses as patients move around.

To create an appropriately resilient, effective antenna, the researchers used a stencil to apply silver nanowires in a specific pattern and then poured a liquid polymer over the nanowires. When the polymer sets, it forms an elastic composite material that has the nanowires embedded in the desired pattern.

This patterned material forms the radiating element of a microstrip patch antenna. By manipulating the shape and dimensions of the radiating element, one can control the frequency at which the antenna sends and receives signals. The radiating layer is then bonded to a "ground" layer, which is made of the same composite, except it has a continuous layer of silver nanowires embedded.

Further, it was demonstrated that while the antenna's frequency does change as it is stretched (since that changes its dimensions), the frequency stays within a defined bandwidth. Consequently, the antenna will still communicate effectively with remote equipment while being stretched. When the antenna returns to its original shape it was found to still work even after it had been significantly deformed, bent, twisted or rolled.



Credit: Amanda Myers, co-author.

"Our technique is relatively simple, can be integrated directly into the sensors themselves, and would be fairly easy to scale up," says Dr. Yong Zhu, an associate professor of mechanical and aerospace engineering at NC State and senior author of a paper describing the work.

www.ncsu.edu

Anite joins test project for 4G and 5G technologies

Anite is participating in a project initiated by Intel to develop "virtualised" testing environments in order to accelerate 4G and 5G technology development and testing.

Project Virtuoso (Virtualised environment for communication system development and optimisation), subsidised by the Danish High Technology Foundation, will run for four years and other partner companies include Telenor, one of the world's major mobile operators, and Aalborg University Department of Electronic Systems, who will bring valuable operator and research knowledge.

Within this project, Anite aims to enhance its Virtual Drive Testing Tools (VDT) to utilise data measured in the field to "virtually" recreate the field test environment in a laboratory. This enables quick, realistic and repeatable benchmarking of devices or base stations as well as simplifying the debugging of errors found in the field.

VDT, based on the Propsim channel emulator, is a performance testing toolset which enables chipset and device manufacturers, as well as operators, to reduce the time and money spent on device design, integration and verification. By significantly enhancing the feedback loop from final-stage field trials to early-stage design development, the industry is able to accelerate development and launch of new mobile technologies.

www.anite.com

M2M satellite comms market to grow over 50% by 2019

A recent study by MarketsandMarkets reports that the global M2M satellite communication market is expected to grow from $2,983.4 million in 2014 to $4,763.4 million by 2019, at an estimated compound annual growth rate (CAGR) of 9.8% from 2014 to 2019.

Increasing data communication need, rising M2M applications, and fast return on investments is leading to the creation of more and more avenues for M2M satellite market. With the advent of cloud applications in almost every other vertical, M2M satellite communications can offer enormous opportunities for the development of such solutions and services. Indeed, the application of M2M satellite communication across different verticals has created lots of opportunities for cloud-based solution providers.

Transportation and logistics has the major market share in the vertical and is expected to grow in the forecast period.

www.marketsandmarkets.com

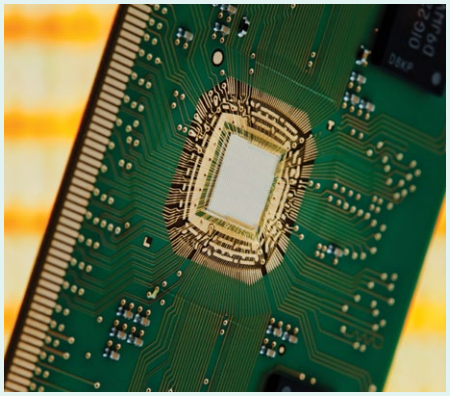
64-bit mobile processors to dominate in 2018

With the introduction of A7, Apple has once again shaken the whole mobile industry, forcing chipset suppliers and device vendors to make 64-bit chips a high priority in their roadmaps. Just one quarter after the launch of the A7, the first 64-bit mobile processor, the company managed to power more than 36 million iPhones and iPads with this chip.

Intel, Marvell, MediaTek, Qualcomm, and Nvidia all announced their first 64-bit mobile processors at Mobile World Congress this year but 64-bit-compliant smartphones are unlikely to hit the market before the release of the next Android update, expected in the second half of the year. By the end of 2014, ABI Research expects shipments of 64-bit mobile processors to exceed 182 million, of which only 20% will power Android devices. ARM will be the dominant instruction set for 64-bit mobile processing over the forecast period.

www.abiresearch.com

Fast energy-saving microchip for 5G radio networks



The Center for Advancing Electronics Dresden (cfaed) has introduced the second iteration of its power-optimized Tomahawk microchip. The little axe is described as "very fast, energy-saving and resilient". According to cfaed, an institute of the Dresden Technical University, the device is designed to interconnect heterogeneous components. Applications could be in the car-to-x context, as well as in the Internet of Things.

The Tomahawk 2 prototype aims at what the Dresden scientists call the "tactile internet". It can transfer large quantities of data in real-time and enable innovative application - for example, it enables cars to automatically react to changes in road conditions, because the vehicles could be connected through sensors. This description hints to potential applications in a car-to-car communications environment.

Other potential application fields are telemedicine and e-learning, or augmented reality applications such as Google Glass. "This is the next step of the digital revolution", said Gerhard Fettweis, professor and holder of the Vodafone chair at TU Dresden. He added that he believes the technology represented by the Tomahawk chip can be implemented from 2020. A requirement for its deployment is the availability of very powerful mobile networks. In the development of 5G mobile networks, the Dresden university will closely collaborate with the London Kings College and the University of Surrey.

www.cfaed.org

Big data analytics needed as mobile traffic goes parabolic

Mobile Network Operators (MNOs) main use of collecting subscriber and network data is to be able to produce valuable insights on customer experience, customer behavior and network performance.

But there is so much more operators can do to make accurate business decisions that generate more revenue, fight competition, and build on customer quality of experience (QoE).

Research analyst, Sabir Rafiq comments, "MNOs and Communication Service Providers (CSPs) are actively looking into Big Data and Analytical solutions. They need tools that can impact their businesses and find new ways to reduce costs, improve efficiency of the networks, increase and generate new revenue streams, and increase QoE."

Rafiq continues, "Big Data Analytics are no longer the exclusive province of IT Software, as leading telecom vendors such as Astellia, Ericsson, Nokia Solutions and Networks, and Huawei have stepped up. Software vendors, including Citrix and Guavus, offer big data and analytical solutions to help telecoms collect and analyze data effectively."

Key aspects of a successful mobile big data analytics offering include the ability to easily identify the key data sets, hook them efficiently and retain relevancy. The most successful implementations will start with a clear understanding of the project goals and will be tailored to individual needs. It is imperative that Telcos and Telecom providers understand that it is not one-size-fits-all but they take a more customer-defined and results-driven approach.

www.abiresearch.com

Axell Wireless installs DAS system at World Trade Center

Axell Wireless is supplying the public safety communications system for the new World Trade Center complex in New York City, including One World Trade Center, the tallest building in the U.S. at 1776 feet and the fourth tallest in the world.

The deployment is the largest public safety system installed by Axell and will cover One World Trade Center, implemented by TechMer and Axell Wireless. It will also cover the surrounding buildings including the World Trade Center HUB, Pavilion, Vehicle Security Center Roadway (shopping malls and transportation center for the complex), Museum and Memorial, implemented by Pinnacle Wireless and Axell Wireless.

The integrated public safety system includes Axell Wireless' optical master unit (OMU) fiber head end units, directional couplers, VHF filters and distribution amplifier packages covering 88 channels for UHF, VHF, and 800 MHz frequency bands. The high-speed system involved laying over 5 miles of high-capacity optical fiber to create the largest public safety system in the USA.

www.axellwireless.com

IoT to drive growth for German sensor industry

A positive overall industry outlook for the sensor and measuring industry has been published by Berlin-based Association for Sensors and Measurements (AMA). Across the industry, R&D investment is expected to grow further. And so will the headcount.

A survey among the 480 AMA member companies reveals an average sales growth of 3%. For the year ahead, they expect an even better result of 7% on average. Investment into research and development averaged at 10%. Overall investments are expected to increase by 8%. The main growth driver for sensors is the internet of things (IoT) and its specific manifestation in the German manufacturing industry, dubbed 'Industrie 4.0"

www.ama-sensorik.de/en

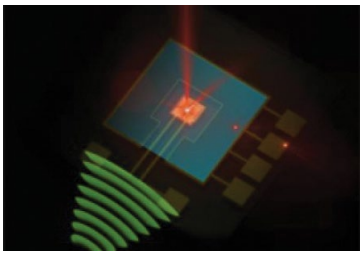
Lasers allow ultra-sensitive detection of radio waves

When detecting radio waves, 'noise' in the detector of the measuring instrument limits how sensitive and precise the measurements can be. Researchers at the Niels Bohr Institute have developed a method where they can avoid noise by means of laser light and can consequently achieve extreme precision of measurements.

'Noise' in the detector of a measuring instrument is first and foremost due to heat, that causes atoms and electrons to move chaotically, so the measurements become imprecise. The usual method to reduce noise in the detector of the measuring equipment is therefore to cool it down to 5-10 degrees Kelvin, which corresponds to around -265 °C. This is expensive and still does not enable the weakest signals to be measured.

"We have developed a detector that does not need to be cooled down, but which can operate at room temperature and yet hardly has any thermal noise. The only noise that fundamentally remains is so-called quantum noise, which is the minimal fluctuations of the laser light itself," explains Eugene Polzik, Professor and Head of the research center Quantop at the Niels Bohr Institute at the University of Copenhagen.

The method, called optomechanics, is a complex interaction between a mechanical movement and optical radiation.



Artists impression by Mette Høst.

The experiment comprises an antenna, which picks up the radio waves, a capacitor and a laser beam. The antenna picks up the radio waves and transfers the signal to the capacitor, which is read by the laser beam, i.e., the capacitor and the laser beam make up the detector. However, the capacitor is not an ordinary pair of metal plates.

"In our system, one metal plate in the capacitor is replaced by a 50 nanometer thick membrane. It is this nanomembrane that allows us to make ultrasensitive measurements without cooling the system, explains Research Assistant Professor Albert Schliesser, who has coordinated the the experiments in Quantop's optomechanical laboratory at the Niels Bohr Institute.

He explains that the capacitor is made up of three layers. At the bottom is a chip made of glass with a layer of aluminum, where the positive and negative poles are. The nanomembrane itself is made of silicon nitrate and is coated with a thin layer of aluminum, since there has to be a metallic substance to better interact with the electric field. The chip and the membrane are only separated by a micrometer.

The radio wave signal produces fluctuations in the membrane, which in turn enables the signal to be read optically using a laser beam. This is done through a complex interaction between the membrane's mechanical fluctuations, the electrical properties of the metallic layer and the light that is hitting the membrane.

www.nbi.ku.dk/english

Wearable ring for gesture control

In the spirit of Lord of the Rings, could a ring, in this case a clever piece of technology, become a powerful tool for controlling everything.

Ring from Logbar Inc., CA is a wearable input device that lets the user perform a multitude of tasks such as gesture control of smart appliances and devices, send texts, pay bills and so on. The company is currently running a kickstarter campaign and to get the device mass produced, with shipping expected to start in 2014.

Ring uses a Bluetooth Low Energy signal to connect to smart devices. Basically Ring detects the movement of the finger that is inside and identifies the gesture being made. Gestures can be performed anytime and anywhere. A lot of the companies IP is in the development of this gesture recognition technology with a particular focus on the accuracy of recognition and power consumption.

The device provides four functions: a gesture control function to control home appliances and apps; texting where gesturing of letters in the air enables the user to write a text; payment information transmission to settle payment of bills with a single gesture; and a receive/alert function to detect incoming transmissions/alerts through built-in vibration and LED.

Each application has its own unique gesture mark and is activated when the user performs the designated action. Gestures can also be edited and customised via a smartphone or tablet.

Ring uses precise letter recognition software called Ring Font that enables users to type letters anywhere, anytime. This enables the use of Twitter, Facebook, or other social network features, sending of texts, and even changing the station on the TV, by performing a simple gesture.

To control appliances and devices Ring connects via Bluetooth directly or via Hub pairing. Hub is basically a routing device that enables the sending and receiving of Infrared or WiFI signals to connect Ring to devices that do not support Bluetooth.

Ring supports payments using IBeacon or GPS to enable fast payments at participating retails stores, restaurants and even between individuals. It supports direct number payment that only requires tracing a number with a finger or checkmark payment that allows quick payments by gesturing a checkmark.

Currently, Ring has been tested with the iPhone, iPad, Andorid, PCs and wearable devices such as Google Glass and smart watches, home control devices, web services including Twitter, Facebook, Evernote, amongst others, and iOS native apps.

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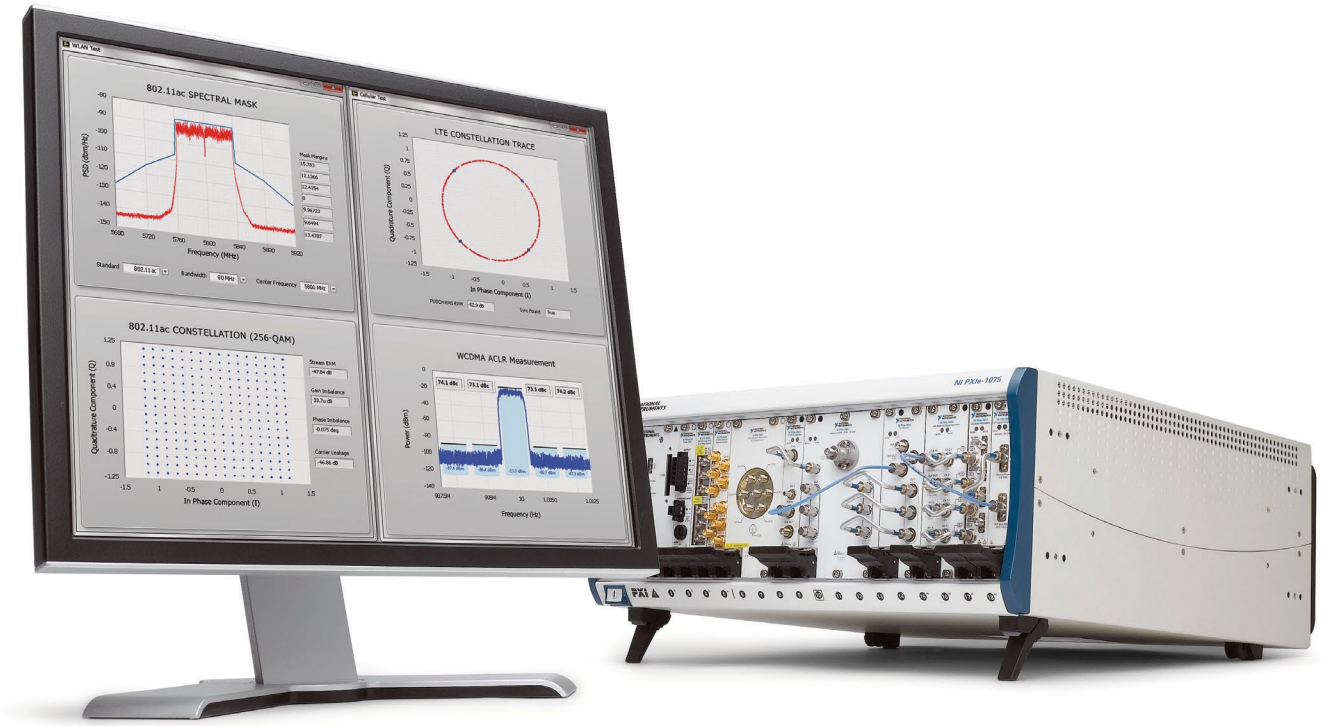

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Real-time calibration of gain and timing errors in two-channel time-interleaved A/D converters for software defined radio applications

By Djamel Haddadi, Integrated Device Technology, Inc.

The explosion of mobile data is driving new receiver architectures in communication infrastructure in order to provide higher capacity and more flexibility. These next generation software defined radio systems are based on power efficient RF A/D converters (RF-ADCs) capable of sampling at the antenna while delivering high dynamic range. Such ADCs are designed in very advanced CMOS technologies using time-interleaved (TIADC) architecture to achieve very high sample rates [1]. This architecture suffers from time-varying mismatch errors [2] that necessitate real-time calibration. This article describes a novel background calibration method for gain and timing mismatch errors through low complexity digital signal processing algorithms.

Mismatch errors in two-channel TIADC

An efficient way to double the speed of an ADC is to operate two ADCs in parallel with out of phase sampling clocks. The unavoidable small mismatches between the transfer functions of the sub-ADCs result in spurious tones that significantly degrade the achievable dynamic range. There are four types of error in this kind of ADC:

- DC offset error,
- Static gain error,
- Timing error,
- Bandwidth error.

The DC offset error is very simple to handle in practice through digital calibration. The bandwidth error is the most difficult to manage and it is usually mitigated through careful design and layout. In this article we will focus on gain and timing error calibration as they are the major contributors to dynamic range loss.

Proposed calibration method

In practice the Nyquist bandwidth of an ADC is never fully used, and a fraction of it is usually dedicated to the roll-off of the anti-aliasing filter. This free band is exploited to inject a constrained calibration signal. A sine-wave is selected for calibration as it is easy to generate with high spectral purity on which two main constraints are imposed:

1: The amplitude is kept small enough to avoid any impact on the dynamic range while providing enough estimation accuracy. Experiments show that -40 dBFS to -35 dBFS level range provides the best tradeoff for a 14-bit ADC.

2: The frequency is limited to the following discrete values in order to reduce the complexity of the digital signal processing algorithms:

$$F_{cal} = \frac{2P + S}{8K} F_s \qquad \text{(Equation 1)}$$

Where Fs is the TIADC sampling frequency, P, K are unsigned integers and S=+-1 depending on the location of the calibration signal with relation to the edge of the Nyquist zone (see Figure 1). This signal can be easily generated on-chip with a fractional-N PLL using the clock of the ADC as a reference signal. By choosing K high enough, the harmonics of the calibration signal will alias outside the useful band which relaxes their filtering requirements. The swing adjustment can be achieved with a programmable attenuator placed at the output of the PLL.

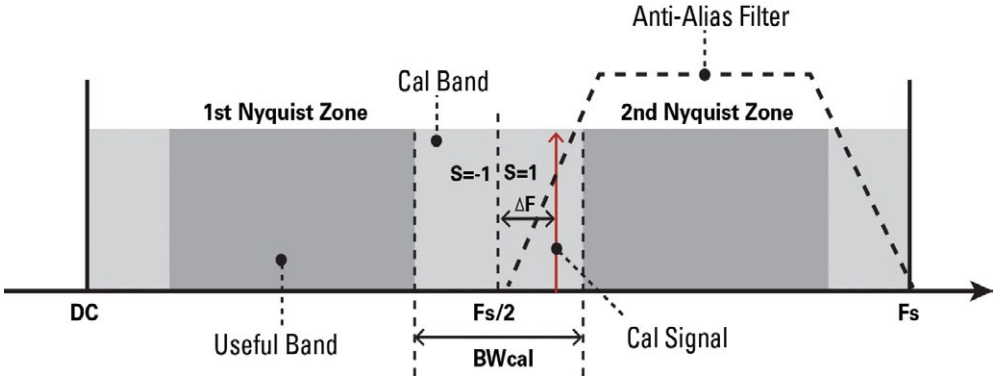

Figure 1: Frequency plan showing the location of the calibration signal.

If x0 and x1 denote the outputs of the two sub-ADCs with the calibration signal as input, it can be shown using Equation 1 that these two signals are linked by the following expression (the noise has been ignored):

$$x_1(n) = h_0 x_0(n) + h_1 x_0(n - K) \qquad \text{(Equation 2)}$$

The coefficients h0 and h1 of this linear filtering formula are related explicitly to the gain g and timing Δt errors by:

$$\begin{cases} h_0 = g\cos\theta,\ h_1 = S(-1)^{P+1} g\sin\theta \\ \theta = \omega_{cal}(1+d), \omega_{cal} = \pi\dfrac{2P+S}{4K}, d = \Delta t F_s \end{cases} \qquad \text{(Equation 3)}$$

This nonlinear set of equations can be linearized and inverted by using a first order approximation, given the fact that the mismatch errors are kept small by design.

The estimation algorithm consists of three steps:

1: The calibration signal is extracted and cancelled from the output of the sub-ADCs using an LMS algorithm, yielding the discrete-time signals x0 and x1. This algorithm requires a digital cosine/sine

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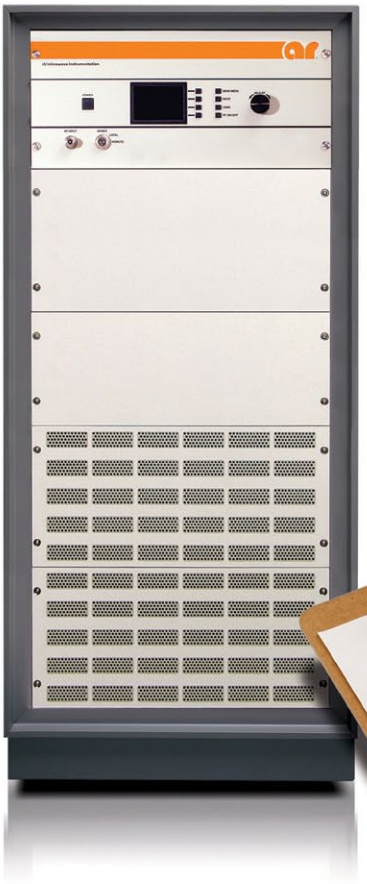

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reference signals at the calibration frequency. The cosine signal is generated with a small Look Up Table (LUT) of size 4K (K < 64 in practice). The sine signal is derived from the cosine by a simple delay of K.

2: The coefficients h0 and h1 are estimated adaptively from the extracted x0 and x1 signals using an LMS algorithm as shown in Figure 2.

3: The gain and timing errors are then computed from the linearized set of equations as derived from Equation 3.

Once estimated, the gain and timing errors are used to feed a digital correction engine. The gain is compensated using a simple digital multiplier. The correction of the timing error is accomplished with a modified fractional delay filter [3]. Polyphase and symmetry are exploited to reduce the implementation complexity of the filter. Both the estimation and correction engines operate at the sub-ADC sampling rate. Down-sampling can be envisioned for the estimation block for further optimization.

Proof of concept

A composite test signal consisting of:

- a TM3.1, 20 MHz LTE carrier centered at 300 MHz,
- and a 253.44 MHz, -35 dBFS calibration sine-wave, corresponding to S=1, K=8, P=2K,

can be generated using the test setup shown in Figure 3. This setup provides very high dynamic range thanks to low noise and high linearity D/A converter [4] and DVGA [5]. A commercially available 14-bits / 500-Msps TIADC that integrates high resolution tunable gain and timing errors is used. The ADC raw data was captured with an FPGA and processed with IDT's calibration algorithm using Matlab® software. The gain and timing errors of the TIADC have been set to approximately 0.5 dB and 5 ps respectively to simulate a worst case situation.

Figure 4 shows the power spectrums of the data before and after calibration. The LTE carrier image, at -80 dBFS before calibration, has been reduced by about 30 dB to -110 dBFS level after calibration. The calibration signal and its image have been completely cancelled by the extraction and cancellation algorithm. This performance has been achieved within about 200 µs convergence time.

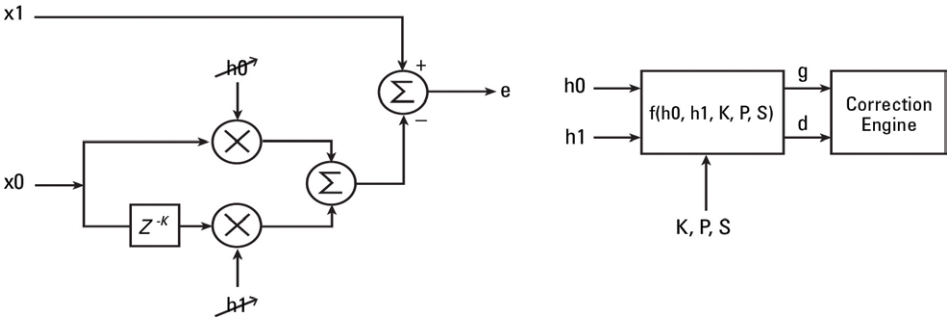

Figure 2: Background estimation of gain and timing errors through a 2-tap digital adaptive filter.

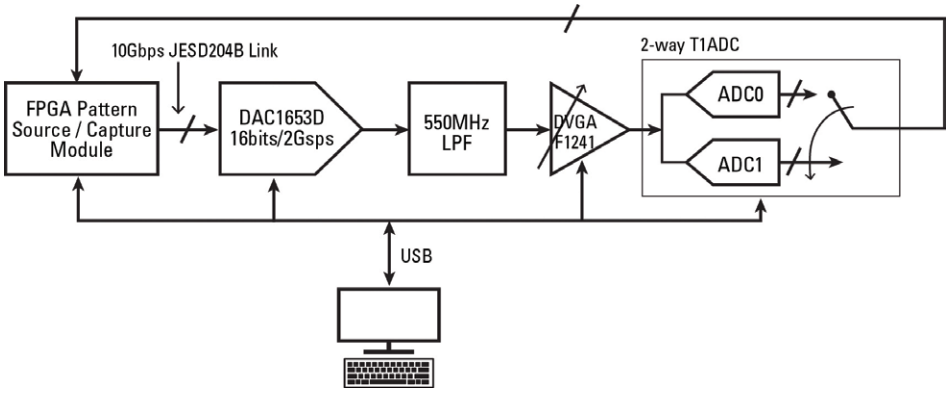

Figure 3: Block diagram of the test setup.

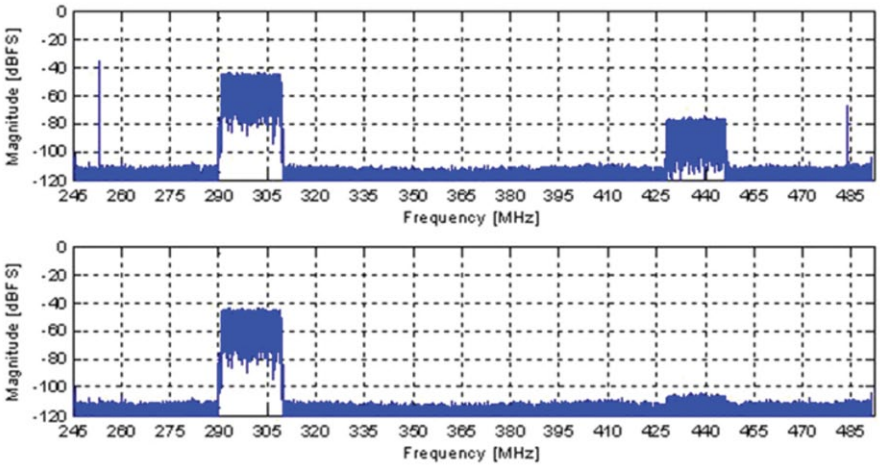

Figure 4: Power spectrums before (TOP) and after calibration (Bottom) with 300 MHz LTE carrier.

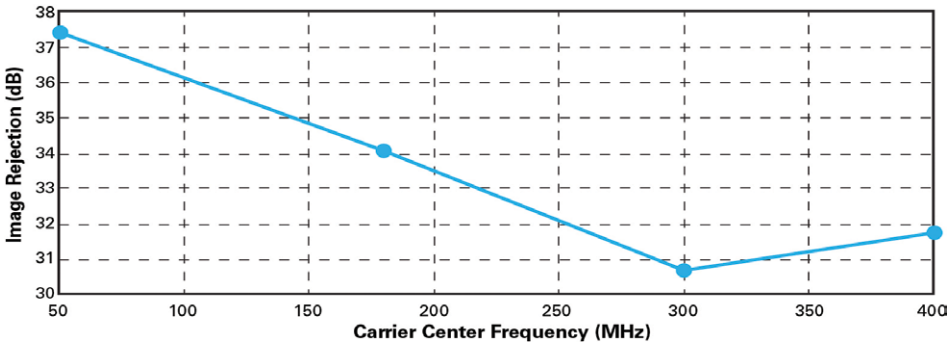

Figure 5: Image rejection versus the LTE carrier center frequency with fixed calibration signal.

The calibration signal was kept unchanged and the LTE carrier center frequency swept from 50 MHz to 400 MHz in order to assess the frequency behaviour. The resulting image rejection, as shown in Figure 5, shows that at least 30 dB dynamic range improvement is maintained across the two first Nyquist zones. As expected, the image rejection decreases with frequency limited by the contribution of the bandwidth error which is not corrected.

Conclusion

RF sampling A/D converters are key components for next generation software defined radio systems. Time-interleaved architecture is leveraged to achieve very high sampling rates and low power consumption at the cost of degraded dynamic range. It has been shown that injecting a constrained calibration signal out of the useful band improves significantly this dynamic range thanks to a low complexity calibration algorithm for gain and timing errors. Measurements on 14/500 Msps prototype showed an approximate 30 dB dynamic range improvement across the two first Nyquist zones. The proposed method can be used for higher-speed applications as long as the gain/timing mismatch error model remains valid.

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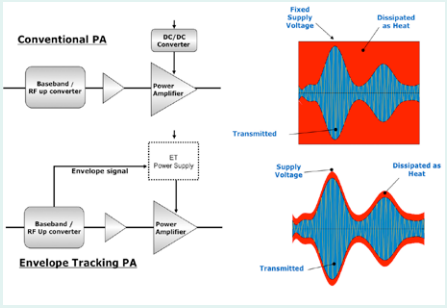
Easy implemantation of Envelope-Tracking in RF front ends



EasyET from Nujira is a development toolkit that radically simplifies the deployment of envelope tracking ET and enables handset designers to achieve maximum RF front end system performance with minimal design effort.

EasyET is a combination of PA characterization tools, reference hardware and a suite of software that reduces ET development time for platform vendors and handset OEMs by up to three months. By maximizing flexibility, EasyET enables rapid development and performance tuning of multiple region-specific RF front end platform configurations.

Julian Hildersley, VP of Applications at Nujira, said: "We know ET is a complicated technology to get right. The hardware challenges of ET have largely been resolved, but new demands on the RF front end have made software development much more complex. One of Nujira's strengths is our system and software expertise and, with the introduction of EasyET, we are streamlining the design flow and removing the software bottlenecks for chipset vendors and handset OEMs.

"You can compare ET to the introduction of fuel injection in the automotive industry – while the additional system complexity initially lengthened the development cycle, the technology quickly became universally adopted because the ultimate benefits were too significant to ignore. The benefits of ET are apparent to everyone and EasyET makes unlocking them significantly easier."

ET introduces a new set of variables into the low-level firmware associated with transmit power control, linearization and production calibration. The adoption of ET also coincides with the introduction of more complex multimode multiband (MMMB) power amplifiers (PAs), and the move from GPIO controlled PAs to MIPI RFFE serial control, which now requires vendor-specific programming sequences to control each individual RF front end component. As a result there has been a significant jump in complexity for low-level firmware development to support the RF front end. Software complexity is further increased because platform vendors increasingly need to deliver and support multiple regional reference designs to handset OEMs, with each design supporting a different set of frequency bands and multiple sources of hardware components.

EasyET allows a single firmware build to support multiple RF front end configurations and components by simply modifying configuration tables stored in flash memory. EasyET also includes the device characterization and platform configuration tools allowing chipset vendors and OEMs to generate the required configuration tables.

The EasyET design flow features a comprehensive set of hardware and software tools that include:

- **ET Surface Explorer** - an advanced ET PA characterization system, which now supports a variety of third party test and measurement platforms, and can also be run on the target hardware platform;
- **EasyET Configuration Manager** - a set of software configuration tools, which make it easy for platform vendors and OEMs to mix and match RF front end components, and export the required control and calibration tables without rewriting any firmware;
- **EasyET Universal RFFE Driver** - a low-level software architecture for the RF front end driver, enabling chipset vendors to support multiple components and optimize performance with a single firmware build. All component-specific ET IC, PA and switch parameters (including RFFE timing and programming sequences) are stored together with calibration data in flash-based configuration tables, rather than being hard-coded into the firmware;
- **Reference designs** - this range of reference designs are based on Nujira's NCT-L1300, a high performance ET IC, and best-in-breed ET PAs from a number of tier 1 suppliers.

www.nujira.com

Cloud RAN – emergence in heterogeneity

By Harpinder Matharu, Xilinx Inc.

Wireless infrastructure network is going through a critical phase of technology evolution where a slew of different equipment form factors are being rolled out to meet perpetual growth in demand for capacity. All these solutions are gravitating towards maximising the potential of precious and limited spectrum resource. While 3gpp standardisation efforts are devising ways to pack more and more bits into available spectrum within the capacity constraints governed by Shannon's law, wireless radio network is on the move to create topologies that allow less and less number of users to share more and more of the available spectrum. There are two major macro trends that are splitting the network into completely opposite directions.

The first macro trend is pushing the network to deploy an underlay of 10's of small cells per macro base station to add micro cells within a macro cell to initially improve coverage and then deliver capacity by serving fewer numbers of users. This trend simplifies radio access but creates complexity and scale challenges in the backhaul network.

The second macro trend is splitting the base station into a network. This trend simplifies backhaul but adds complexity to the radio access. Cloud RAN and high density base stations are other names of this trend. The move to distributed base stations in terms of remote radio heads has been happening long before the days of cloud.

Success of a distributed wireless network depends not only on a framework that allows adaptation and growth of distributed intelligence within the network via continuous self-learning but also on a solid foundation that allows coordination among the distributed intelligence to launch new services and profitable monetization of the network. Timing and synchronization is a key element of this foundation aside from self-healing, self-optimizing and software defined network functionality. Timing and synchronization dictates the network performance while software defined network eases effective network sharing and virtualization, service deployment and maintenance. Figure 1 shows a traditional base station architecture.

Due to pros and cons of the above stated trends and ongoing deployments, there will be no clear winner resulting in coexistence and eventual coopetition of Cloud RAN technologies and small cells. However, it is author's view that network evolution would favor the fundamental precept of successful network monetization that builds upon continuously growing intelligence within the network to launch new and better services. Given the proliferation of distributed base station and remote radio head technologies, it is likely that the wireless network evolution will tilt more towards cloud RAN in coming time (Figure 2). This path is not going to be easy. Operators and system vendors would need to work collectively in standardizing some critical elements of cloud RAN to bring about cohesive framework that eases adoption and guides a series of future innovations to this cause.

In order to delve into standardization needs for timing and synchronization, it is important to understand the present state of the wireless infrastructure network. Base stations and associated access connectivity has been a closed network where both proprietary and

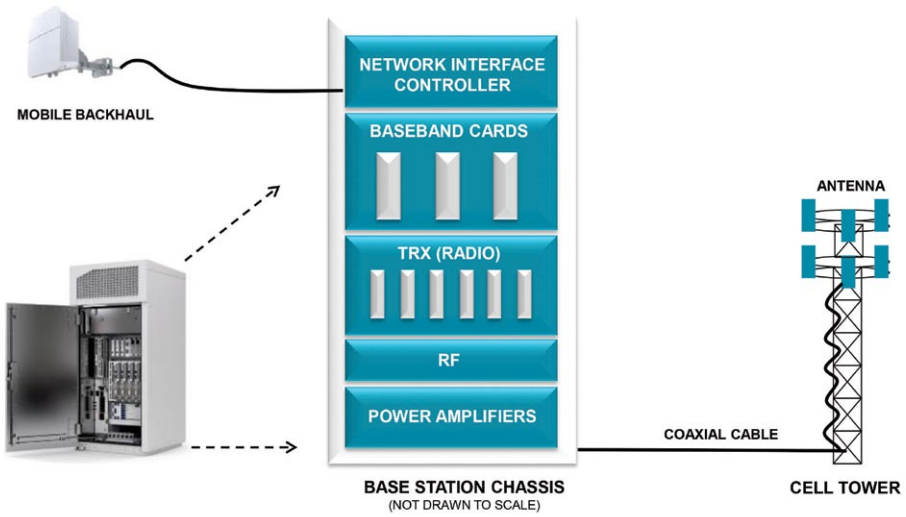


Figure 1: Traditional base station architecture.

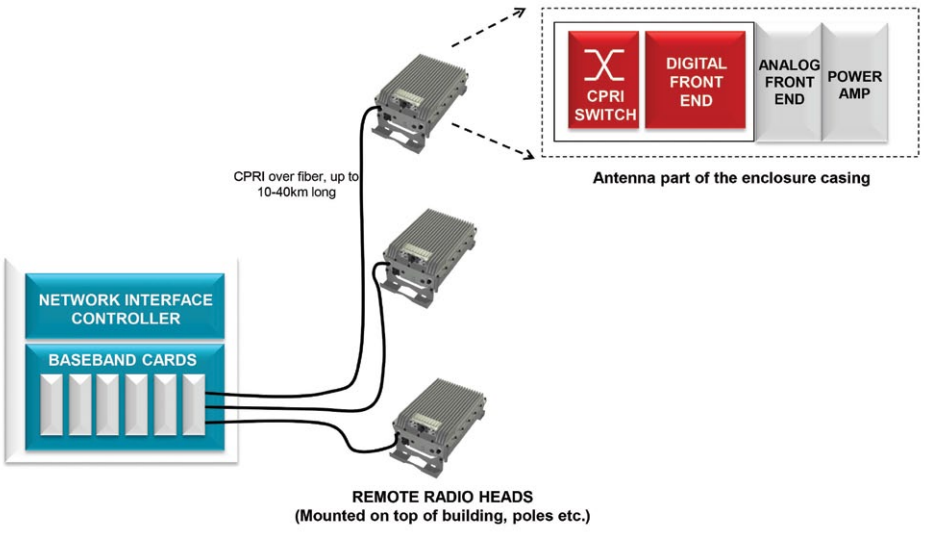


Figure 2: Distributed base station and remote radio heads.

pseudo-standards abound. However, there is a tremendous latent desire to leverage standards based connectivity and synchronization for performance optimization and economies of scale. The proliferation of Ethernet and slow but sure adoption of timing over packets is the right catalyst to fire this latent desire into an engine of innovations for the next generation cloud based network. As we all know that economically viable technology wins every day over better technology, care has to be given to create a framework that aptly serves the need for coexistence with the legacy, cost of deployment, and scalability concerns effectively. And this needs to be done without compromising delivering better and better network performance reliably and profitably.

Base stations synchronize with the core network by using combination of multiple timing and synchronization inputs. GPS and legacy TDM networks such as T1/E1 lines continue to be used along with new ways of synchronizing network nodes by packet timing protocol (PTP 1588v2) and synchronous Ethernet. PTP and synchronous Ethernet are gradually becoming mainstream ways in achieving synchronization within wireless infrastructure. The clock and control module (CCM) within base station leverages these different mechanisms to achieve frequency, phase, and time of day accuracy with the network. The base station clock control module in turn provides the synchronized clocking information to the radio elements. This is fairly straight forward in traditional centralized base station where radio elements reside in the same chassis. Successful distribution of synchronized clocks becomes challenging in distributed base stations where radio elements are located remotely.

In order to distribute timing and synchronization to remote radio heads, system vendors used proprietary protocols to begin with. Open base station architecture initiative (OBSAI) and common public radio interface (CPRI) standards were introduced to standardize connectivity between base station chassis and remote radio heads. CPRI and OBSAI protocols enabled transport of synchronization information along with essentially TDM based data plane transport. Stringent requirements of maintaining round trip deterministic latency to sub 16ns and timing alignment error for transmit diversity chains to within 65ns resulted in use of dedicated fiber links between base station chassis and remote radio heads.

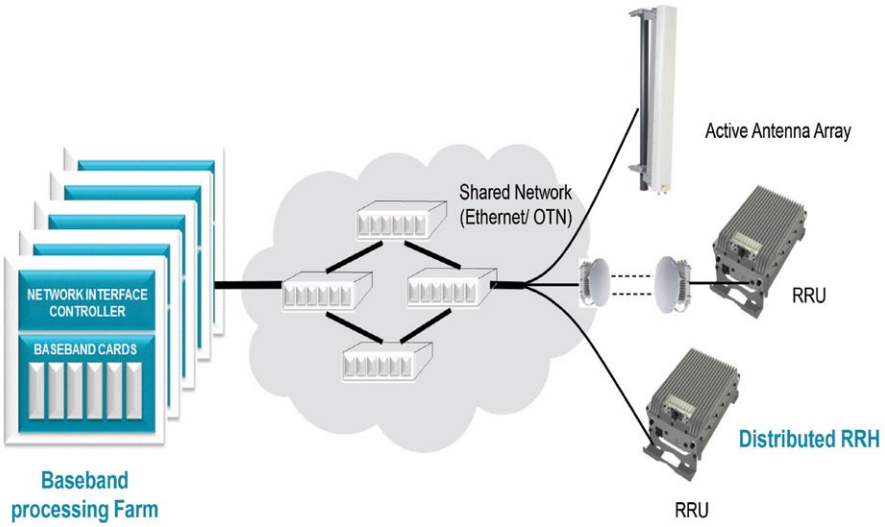


Figure 3: Conceptual Cloud RAN network architecture sharing network using QoS/ traffic engineering.

In distributed base station network architecture, several remote radio heads are connected to the base station chassis using chain, tree, or star topologies. White CPRI and OBSAI standards support up to 40km long fibers, dedicated fiber for connectivity between each base station chassis and the radio heads is extremely limiting and expensive. For these reasons, majority of remote radio installations are constrained to distances of hundreds of meters from the base station chassis. A successful rollout of Cloud RAN based distributed base stations require fiber reach of up to 40km but more importantly over a shared network.

Critical first step to this lofty goal would be adoption of standard based connectivity and synchronization technologies in distributed base stations in order to set the stage for mainstream Cloud RAN deployments in 3-5 years' time domain. Ethernet is going to be the obvious choice. The price points of 10G Ethernet ports are dropping quickly with ubiquitous deployments. In parallel, activities around standardizing timing and synchronization over Ethernet have picked up in standards bodies such as ITU and IEEE. Ethernet standards and rich ecosystem are ushering distributed base stations to transition to 10G Ethernet connectivity as an end to end protocol within distributed wireless network. However, a more focused effort within standards bodies is needed to address wireless application specific requirements for connecting base band chassis and remote radio heads or often termed as wireless infrastructure front haul. Support for mechanisms in standards to coexist with legacy pseudo-standard connectivity and synchronization schemes is critical to accelerate this transition.

Sharing of the network for front haul and widespread transition of distributed base station architecture to data center form factor leveraging virtualization is far out in time but underlying shifts are already beginning to happen in this direction. Challenges emerging from network latency, secure transport and stringent synchronization needs for coordinated multipoint transmission and reception will take some time to materialize to make shared network a reality. An engineered and traffic managed network with controlled access may be the first step to effectively address quality of service needs to connect bigger base band chassis to 10's and even 100's of remote radio heads. Sharing of this network among operators would be necessary to contain cost of deployments.

Coexistence of Cloud RAN and small cells in the race to ever growing capacity within networks is going to throw some scalability and interoperability challenges. Rolling in support for small cells in Cloud RAN architecture would be important to allow both the mega trends within wireless infrastructure to flourish in their domains. Cloud RAN initiatives are setup nicely to become a much needed network platform to abstract underlying heterogeneity enabling effective network monetization while easing network deployment and maintenance.

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MIMO receivers demand high performance dual passive mixers

By Bill Beckwith, Xudong Wang, Tom Schiltz, Linear Technology Corporation

Multiple-Input Multiple-Output (MIMO) technology is increasingly being used in high data rate systems such as Wi-Fi and 3G/4G cellular technologies. The higher data rates of MIMO systems provide increased system capacity and improved levels of efficiency. In order to reduce system complexity and size, MIMO receivers require integrated circuits (ICs) that are capable of handling multiple channels. To address this need, the LTC559x family of dual passive down-converting mixers provides frequency coverage from 600 MHz to 4.5 GHz. The mixer family includes the LTC5590, LTC5591, LTC5592 and LTC5593. The frequency coverage and typical 3.3 V performance of each mixer is shown in Table 1. These mixers deliver high conversion gain, low noise figure (NF), and high linearity with low DC power consumption. Typical conversion gain is 8 dB with an input 3rd order intercept point (IIP3) of 26 dBm, 10 dB of noise figure and 1.3 W power consumption.

The LTC559x family of dual high-performance mixers is ideal for wireless infrastructure MIMO receivers. The dual channel solution reduces parts count, simplifies routing of LO signals and reduces board area. Additionally, each LTC559x incorporates integrated RF and LO baluns, double-balanced mixers, LO buffer amplifiers and differential IF amplifiers, further reducing overall solution size, complexity, and cost.

PART NUMBER	RF RANGE (GHz)	LO RANGE (GHz)	GAIN (dB)	IIP3 (dBm)	NF (dB)
LTC5590	0.6 – 1.7	0.7 – 1.5	8.7	26.0	9.7
LTC5591	1.3 – 2.3	1.4 – 2.1	8.5	26.2	9.9
LTC5592	1.6 – 2.7	1.7 – 2.5	8.3	27.3	9.8
LTC5593	2.3 – 4.5	2.1 – 4.2	8.5	27.7	9.5

Table 1: LTC559x frequency coverage and 3.3 V performance summary.

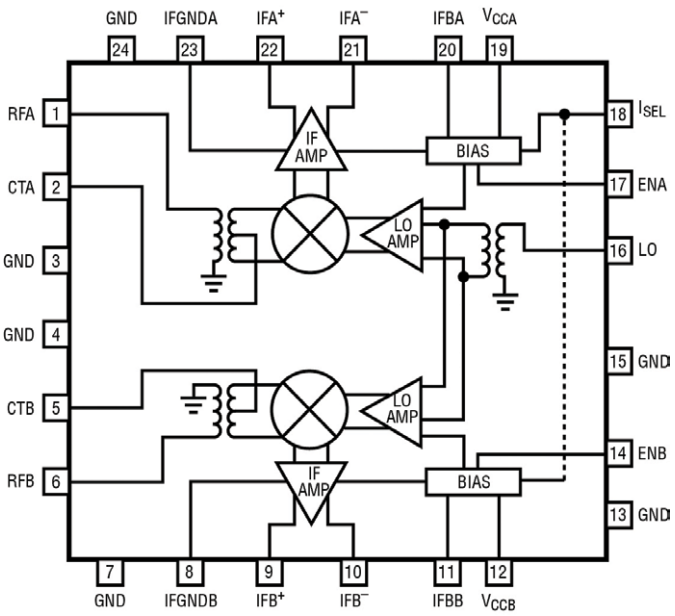

Figure 1: Block diagram of dual-channel mixer.

Mixer description

The simplified block diagram in Figure 1 shows the dual-mixer topology, which uses passive double-balanced mixer cores driving IF output amplifiers. The mixer cores are switched-MOSFET quads, which typically have about 7 dB of conversion loss. However, in this case the loss is more than compensated by the gain of the subsequent IF amplifiers, resulting in overall gain of about 8 dB. The differential IF output has been optimized for 200 Ω loads.

The LO path uses a shared balun to convert the single-ended input to a differential LO and then drives independent buffer amplifiers for each channel. To prevent unwanted load-pulling of the VCO, good LO impedance matching is maintained in all operating modes. Figure 2 shows the LO input return loss of the LTC5591, as an example, under various operating conditions. This feature eliminates the need for an external LO buffer stage.

Traditional base-estations maintain a temperature-controlled environment and require that components work up to +85°C. Smaller cells and remote radio heads, however, present a more harsh environment for components, requiring operation up to +105°C. The LTC559x mixers have been designed for, and tested at +105°C to meet this demand.

To minimize solution size, the LTC559x mixers are assembled in a small 5 mm x 5 mm 24-lead QFN package. The small package size is only part of the total solution size reduction, however. The high integration level reduces the number of required external components to about 19, minimizing board area, complexity, and cost.

Receiver application

The functional diagram of an LTC559x mixer in a two-channel receiver is shown in Figure 3. Single-ended RF signals are amplified and filtered before being applied to the mixer inputs. In this example, differential IF signal paths are shown, eliminating the need for an IF balun. The SAW filter, IF amplifier, and lumped-element bandpass filter are all differential.

High-selectivity SAW filters are used in many MIMO receivers to block unwanted spurs and noise at the mixer output. The mixers' 8 dB of conversion gain compensates for the high insertion loss of these filters and reduces their impact on the system noise floor. The overall mixer performance allows the filter loss to be accommodated while enabling the receiver to meet sensitivity and spurious requirements.

Another important specification for multichannel receivers is the channel-to-channel isolation. The channel-to-channel isolation is the IF level at the undriven channel's output relative to the IF level at the driven channel's output.

This parameter is usually specified to be 10 dB better than the antenna-to-antenna isolation to avoid degrading system performance. Based on its precise IC design, the LTC559x mixers achieve greater than 45 dB of channel-to-channel isolation, which satisfies most multichannel application requirements.

Power consumption and size

With the maturing of multiband/multimode base station topologies and a more refined system definition of 4G networks, wireless infrastructure systems are moving toward platform configurations that allow implementation of various band or mode requirements with minimal hardware and software changes. The LTC559x mixers all share a common pinout, making it easy to use the same board layout for all bands.

The continued growth of wireless communications has also spurred the use of smaller cells such as picocells and femtocells. The need for more, and smaller, cells plus the increased use of remote radio heads has placed additional constraints on infrastructure systems, demanding higher integration and smaller solution size.

As the number of cells grows, power consumption has also become increasingly important as energy costs go up proportionally. In remote radio heads, on the other hand, thermal stress is a major concern due to reliance on passive cooling. Simply reducing the solution size is not sufficient, as reduced system size would result in higher power density, higher junction temperatures and potentially reduced component reliability. Thus, it is necessary to simultaneously reduce system power consumption and size. This goal is challenging, because the RF performance must not be compromised.

In the past, combining two individual mixers on one chip would result in total power consumption of 2 W. To reduce power consumption, the LTC559x mixers have been designed for 3.3 V operation instead of 5 V. Low voltage circuit design techniques reduce power dissipation without impacting conversion gain, IIP3 or noise figure performance. The only parameter affected by the lower supply voltage is the P1dB performance, which is approximately 11 dBm. The P1dB performance is output limited by the voltage swing at the open collectors of the IF amplifiers when driving the 200 Ω load impedance. For applications where higher P1dB is necessary, the mixers have been specifically designed to allow the use of a 5 V supply on the IF amplifier. The higher voltage improves the P1dB to greater than 14 dBm.

As shown in Table 1, the dual-mixers achieve excellent performance while using just over 1.3 W of power, with both channels enabled. For additional power savings, each channel can be independently shut down as desired by using the independent enable controls. In instances where reduced linearity requirements are acceptable, the ISEL pin allows the user to switch to low current mode and further decrease DC power consumption.

Conclusion

The LTC559x family of dual passive downconverting mixers delivers the high performance needed to meet the demanding requirements of today's multichannel infrastructure receivers. The mixers' combination of high conversion gain, low NF, and high linearity improves overall system performance, and low power consumption and small solution size meet the more stringent needs of today's smaller base stations and remote radio heads.

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www.linear.com

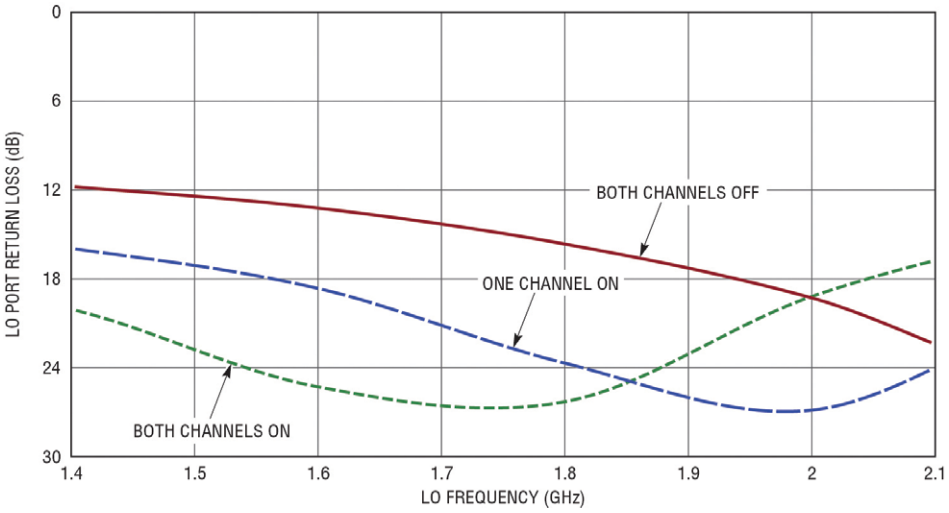


Figure 2: LTC5591 LO return loss for different operating states.

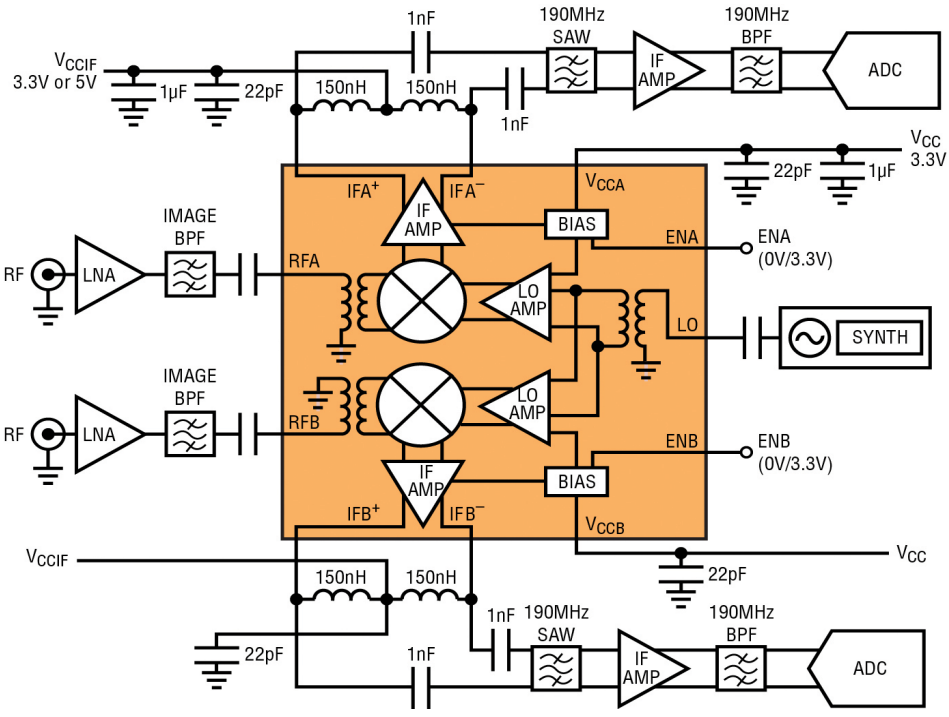


Figure 3: LTC559x dual passive mixer in a receiver application.

Internet of Things (IOT): Making the component industry think inside the box

By Milan Yudkovich, Arrow Israel

The Internet of Things (IoT) vision that is emerging will result in homes, offices and cities becoming gradually interconnected. No single company owns the M2M (machine-to-machine) and the IoT concepts of course; so for this vision to develop and progress, close cooperation between companies from various backgrounds will be required. The IoT has rapidly achieved a high level of interest and excitement amongst entrepreneurs. The prevalence of smart phones, inexpensive computers and connectivity result in many business opportunities.

What will really happen when things, homes, offices and cities become smarter? We are likely to see radical alterations to the way we live: this could include a vacuum cleaner that starts cleaning on its own following receipt of a dust storm weather forecast… or a coffee maker that might order coffee itself after running out of a specific flavour. This may sound far-fetched, but the means to make these examples happen exist. A good way for the IoT idea to expand is to add "intelligence" to mainstream products in the form of microcontroller (MCU/MPU) and sensor; this will enable a sensing of the environment and the transmission of information for processing to the controller. We can foresee 'things' being fitted with an artificial brain linked to the Cloud, from where it would be controlled and multiple tasks assigned.

Another consequence is that the market will require far more smart chips than it currently does. In general, smart chips are divided into three categories: control, sensing and connectivity. Interestingly, each of these categories falls into a "Blue Ocean" (W. Chan Kim, 2005) type of definition with new demand created in what is an uncontested market space. Manufacturers that can support all three categories, like STMicroelectronics for instance, will lead the IoT era. These categories are expected to thrive in the future, with great volume and room to expand.

Category 1: Adding control components – these chips are the 'brain' of the operation.

Low end, microcontrollers can vary between 8bit processors designed to manage a microwave oven menu, to more complex chips such as 32bit or multi-core chips seen in TV converters (also known as set-top box). MCU that can support the Internet of Things vision taking shape at present. The extensive range of usage scenarios and devices within connected devices means that the gadgets will require more power than saving in performances or only inexpensive 32bit chips designed for more industrial application. Many of these companies have an edge because they are using ARM hardware-software solutions in a broad variety of end products.

Category 2: The addition of Sensors to our smart phones and tablets. The sensors we are referring to include microphones, acceleration, Gyro, humidity, pressure, light and temperature; in the past, many of these were complex and even large in size, but today they are convenient, inexpensive and small which helps explain why they can be found embedded in any existing product as well as in battery-based products. This technology is coming to the mass market, heralding a new way in which we communicate with our daily appliances.

Because of the addition of functionalities such as MCU, sensor and radio, the technologies must be miniaturized

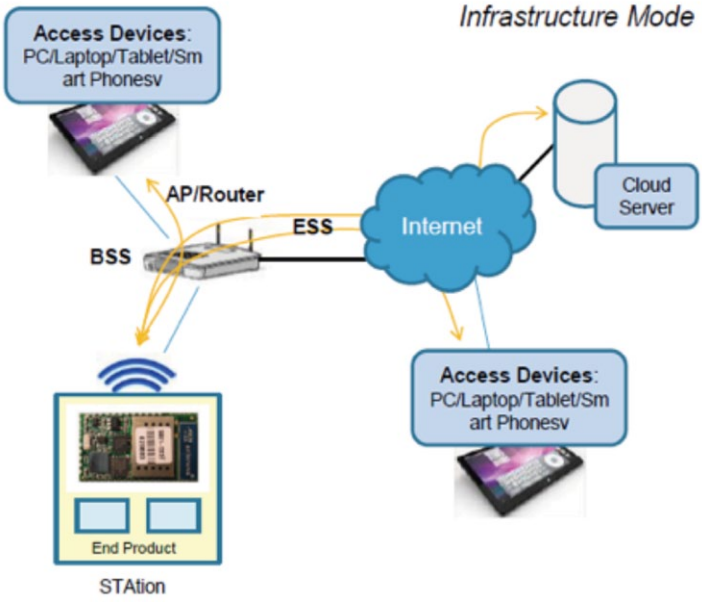


Figure 1: The Internet of Things will result in homes, offices and cities becoming gradually interconnected.

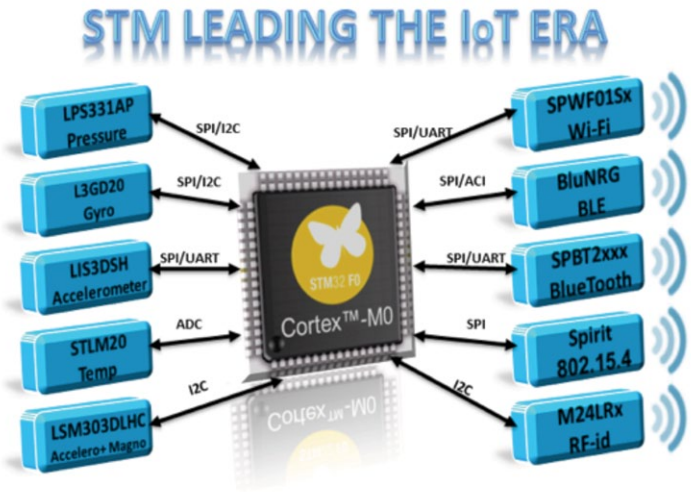


Figure 2: Manufacturers that can support all three categories (control, sensing and connectivity), like STMicroelectronics for instance, will lead the IoT era.

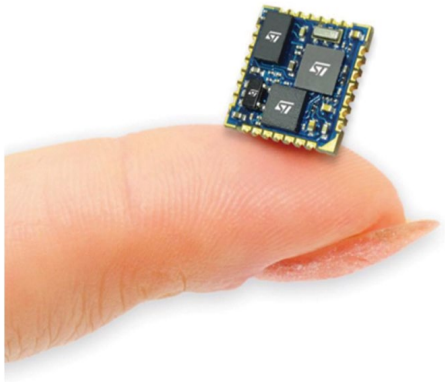


Figure 3: The INEMO-M1 system-on-board comprises a complete set of communication interfaces and motion-sensing capabilities in a 13 x 13 x 2 mm form factor.

and merged into a single component. The INEMO-M1 is the first 9-axis motion sensing system-on-board (SoB) of the iNEMO module family. It integrates multiple MEMS sensors from ST and a powerful computational core: a 6-axis digital e-Compass, a 3-axis digital Gyroscope and an ARM®Cortex™-M3 32-bit MCU. This 9-DoF inertial system represents a fully integrated solution that can be used in a broad variety of applications such as robotics, personal navigation, gaming and wearable sensors for healthcare, sports and fitness.

A complete set of communication interfaces and motion-sensing capabilities in a very small size form factor (13 x 13 x 2 mm) and the possibility to embed ST's sensor fusion software make the INEMO-M1 system-on-board a flexible solution for high-performance, effortless orientation estimation and motion-tracking applications.

Category 3: Perhaps the clearest category of all involves adding Connectivity. It can be easily understood that if we want to connect to the Internet, there must be a certain kind of radio communications in all the end units. It can be Wi-Fi, NFC, RFID, Bluetooth, Z-wave, ZigBee or even standard cellular 3G or 4G (or all the above) and additional types of communications that will be developed in the near-distant future for a specific need with development of the Internet of Things (IOT), e.g. BLE - Bluetooth Low Energy. STMicroelectronics has developed BlueNRG, single component incorporating Cortex-M0 and Bluetooth specification v4.0.

These radio technologies will be embedded in additional products with which we are all familiar. A report on the IoT from the OECD estimates that a four-member household which today uses on average 10 Internet-connected devices will increase usage to 25 by 2017 and to 50 by 2022.

A rapid survey shows a wealth of available home Wi-Fi devices and sensors that have embedded radio appliances.

The hardware industry has been widely eulogized, with the claim that everything is on the shelf. We often hear that there is no need to manufacture hardware, but only to write software. However the Internet of Things concept is changing the rules of the game and leads the industry to developments and the manufacturing of components that did not exist previously.

The high-tech industry is best described as cyclical and will always be affected by market fluctuations, but the IoT vision is likely to drive the industry forward in the coming years.

The author, Milan Yudkovich holds the position of FAE at Arrow Israel.
www.arroweurope.com

Network Functions Virtualisation – fit for purpose?

Network Functions Virtualization introduces new levels of uncertainty into the already complex network environment, that demands a return to first principles and a test solution based on the accumulated knowledge and skills of experienced specialists, says Steve Jarman, Spirent

The virtualization of essential network functions – such as firewalls, BRAS, even customer premises routers etc – is catching on. You could say it had to happen, given the ubiquity of virtual technology and Moore's Law increases in server power.

For many users the first experience of virtualization was a workaround for proprietary operating systems – the remarkable discovery that one could run a Windows PC on a Mac computer. Then came datacentre consolidation, where racks of autonomous servers converged into a single data processing resource out of which one could mould any number of virtual machines flexibly, as and when needed. From there to software-defined networking (SDN) where the new techniques allow the network infrastructure to be re-configured as needed via software and without needing to move or manually configure any physical cables or boxes.

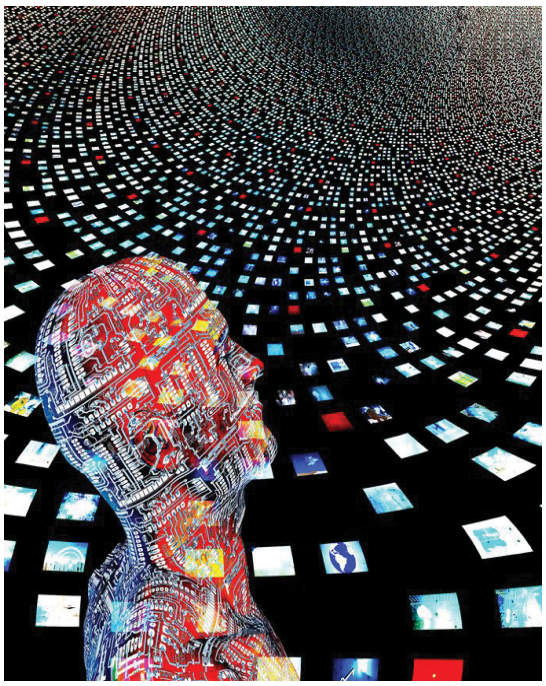
But what about those physical boxes on the network? Large networks are populated with a growing number of proprietary hardware appliances – not just switches and routers but also security and deep packet inspection devices, QoE monitors, WAN accelerators and other specialist functions. Each time a service provider adds a new service it may be necessary to install further devices – time consuming in itself but also demanding additional space and power. What's more, hardware goes out of date, and the whole expensive cycle from procurement to deployment has to be repeated.

Is it possible then to follow the datacentre consolidation approach and replace many of these specialist devices with software functions running in a small number of general purpose servers?

This is the essence of Network Functions Virtualisation (NFV). In the words of the original NFV White Paper it involves: "leveraging standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage, which could be located in Datacentres, Network Nodes and in the end user premises". The idea is that ultimately any data plane packet processing and control plane function in fixed and mobile network infrastructures could be virtualized in this efficient manner.

It isn't such a radical notion either, as PC-based network devices have been around for a while, providing cheap networking solutions for small businesses. Recent advances in last-mile Ethernet, improved network interface cards, and Intel's increasing focus on integrated networking processing – allowing processor cores to be re-programmed into network processors – mean that today's PC-based network devices are increasingly capable of handling traffic up to hundreds of Gbps.

NFV is already happening. In October 2012 a group of telcos including AT&T, BT, China Mobile, Deutsche Telekom and many others published an NFV Call to Action document, and an ETSI (European Telecommunications Standards Institute) committee was set up to promote the project.



NFV and SDN

SDN began as an academic project: a quest for flexibility in the network that would make it easier to in a research setting – and then industry caught on to the business benefits of a nimble network structure. NFV, however, began with that consortium of service providers sharing a solution to a challenge.

The idea of removing every network box and ending up with one central server installation is attractive, but a little too simple, because some network functions are tied to a physical location. Just as switches need to be at network junction points, a firewall, for example, needs to be at the edge where the internal network connects to the public network. Allowing external traffic to travel through the internal network to a central server could be risky SDN facilitates simple stateless firewall rules within a network switch but full statefull functionality is still required. A pure NFV play may deploy virtual machine-based firewalls to servers at every entry point within the network; something that could be prohibitively expensive if using hardware appliances.

The ideal solutions could involve a combination of SDN and NFV: because a virtualized network is far less restricted by location. In the above example: once the firewall function has been allocated to a specific virtual machine, then a software defined network could place it at the network edge regardless of its actual physical location, by providing a direct, quarantined link from the Internet to the virtual firewall before traffic entered the internal network.

At present, most providers using NFV are still relying on manual reconfiguring of the network to route traffic to the virtual network functions, but combining SDN and NFV in this way has incredible potential. Not only could a costly hardware device be run as a virtual machine in an off-the-shelf server, but in the event of network problems the task could shift to a different virtual machine and the network reconfigure immediately to make this possible.

Testing virtual network functionality

There is no doubt that NFV has a great future, all the more so when combined with SDN to allow automation and near real-time response to business needs. A golden future lies ahead but, as with so many technological advances, a swamp of

uncertainty lies between the present situation and that future. The problem is this: can we trust a network based on NFV?

Logically we should be able to, provided the functions are properly virtualized. But complex systems don't always reflect simple logic, and surprising behaviour can emerge in a complex network. A virtual network must be aware of the constraints imposed by the underlying physical topology. In practice, a security system that re-routed signals to a central controller for packet inspection could add latencies that lead to unexpected consequences. A DoS attack, or simple "domino effect", could crash the system internally.

Of course, the only sure solution to such uncertainties is stringent testing under realistic operating conditions. In the case of a fast-evolving virtual system this also includes on-going monitoring as the system reconfigures to make sure that the new configuration has not introduced a problem.

After all, a 'virtualized network' function is still a network function. It can be tested as such in much the same way as it's physical equivalent. However, physical test ports are now no longer sufficient. Testing needs to come from within the virtual infrastructure and should also seamlessly span the virtual and physical realms.

Performance, availability, security and scale of any proposed solution must be assessed as before particularly given the potential of the new networking paradigms to affect these aspects both positively and negatively.

The good news is that the network test industry is ahead of the virtualization game – test and monitoring devices have themselves been virtualized and, in this form.they can adapt as rapidly as the systems they are testing. Using the latest test techniques correctly, you can be as well assured of the performance of virtual systems as of any physical set up.

But is that all there is to it? Not quite, because every major new development requires new learning. We have the tools for testing virtual systems, but the swamp of uncertainty still lies between now and the golden future of NFV and SDN.

The only way to tackle such uncertainty is to call on the wisdom of acquired experience. When new challenges arise, even though they really are new they can still be analysed in terms of what has already happened before. The network test industry has many years experience of not only testing networks but also adapting to constant changes in the technology and the business environment.

We can be pretty sure that NFV will throw up some surprises, and maybe need drastic remedies. But we can also be sure that test teams with sufficient experience and skills will find a way around these problems and learn to anticipate them – as they have always done in the past.

The moral of this tale? Get on the NFV bandwagon, grab the opportunities and competitive advantages it promises — but make sure you do it in the company of truly experienced network test specialists!

GaAs MMIC distributed amplifier

covers DC to 20 GHz

Custom MMIC is adding a driver amplifier, the CMD192C5, to its growing product library. The CMD192C5 is the packaged version of the highly popular CMD192 amplifier that until now had only been available in die form.

The CMD192C5 is a wideband GaAs MMIC distributed amplifier that operates from DC to 20 GHz and has a positive gain slope versus frequency. This design feature allows for the cascading of multiple amplifiers without the need for extra gain compensation circuitry.

The amplifier delivers greater than 19 dB of gain with a corresponding output of 1 dB compression point of +25 dBm, and has a low noise figure of 1.9 dB at 10 GHz. The CMD192C5 is a 50 Ohm matched design, housed in a Pb-free, RoHs-compliant, 5x5 mm SMT package.

Ideal applications for the CMD192C5 are microwave radio and VSAT, telecom infrastructure, test instrumentation, military and space, and fiber optics.

www.CustomMMIC.com

Embedded, pre-certified modems

speed up design of specialized systems for M2M

Telit Wireless Solutions has partnered with NimbeLink in order to speed up design of specialized systems for M2M applications.

NimbeLink's Skywire pre-certified embedded modems, which are based on the Telit xE910 family of modules, allow designers to incorporate cellular connectivity into their designs.

The Skywire family starts with an embedded 2G CDMA 1xRTT product that claims to be the smallest embedded cellular modem on the market. It employs the Telit CE910-DUAL module that features a compact LGA package as well as the SMT form factor that is pin-to-pin compatible with the xE910 family. This allows products and systems to be designed once and be deployed globally. The modem is available with bundled CDMA 1xRTT data plans from leading carriers, allowing developers to add compliant cellular connectivity without having to apply for certification.

Skywire is available with a complete development kit that includes the cellular modem, baseboard, antenna, power supply, debug cables, and cellular service plan. NimbeLink employs Skywire for use in its own TextAlert product, a multi-function cellular gateway for commercial and industrial applications.

www.telit.com

2-W amplifier covers 1500 to 2700 MHz

delivers over 40 dB of gain

Freescale Semiconductor claims to offer the first 2-W integrated power amplifier operating with a 5-V supply and delivering more than 40 dB of gain to cover all frequency bands between 1500 MHz and 2700 MHz. The MMZ25333B supports any cellular standard operating at this frequency including GSM, 3G, 4G and LTE.

The high gain MMZ25333B is suitable for driver and pre-driver applications in macrocell base stations, and final-stage applications in small cells. The high performance and integration of the PA help customers reduce part counts, streamline supply chains and optimize costs. Further, since the device can be used across multiple platforms and frequency bands, it can be reused from project to project, simplifying supply chain inventory.

The MMZ25333B is a multi-stage power amplifier based on InGaP GaAs HBT technology and is housed in an industry-standard 4 mm QFN package.

www.freescale.com/RFlowpower

Microwave filters

deliver high Q in small size

As system designers are driven to miniaturise, many high performance designs are limited by the high Q requirements of filtering.

High Q" proprietary techniques realised in high K materials by BSC allow filters to be produced in small physical footprint. The company uses a thin film foundry process that produces high levels of precision and repeatability with a broad operating temp of -55 to +125 °C.

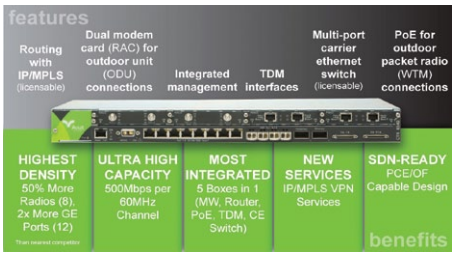
Applications covered will encompass L band to millimetre frequencies with varying topologies including diplexers, band-pass, notch, low-pass, high-pass and roofing. Products can be produced in open tile for direct die level integration or packaged foot prints for solder reflow.

Features include small physical size, high Q, low loss, high temperature stability, and high selectivity options.

www.bscfilters.com

Microwave networking platform

simplifies mobile operator networks



The CTR 8000 microwave networking platform from Aviat Networks is designed to simplify mobile operator networks. The first product in the CTR family, the CTR 8540 microwave router includes a fully featured IP/MPLS router, making it ideal for advanced microwave backhaul.

A purpose-built microwave router, the CTR 8540 features a powerful combination of microwave transport, Layer 2 Carrier Ethernet and Layer 3 IP/MPLS routing — all in one box.

Aviat has already received orders for the CTR 8540 from Osnova Telecom of the Russian Federation and Entel in Chile. Deliveries are scheduled to commence within the coming weeks.

According to Michael Pangia, president and CEO, Aviat Networks, the CTR 8540 combines the functionality of five separate devices and supports 50 percent more radio interfaces and twice as many Gigabit Ethernet ports as any other microwave platform and delivers

up to 4 Gbps of aggregate capacity per link. Further, the CTR has an open, software-based architecture, so it can be deployed now as a Layer 2 microwave device, with IP/MPLS functionality capable of being added when required via simple software upgrade. CTR leverages MPLS traffic engineering to offer SDN (software-defined networking) backhaul resource management and optimization, which provides a practical migration path to SDN architecture over time.

www.aviatnetworks.com

Schottky microwave detectors

offer high sensitivity

AtlanTecRF is introducing two models of zero bias Schottky detectors with high sensitivity and a wide operating temperature range.

The first two frequency ranges offered are 10 MHz to 18 GHz and 2.0 to 8.0 GHz, both with sensitivity of 500 mV/mW and TSS of -50 dBm. Flatness over the 10 MHz to 18 GHz frequency band is ±1.25 dB maximum and VSWR for this device is 2.0:1.

"These detectors are designed to be an affordable method in RF signal measurement for engineers designing a wide variety of equipment and test stations," said AtlanTecRF's CEO, Geoff Burling.

Input RF connectors are SMA male while the output video connector is SMA female and the output impedance is in the range 3.0 to 5.0 k-ohms with 20 pF shunt capacitance. No bias is required and there is a choice of either positive or negative output polarity.

www.atlantecrf.com

Passive network probe

targets LTE networks

Agilent Technologies has announced a significant enhancement to its Passive Network Monitoring System for converged telecommunication networks across 2G, 2.5G, 3G and now 4G LTE technologies. The company's Passive Network Monitoring Systems offer a highly scalable monitoring and processing portfolio that effectively processes both voice and data completely independent of the telecom network elements. These systems allow legally authorized users to identify and extract communications of interest and provide accurate location information, correlate voice and data selectors, and provide advanced filtering and selection for multiple 10GbE and legacy communications links.

The Passive Network Monitoring Systems are based on a high-availability 2U industry-standard platform. A flexible API with an extremely wide range of selection triggers and filters enables integration with multiple network management, lawful intercept, geolocation and cyber defense applications. High levels of security procedures and protocols ensure that only authorized users gain access to warranted information.

www.agilent.com

NFC antenna

3.2 mm high, targets smartphones

With a profile less than 3.2 mm high, the ZC1003HF series Z-axis antenna is well suited for slim smartphone designs.

It improves communication distance for near-field communication applications such as cashless payment, physical access, driver identification, peer-to-peer file sharing, and credential storage and exchange.

The highly sensitive antenna measures only 10 x 10 x 3.1 mm — it requires less board space compared with PCB printed loop antennas, and offers up to 30% longer reading distances, claims

manufacturer Premo. The ZC1003HF series is offered with 2.5 µH at 13,56 MHz inductance, but can be tailored to customer's specifications.

The antenna includes a high performance NiZn ferrite core material (>10^6 Ohm·m) and low initial permeability to work at high frequency. It provides a very stable performance in a wide range of temperature from -40°C to +100°C. The antenna offers better performance over metal parts ground planes or batteries devices.

www.grupopremo.com

50 GHz low-loss RF coaxial cable assemblies

Crystek has extended the frequency range of its high performance RF coaxial cable assemblies to 50 GHz.

The latest 50 GHz low-loss RF cable assemblies feature corrosion-resistant 2.4 mm 303 stainless steel connectors and three levels of shielding for low attenuation (loss) over distance (1.44 dB/foot at 50 GHz). They are in stock in standard lengths of 24" (61-cm), 39.4" (100-cm) and 48" (122-cm), with custom lengths available. Ideally suited for high-frequency interconnects in mission-critical applications and microwave laboratories, the cable assemblies (P/N series CC2450-MM-150) provide RF shielding of >90 dB with an operating temperature range of -55° to +85°C.

www.crystek.com

MIMO test environment

developed for satellite RF links

During a multi-year study with the European Space Agency (ESA), Finnish electronics and software group Elektrobit (EB) has developed a test environment for multiple antennas (MIMO) in satellite communications. This software-defined radio based environments is now available to satellite operators and infrastructure vendors, enabling them to scrutinize RF link performance.

MIMO is already widely accepted, but in satellite communications it still has to be adopted. In the ESA study EB fathomed out if, and to which extent MIMO could be beneficial in the context of satellite communications. To this end, the company carried out a literature study, followed by computer simulations and laboratory experiment with an existing satellite system.

The MIMO test environment devised in this context is based on an earlier development, also by EB: RACE, a software-defined radio platform for the development, evaluation and demonstration of wireless technologies. The RACE platform connects computer simulations to existing RF interfaces and provides a smooth transition from simulation up to real-world implementation in small, controllable steps. The test environment also includes a sophisticated radio channel emulator.

www.elektrobit.com

Small transistors

reduce footprint in smartphones, wearables

The VML0604 from ROHM Semiconductor claims to be the smallest transistor in the industry ans is available in a 0.6 mm x 0.4 mm x 0.36 mm package. The transistor reduces board space by 50% compared with alternative offerings, making it ideal for smartphones and other devices requiring smaller, thinner form factors.

For transistors in particular, in addition to technical challenges such as bonding stability and package processing accuracy, it has been especially difficult to decrease transistor size, resulting in higher ON resistances and maximum voltages in the 20 V range. ROHM, however, was able to successfully reduce package size and ON resistance while improving voltage resistance up to 60 V, providing breakthrough performance and reliability.

New high precision package and transistor processes, combined with internal structure optimization, have allowed ROHM to successfully develop the smallest transistor package in the industry. This package will be expanded to small-signal MOSFETs, contributing to increased space-savings in a variety of offerings.

As devices become smaller substrate mounting becomes increasingly difficult. In response, ROHM has maintained a 0.2 mm terminal gap that facilitates mounting using existing equipment.

www.rohmsemiconductor.com

Tiny multilayer diplexer

for WLAN and Bluetooth circuits

TDK Corporation has developed a multilayer diplexer in case size IEC 1005 for the implementation of 2.4 GHz and 5 GHz band WLAN in smartphones and other mobile devices.

With its miniature dimensions of only 1.0 mm x 0.5 mm x 0.4 mm the DPX105950DT-6010B1 diplexer claims to be the smallest in the industry.

The volume of the diplexer is more than 60 percent smaller than existing 1608 diplexers. In spite of the significant size reduction, the tiny diplexer provides equal or even better insertion loss and attenuation performance. For example, the maximum low band insertion loss at 2.4 to 2.5 GHz is just 0.5 dB, while the high band attenuation in the same frequency range is at least 25 dB. Mass production of the diplexer started in February 2014.

www.tdk.com

Cable assemblies

offer low loss to 18 GHz

Fairview Microwave has introduced a line of low loss test cables using LL335i and LL142 coax. Rated to 18 GHz, these low loss cable assemblies are ideal for test environments where a rugged, phase stable cable assembly is required.

The company's LL335i and LL142 cables allow for higher power transmission because the resulting higher temperatures do not have a negative effect on the cable due to the thermal stability of the PTFE tape dielectric. Where phase

stability requirements are critical, these low loss cables allow for a 75% lower phase shift due to the precise construction of the cables. This cable configuration offers attenuation levels 20 to 35% lower than comparable mil-spec cables.

The RF cable assemblies come equipped with a choice of stainless steel TNC, SMA and N-Type connectors and a heavy duty booting to improve strain relief.

www.fairviewmicrowave.com

RFID chip IC

authenticates goods via NFC

The EM4237 IC from EM Microelectronic is claimed to be the first high-secure ISO/IEC15693 compliant device to guarantee anti-counterfeiting and brand protection. The chip provides a universal identity card and an encrypted tamperproof digital certificate to convey the guarantee of good quality anywhere in the world, to be read by any NFC-enabled smartphone.

The device's security measures are based on public stream cipher technology used to safeguard the memory data integrity and to ensure communication confidentiality between the IC and the reader. The 2k-bit of data memory can be protected by setting the appropriate access conditions and access rights.

After a successful mutual authentication process, data communication can optionally be encrypted (secure messaging) and the data integrity can optionally be protected by a 4-byte MAC (Message Authentication Code).

Each EM4237 device contains a unique 64-bit identifier and an optional 32-byte ECC based digital certificate. A secure application running on an NFC-enabled smartphone can read out these two unique and personalized pieces of information, connect to a server through the cloud, manage the collected data and confirm the authenticity of a good. The 32-bytes digital signature is calculated using the device's unique 64-bit ID number, a public and a secret key.

Further, the EM4237 offers a privacy mode. In this particular mode, the IC remains silent to any received commands from the RFID reader or can return a random UID number that will be used during the next transaction. The on-chip resonant capacitor is of 23.5pF, the same value present on other ISO/IEC15693 devices. The EM4237 does not require any update of existing antenna designs.

www.emmicroelectronic.com

LTE module tester

offers 80 MHz bandwith for RF ICs

Advantest has expanded its T2000 platform with two test modules for RF ICs as they are commonly used in cellphones and WiFi devices. Both are offering a wide bandwidth of 80 MHz, enabling these modules to test according to 802.11ac and LTE-Advanced mobile communications standards.

The modules use vector signal generation (VSG) and vector signal analysis (VSA) software to meet the wide-range modulation challenges presented by today's most advanced portable electronics. Besides their large modulation bandwidth, the modules offer waveform generator software and modulation analysis software for 802.11ac and LTE-Advanced protocols. The modules differ in that the WLS32-A offers 32 ports while the WLS16-A is equipped with just 16 ports.

www.advantest.com

Oscilloscope covers 200 MHz to 1 GHz

with fast acquisition rates

With bandwidths from 200 MHz to 1 GHz, RTE digital oscilloscopes from Rohde & Schwarz feature an acquisition rate of over one million waveforms per second to help users find signal faults quickly.

The scope's highly accurate digital trigger system with virtually no trigger jitter delivers highly precise results. The single-core A/D converter with more than seven effective bits (ENOB) almost completely eliminates signal distortion. With a sampling rate of 5 Gsample per second and a maximum memory depth of 50 Msample per channel, the RTE can accurately record the long signal sequences required when analyzing the data content of serial protocols such as I2C and CAN.

Users performing complex tasks will especially appreciate the high measurement speed of the RTE. Mask tests, for example, quickly return statistically conclusive results. The highly responsive, spectrum-analyzer-like FFT reliably detects even sporadic signals, making the oscilloscope ideal for EMI debugging during product development.

Innovative tools help users boost their productivity. The QuickMeas function simultaneously performs several measurements on a signal. Fingertip zoom allows users to simply swipe a signal's zoom area to quickly view signal details. Tools are selected from a configurable toolbar.

Rohde & Schwarz also offers a wide range of dedicated application solutions for the RTE, including trigger and decoder options for serial protocols, a mixed-signal option with 16 additional digital channels and a power analysis option. A broad probe portfolio rounds out the offering.

The RTE can be ordered with two or four channels and a bandwidth of 200 MHz, 350 MHz, 500 MHz or 1 GHz.

www.scope-of-the-art.com
www.rohde-schwarz.com

Dual-polar 'White Space' UHF sector antenna

Cobham Antenna Systems, Microwave Antennas (Cobham has developed a dual-polar UHF sector antenna for use in the 'White Space' frequency bands. This is the first product in a range of similar dual-polar base station antennas, which

will be available from the company soon, in 2 GHz, 3 GHz and 5 GHz bands. The wideband SA11-90-0.6VH/2178 antenna provides both vertical and horizontal polarisations. In conjunction with radios, having two-port diversity, it can provide non-line-of-sight (NLOS) connectivity and reliable communications in challenging environmental conditions.

The antenna covers the entire frequency range 470 to 700 MHz, meaning that it can be used in situations where a number of channels are spaced widely apart.

Having high gain (11 dBi peak) and wide area coverage, with a 90 degree beamwidth the SA11-90-0.6VH/2178 antenna can be used stand-alone to provide sector coverage. Used in a configuration, four units are required to achieve 360 degree coverage. With appropriate power dividers and phase-matched cables, several antennas could also be stacked vertically, producing a narrower elevation beamwidth and increased gain.

www.cobham.com

LTE protocol stack

targets small cell relay nodes backhaul

ALPS 521, a Release 11 compliant UE protocol stack from NextG-Com, is designed for easy integration of relay node (RN) backhaul functionality with an existing eNodeB (eNB). Relays are a key element of LTE-Advanced (LTE-A).

Traditionally, user equipment (UE) architectures are optimized for a high level of hardware integration, for example using an ASIC, and unlike eNB are based on different design approaches that focus on high volume and power efficiency. ALPS 521 is designed to provide interfaces to eNB network protocols via the NextG-Com IPC framework, and is pre-integrated with eNB RN interfaces to the scheduler and eNB controller entities.

Using an in-house 3GPP test environment, ALPS 521 is pre-tested with RN-specific scenarios and configuration parameters, and can be flawlessly integrated into the relay architecture. It is fully tested against relevant 3GPP/non 3GPP third party conformance tests specific for relays.

www.nextgcom.co.uk

Packet microwave 70/80 GHz radio

cuts spectrum costs

DragonWave has expanded its product portfolio with the introduction of the Harmony Eband, a compact, lightweight radio that operates in the 70-80 GHz spectrum with low-energy consumption.

Harmony Eband provides an enhanced option for mobile backhaul markets, that provides reach comparable to the 23-38 GHz band, higher capacity and a lower OPEX. It is also ideally suited for urban and small cell deployments, and comes equipped with multiple ports and a proprietary mechanical design for self-weatherization that simplifies installation and saves on deployment cost. With its integrated switch, the all-outdoor radio claims to provide the industry's first uncompressed CPRI transport mode that enables wireless fronthaul.

Harmony Eband allows operators to tap into readily available spectrum that is generally available at a lower cost and more lightly licensed than lower frequency spectrum. Equipped with a number of features that increase spectral efficiency and that extend the radio's reach, it also includes extensive networking capabilities compliant with the latest Carrier Ethernet standards.

Harmony Eband's leading performance is demonstrated by operation up to 64 QAM to achieve throughput of 2.6 Gbps full duplex in 500 MHz mode. Spectral efficiency is further enhanced by DragonWave's Bandwidth Accelerator+, which delivers capacity of up to 4 Gbps. Additionally, Harmony Eband features the DragonWave Reach Extender, leveraging Waveform and Modulation Adaptivity (WMA) and MIMO to extend the radio's reach and deliver 3 to 7 km links with high availability. With an ultra-low delay mode and its CPRI interface, the radio also supports fronthaul applications.

According to the company Harmony Eband meets the capacity and latency requirements required to support fronthaul, macro backhaul and small cell aggregation, and is LTE synchronization ready.

www.dragonwaveinc.com

Rotary joint for Ka-band SOTM applications

Link Microtek has expanded its range of rotary joints with a compact dual-channel coaxial model that has been specifically designed for use in low-profile Ka-band satellite-on-the-move (SOTM) terminals in either military or commercial applications.

Manufactured at Link Microtek's premises in Basingstoke, UK, the AMCORJD-Ka rotary joint features a central K-type coaxial channel for transmissions in the 27.5 to 31.0 GHz range, together with an outer DC to 3 GHz SMA coaxial channel for L-band receive signals.

Microwave performance is excellent, with the transmit channel offering an average power rating of 20 W, a VSWR of 1.5:1 and a maximum insertion loss of 1.0 dB. The receive channel can handle an average power of 1 W, and its VSWR and maximum insertion loss are 1.5:1 and 0.25 dB respectively. Isolation between the two channels is a minimum of 50 dB.

The device has been successfully tested with currents as high as 2 A at 24 V, which means that DC can be fed down the outer channel to drive not only the terminal's LNB but also the motors that enable the antenna to track a satellite while the host vehicle is moving.

www.linkmicrotekeng.com

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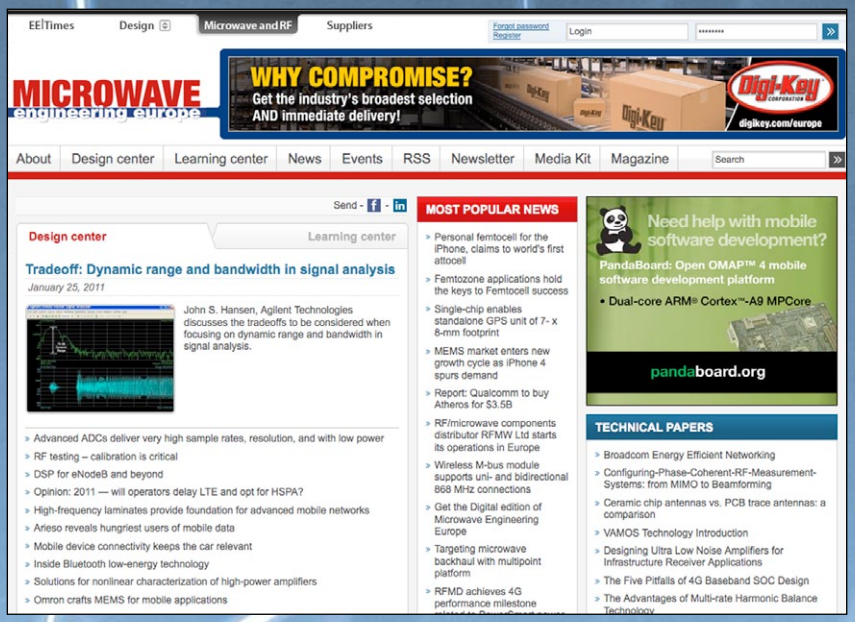

www.microwave-eetimes.com

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IT'S MORE COSTLY NOT TO GO...

IMS is the single annual opportunity to get the entire pulse of our industry in just one week. Attending IMS2014 enables you to see what is new, improve your technical knowledge and meet your colleagues, partners and vendors face-to-face in one efficient trip. It is the one event where you can connect with key people and learn about the technology advances you need to make informed decisions.

Innovations and Emerging Technologies Benefits:
IMS2014 offers Focus Sessions which highlight emerging new technical topics that are gaining importance and may be of significant interest to the microwave and wireless community.

Technical & Knowledge Benefits:
IMS2014 offers technical sessions, interactive forums, plenary and panel sessions, workshops, short courses, application seminars, and a wide variety of other technical activities.

Networking Benefits:
Microwave Week has countless opportunities to connect with other members of our growing community. No other event in the industry offers access to as many technical experts, and product representatives, or provides as good a forum to exchange ideas and meet the people who truly move our industry forward.

Exhibit Benefits:
Over 550 Exhibitors represent the state-of-the-art when it comes to materials, devices, components, subsystems and services as well as design and simulation software and test and measurement equipment. Whatever you are looking to acquire, you will find the industry leaders ready and willing to answer your purchasing and technical questions.

With all these benefits of attending, it is hard to imagine a more productive way than spending one week with us!

JOIN THE CONVERSATION: #IMS2014