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Radio waves beamed with a twist akin to fusilli pasta allow massive multiplexing

A group of Italian and Swedish researchers appears to have solved the problem of radio congestion by cleverly twisting radio waves into the shape of fusilli pasta, allowing a potentially infinite number of channels to be broadcast and received. Furthermore, the researchers have demonstrated this in real-life conditions by beaming two twisted radio waves across the waters of Venice.

Their results have been reported in the Institute of Physics and German Physical Society's New Journal of Physics.

As the world continues to adapt in the digital age, the introduction of new mobile smartphones, wireless internet and digital TVs means the number of radio frequency bands available to broadcast information gets smaller and smaller. "You just have to try sending a text message at midnight on New Year's Eve to realise how congested the bands are," said lead author Dr Fabrizio Tamburini. The researchers, from the University of Padova, Italy, and the Angstrom Laboratory, Sweden, devised a solution to this by manipulating waves so that they can hold more than one channel of information. A wave can twist about its axis a certain number of times in either a clockwise or anti-clockwise direction, meaning there are several configurations that it can adopt.

"In a three-dimensional perspective, this phase twist looks like a fusillli-pasta-shaped beam. Each of these twisted beams can be independently generated, propagated and detected even in the very same frequency band, behaving as independent communication channels," Tamburini continued.

To demonstrate this, the researchers transmitted two twisted radio waves, in the 2.4 GHz band, over a distance of 442 metres from a lighthouse on San Georgio Island to a satellite dish on a balcony of Palazzo Ducale on the mainland of Venice, where it was able to pick up the two separate channels.

"Within reasonable economic boundaries, one can think about using five orbital angular momentum states, from -5 (counter-clockwise) up to 5 (clockwise), including untwisted waves. In this instance, we can have 11 channels in one frequency band. "It is possible to use multiplexing, like in digital TV, on each of these to implement even more channels on the same states, which means one could obtain 55 channels in the same frequency band," said Tamburini.

Scientists can now create single-atom transistors repeatedly

University of New South Wales (UNSW) physicists have created a working transistor consisting of a single atom placed precisely in a silicon crystal. The tiny electronic device, described in a paper published in the journal Nature Nanotechnology, uses as its active component an individual phosphorus atom patterned between atomic-scale electrodes and electrostatic control gates.

This unprecedented atomic accuracy may yield the elementary building block for a future quantum computer with unparalleled computational efficiency.

Until now, single-atom transistors have been realised only by chance, where researchers either have had to search through many devices or tune multi-atom devices to isolate one that works.

"But this device is perfect", says Professor Michelle Simmons, group leader and director of the ARC Centre for Quantum Computation and Communication Technology at UNSW. "This is the first time anyone has shown control of a single atom in a substrate with this level of precise accuracy."

The microscopic device even has tiny visible markers etched onto its surface so researchers can connect metal contacts and apply a voltage, says research fellow and lead author Dr Martin Fuechsle from UNSW.

"Our group has proved that it is really possible to position one phosphorus atom in a silicon environment - exactly as we need it - with near-atomic precision, and at the same time register gates," he says.

It is predicted that transistors will reach the single-atom level by about 2020 to keep pace with Moore's Law. This major advance has developed the technology to make this possible well ahead of schedule.

www.cqc2t.org

IN BRIEF

Huawei places $6-billion chip order

Avago, Broadcom and Qualcomm have been awarded three-year chip deals by Huawei Technologies Co. Ltd., worth $6 billion. Huawei said the three-year OEM contracts awarded to the U.S. companies will directly and indirectly create tens of thousands of jobs for U.S. business while contributing to growth and development opportunities for California.

Huawei has declined to break out the amounts in the individual company contracts. Qualcomm (San Diego, California) said it would be supplying Snapdragon application processors and multimode modems to Huawei under its contract.

"The U.S. holds the leading position in the ICT industry, and when coupled with Huawei's long-term dedication to innovation in the U.S. market, the result is a strategic collaboration to develop a more diversified, balanced and healthier global ICT ecosystem," Ms. Chen Lifang, senior corporate vice president of Huawei, in a statement.

www.huawei.com

Micrel acquires PhaseLink for clock/timing portfolio

Micrel, Inc., has announced it has signed a definitive agreement to acquire a controlling interest in PhaseLink Company Limited, a private company based in Taiwan and Silicon Valley. The acquisition is intended to complement Micrel's high performance clock generation and distribution products for the communication market, as well as expand its offerings into the consumer and industrial markets.

The transaction is expected to close in the second quarter of 2012. Micrel currently expects the acquisition to be dilutive to earnings per share by approximately $0.02 per share on a non-GAAP basis in 2012 and accretive within 18 months of closing. Micrel expects to operate PhaseLink as a wholly owned subsidiary.

www.micrel.com

IN BRIEF

Qualcomm, HiSilicon, China drive unified LTE

The mobile industry has taken a few small but significant steps toward the holy grail of a unified technology, with the announcement by Qualcomm and HiSilicon of multi-mode chipsets that support both the FDD and TD flavors of the LTE. Separately, China Mobile has pledged to launch a converged TD/FDD LTE network this year in Hong Kong and Vodaphone has expressed support for the technology.

To date, global carriers have used two or three flavors of cellular technology. The move to a converged TD/FDD LTE network represents the current best hope for a single global standard. Currently AT&T and Verizon have led global deployments of LTE, using FDD technology, in part because it was ready first. But operators say the converged approach more efficiently uses scarce operator spectrum and eases global roaming issues.

www.hisilicon.com
www.qualcomm.com

Collaboration yields optimised small cell protocol stack

Texas Instruments and Aricent® are to collaborate on a small cell protocol stack optimized for KeyStone-based multicore System-on-Chips (SoCs) from Texas Instruments. With this integrated approach both companies will be able to more quickly, easily and cost effectively design small cell base stations.

This small cell protocol stack is specifically tailored for users of KeyStone-based multicore processors and SoCs. Integrating the field-proven KeyStone architecture elements for layers 2, 3 and transport processing with Aricent's software components optimizes design efficiencies and enables customers to develop more cost-efficient and high performance base stations.

www.ti.com/multicore
www.aricent.com

Alcatel-Lucent and China Mobile to jointly accelerate development of lightRadio

Alcatel-Lucent and China Mobile have signed a co-creation agreement under which teams from the two companies are conducting joint development and test activities on a series of lightRadio projects at Alcatel-Lucent's Stuttgart lab.

The work will help to accelerate the smooth commercial introduction of this groundbreaking product family to meet China Mobile's business initiatives and support growing customer demand for high-bandwidth mobile broadband services.

This co-creation agreement follows the non-binding MoU signed between Alcatel-Lucent and China Mobile in mid 2011. It also builds on the collaboration between the companies on the delivery of superfast mobile broadband using TD-LTE technology and the announcement of the first Trans-Pacific lightRadio video call. This agreement defines the projects that will be undertaken by the two companies and kicks off the co-development activities. This collaboration will speed the introduction of the lightRadio product prototype to the second half of the year.

Alcatel-Lucent's lightRadio™ reduces the size of traditional mobile base stations to a Rubik's cube, while lowering power-consumption and allowing the transfer of vast amounts of data at lightning fast speeds.

Under the terms of the agreement, China Mobile engineers have already begun working with Alcatel-Lucent's R&D team in the company's lab in Stuttgart Germany. The two companies will co-work on a series of lightRadio joint development projects including the cube-based radio, baseband unit (BBU) pooling and redefining the radio architecture.

www.alcatel-lucent.com

One transceiver per radiator is the only effective solution for Active Antenna Systems

There is only one way to build an effective Active Antenna System (AAS) according to Ubidyne. The company featured its LTE 700MHz uB700™ and 900MHz uB900™ Antenna Embedded Radios at the recent Mobile World Congress 2012. While there are multiple AAS architectures, Ubidyne believes it is vital to have one transceiver or M-Radio per antenna radiator. This means that an antenna with 16 radiators — or eight cross polar radiators — will also have 16 transceivers.

While others believe they can build an AAS with less transceivers, simulation results presented by the company at Mobile World Congress prove that having one small amplifier per radiator is the only way to deliver significant performance benefits, according to Michael Fränkle, CEO of Ubidyne. "The results show that only a full AAS can meet critical upper sidelobe suppression requirements with margin, while simultaneously providing the highest possible antenna gain over an electrical tilt range of more than 10 degrees. And because of our Self Healing feature, Ubidyne AAS still delivers this performance with up to four transceivers out of 16 being switched off."

Alternative integrated antennas simply integrate a Remote Radio Head (RRH) into the antenna housing but lack innovative features to increase coverage and capacity such as electronic tilting per carrier or standard, electronic and independent tilting of uplink and downlink, or vertical sectorisation. These features have a major impact on the quality and performance of the network and are packaged in all Ubidyne active antennas.

Other vendors go half-way with a semi AAS that has one amplifier serving several radiators. This reduces the amount of transceivers but performance is significantly impaired and self healing technology cannot correct antenna pattern distortions, such as side lobes.

At Mobile World Congress, Ubidyne showed its latest uB700 full active antenna that supports 4G (LTE) in the 700 MHz digital dividend band for broadband mobile networks in the US as well as the uB900™ that supports GSM, UMTS and LTE in the 900 MHz frequency band to address mobile networks in Europe, Africa, Oceania, Asia and the Middle East. Future products are also in development for the European digital dividend bands of 800 MHz and highband up to 2.6 GHz as well as multi-band solutions.

www.ubidyne.com

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Look What's Happening at IMS2012!

Plenary Session Speaker: Steve Mollenkopf
President and Chief Operating Officer, *Qualcomm*
3G/4G Chipsets and the Mobile Data Explosion

Monday, 18 June 2012
1730-1900

The rapid growth of wireless data and complexity of 3G and 4G chipsets drives new design and deployment challenges for radio and device manufacturers along with carriers. This talk will provide a perspective on the problem from the point of view of a large, worldwide manufacturer of semiconductors and technology for cellular and connected consumer electronics devices. The increase in device and network complexity will result in significant business opportunities for the industry.

Closing Ceremony Speaker: Thomas H. Lee
Professor, *Stanford University*
The Fourth Age of Wireless and the Internet of Everything

Thursday, 21 June 2012
1600-1730

"Making predictions is hard, particularly about the future." The patterns of history are rarely discernible until they're obvious and perhaps irrelevant. Wireless may be an exception, at least in broad outline, for the evolution of wireless has been following a clear pattern that tempts us to extrapolate. Marconi's station-to-station spark telegraphy gave way to a second age dominated by station-to-people broadcasting, and then to today's ubiquitous people-to-people cellular communications. Each new age was marked by vast increases in value as it enlarged the circle of interlocutors. Now, these three ages have covered all combinations of "stations" and "people," so any Fourth Age will have to invite "things" into the mix to provide another stepwise jump in the number of interlocutors. This talk will describe how the inclusion of multiple billions of objects, coupled with a seemingly insatiable demand for ever-higher data rates, will stress an infrastructure built for the Third Age. Overcoming the challenges of the coming Fourth Age of Wireless to create the Internet of Everything represents a huge opportunity for RF engineers. History is not done.

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IEEE

IN BRIEF

Tiny UMTS and LTE-ready small cell demonstrated

Octasic Inc., has partnered with Deltenna Limited to create what is claimed to be the world's smallest Microcell/Small cell platform, the WhiteStar, which was demonstrated recently at Mobile World Congress 2012.

WhiteStar is a fully integrated, true SDR, multi-frequency and multi-standard, small cell platform that can operate two standards concurrently through dual TRx 2x2 MIMO paths (TDD and FDD). It provides system integrators with a way to dramatically reduce the time to market of their microcell/small cell products. Such an innovative small cell design is made possible by the flexibility and capacity (64 HSPA+ users in a 10 km cell) of the OCT2224W baseband SoC that runs any cellular PHY and by the software-configurable FARM100 transceiver sub-system designed by Deltenna.

www.octasic.com

HiSilicon and imec to research reconfigurable RF transceivers

HiSilicon and imec have signed a strategic research collaboration to develop RF transceiver architectures for next-generation mobile terminals. With the partnership, HiSilicon joins the imec R&D program on cognitive reconfigurable radio to jointly conceive low-power, compact, high-performance reconfigurable CMOS RF transceivers.

By combining fundamental rethinking of the circuit architectures and designs with clever use of the benefits tsxwhat the aggressively scaled technology offers (such as high intrinsic speed of the nanoscale transistors) the program aims at developing small, cost-effective, performance- and power-competitive reconfigurable radio transceivers in 28-nm digital CMOS covering all key broadband communication standards including next generation standards such as LTE advanced and next-generation WiFi (802.11ac).

www.imec.be

First phone with 'hover' functionality enabled by Cypress TrueTouch controller

Cypress Semiconductor's TrueTouch controllers are driving the 'floating touch' navigation feature for magic web browsing on the latest Xperia sola smartphone from Sony Mobile Communications. The Xperia sola's floating touch claims to be the-first smartphone to allow users to navigate by hovering a finger above the screen so it acts like a moving cursor without actually touching the screen. Once the desired link is found it can be highlighted and a simple tap will load the page. This alleviates the common problem of tiny links on a phone screen that are difficult to access. The technology also enables users to operate the Xperia sola flawlessly while wearing even thick gloves.

Cypress's TrueTouch controllers enable this feature with patent-pending technology that has the ability to execute both self-capacitance and mutual-capacitance measurements in the same device—and switch dynamically between the two in application. This capability enables the hover and glove touch functionality.

touch.cypress.com
www.cypress.com

GSMA and WBA team up to simplify Wi-Fi hotspot access for smartphones

The GSMA and the Wireless Broadband Alliance (WBA) are working together to simplify connectivity to Wi-Fi hotspots from mobile devices such as smartphones and tablets. The joint initiative is developing technical and commercial frameworks for Wi-Fi roaming, which will bring together the benefits of mobile technology and Wi-Fi networks.

Wi-Fi is increasingly emerging as a feature on smartphones and tablets, but today there is no consistency in the way these devices attach to Wi-Fi networks. This process includes device configuration, the use of access keys and the various mechanisms for acquiring and paying for connectivity. Wi-Fi roaming will allow mobile devices to seamlessly connect to a Wi-Fi hotspot using the SIM card for authentication, as well as enable mobile operators to uniquely and securely identify users whether they are on a mobile or Wi-Fi network.

Wi-Fi roaming will be based on the WBA's 'Next Generation Hotspot' programme and the Wi-Fi Alliance's 'Passpoint certification' technology. It will also build on the GSMA's successful roaming principles.

www.gsma.com

AWR gets patent for block-specific harmonic balance analysis system in circuit design

AWR has been issued US Patent No. 8,131,521, which addresses circuit simulation using multi-rate harmonic balancing (MHRB). MRHB™ speeds the design of complex circuits by enabling the effective reduction of analysis dimensions.

"MRHB satisfies the needs of our customers to perform steady-state analysis of distributive or dispersive systems with more than two or three signal sources," said Taisto Tinttunen, chief director of engineering of AWR's APLAC® division.

"Harmonic balance engines traditionally do not scale well as the number of tones increases. As a result, simulating a complete receiver or high-speed digital circuit was extremely difficult or impossible because of the high computational cost of nonlinear model evaluations and the extensive memory utilization. MRHB eliminates this limitation by defining harmonic balance analysis on a block-by-block basis. Reducing filtered sources and their harmonics by defining new hybrid tones based on linear combinations of the source tones, as MRHB does now, makes it possible to simulate designs that were previously beyond the reach of the harmonic balance technique."

www.awrcorp.com/patents

This month's cover illustrates the ongoing growth of wireless communications and the merging of many networks and technologies to provide the underlying infrastructure. As we move to LTE and LTE-Advanced, the need for interoperability is of paramount importance.

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Increasing the realism of radar testing with an advanced signal scenario generator

By Beate Hoehne, Product Manager Pulse Pattern Generators, Digital Test Division, Agilent Technologies

Radar designers face three seemingly contradictory imperatives: Increasing system capability while shrinking overall size and accelerating time-to-market. They face similar needs when creating systems capable of testing their new designs. All of these exist under today's constant overarching driver: the need to reduce all associated costs, from up-front equipment purchases to on-going maintenance.

In response to these needs, developers are turning to standardized products as the building blocks for new designs and new test systems. This is enabled by today's evolving digital technologies, which provide a foundation for greater flexibility, smaller size and lower costs.

Packing more capability into a test system

Thorough verification of radar system performance requires the creation of realistic signal scenarios that push a design to its limits. The optimum test system will minimize the need for costly flight testing by emulating a variety of flyover conditions in their entirety.

An arbitrary waveform generator (AWG) is typically the signal source of choice. Two of the key requirements are small pulses and long playback times. At first blush, the right solution may appear to be a wide-bandwidth AWG with an ample amount of built-in memory. However, two additional attributes are crucial. First, high resolution at wide bandwidth enables the creation of highly accurate signal scenarios. Second, advanced sequencing capabilities ensure efficient use of available memory while creating highly complex simulations.

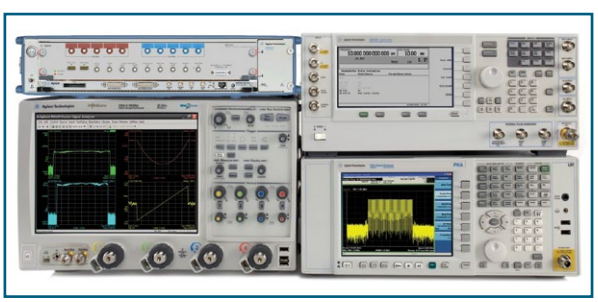
All of these capabilities are built into the Agilent M8190A signal scenario generator (SSG). Based on patented digital-to-analog converter (DAC) technology, the M8190A raises the bar with 14-bit resolution at 8 GSa/s or 12-bit resolution at 12 GSa/s. The unit can easily switch between those modes to meet the needs of different applications. It is also precise enough to serve as the modulation source for an RF/microwave signal generator.

The M8190A SSG can be configured with 128 MSa (standard) to 2 GSa (optional) of waveform memory per output channel. With 2 GSa installed, the maximum playback time is 1.6 s at the highest frequency. The absolute amount of waveform memory is important; however, using the available memory efficiently enables a concept called memory gain. Unlike typical AWGs, the M8190A offers advanced sequencing capabilities such as stepping, looping and conditional jumping. This makes it possible to create repeated segments once and then reuse them programmatically as needed. These capabilities can be applied to waveforms or waveform sequences.

Sketching a versatile test setup

A typical test system configuration will help illustrate the value of the M8190A SSG. In addition to the SSG, the other instruments in the example system are a wide-bandwidth oscilloscope, a signal analyzer and an RF/microwave signal generator, which also serves as an upconverter (Figure 1).

Figure 1: A well-chosen combination of stimulus and measurement instruments enables highly accurate simulation and characterization of radar systems.



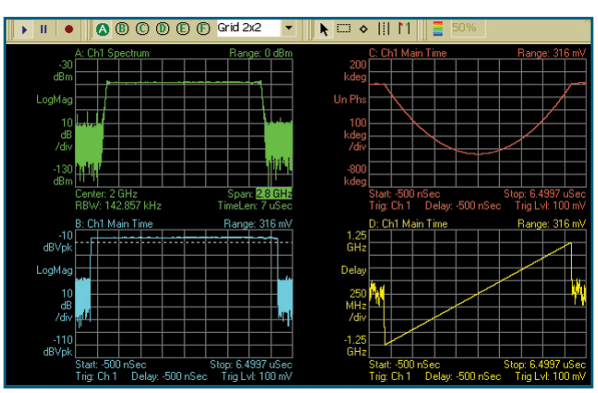


Figure 2: The M8190A enables the creation of highly realistic signals such as this radar LFM chirp (as displayed using vector signal analysis software).

Agilent's recommended configuration includes a 44-GHz Agilent E8257D PSG analog signal generator, 50-GHz Agilent Infiniium DSO90000A Series high-performance oscilloscope, 50-GHz E4448A PSA Series spectrum analyzer (with Agilent 89600B vector signal analysis software) and the M8190A SSG. Within this system, the M8190A adds its unique combination of resolution and bandwidth, enabling developers to push their radar designs to the limit and extract new insights about system performance.

This system is capable of producing the radar LFM chirp shown in Figure 2. In the bottom-right trace, a frequency-versus-time display illustrates the performance of the M8190A across a 2-GHz frequency span.

Conclusion

Successful delivery of future radar systems depends on the ability to increase system capability while shrinking overall size, reducing costs and accelerating time-to-market. The same is true for the test system used to characterize radar accuracy and performance. The most cost-effective way to satisfy these needs is through the use of standardized products in both the radar and its test system. Through advances in digital technology, "standardized" is no longer synonymous with "limited functionality." The Agilent M8190A SSG embodies this new direction: Even though the M8190A is a standardized product, it provides the signal fidelity and functional versatility needed to address a wide range of present and future testing requirements.

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Graphene to eliminate charge times in portable devices?

Electrochemical capacitors (ECs), also known as supercapacitors or ultracapacitors, differ from regular capacitors that you would find in your TV or computer in that they store sustantially higher amounts of charges. They have garnered attention as energy storage devices as they charge and discharge faster than batteries. However they are still limited by low energy densities of only a fraction of the energy density of batteries.

An EC that combines the power performance of capacitors with the high energy density of batteries would represent a significant advance in energy storage technology. This requires new electrodes that not only maintain high conductivity but also provide higher and more accessible surface area than conventional ECs that use activated carbon electrodes.

Recently researchers at UCLA have used a standard LightScribe DVD optical drive to produce such electrodes. The electrodes are composed of an expanded network of graphene — a one-atom-thick layer of graphitic carbon — that shows excellent mechanical and electrical properties as well as exceptionally high surface area. UCLA researchers from the Department of Chemistry and Biochemistry, the Department of Materials Science and Engineering, and the California NanoSystems Institute have demonstrated high-performance graphene-based electrochemical capacitors that maintain excellent electrochemical attributes under high mechanical stress. The paper is published in the journal Science.

“Our study demonstrates that our new graphene-based supercapacitors store as much charge as conventional batteries, but can be charged and discharged a hundred to a thousand times faster,” said Richard B. Kaner, professor of chemistry and materials science and engineering. “Here, we present a strategy for the production of high-performance graphene-based ECs through a simple all solid-state approach that avoids the restacking of graphene sheets,” said Maher F. El-Kady, the lead author of the study and a graduate student in Kaner’s lab.

If this development could be manufactured commercially, the idea of charge times could be a thing of the past. It would also open the door to many new energy storage applications, or even the possibility of making device charging on the move a practical experience.

Jean-Pierre Joosting
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www.microwave-electronics.com

MEMS' new battleground: Hardware-agnostic sensor fusion?

By Junko Yoshida, EE Times

As more and more MEMS sensors are showing up in mobile devices, the focus of MEMS design has begun shifting from discrete MEMS components to MEMS sensor data integration. How raw data from multiple sensors is "fused" and "interpreted" makes a noticeable difference in a system's power consumption and apps performance, according to Ian Chen, executive vice president, Sensor Platforms, Inc., a San Jose, California-based start-up.

Keeping that premise as the company mission, Sensor Platforms rolled out on March 26th a library of software algorithms and middleware designed, according to company claims, "to interpret users' contexts and intents" by using data from multiple sensors in mobile devices.

Commonly found MEMS sensors in today's smart phones and tablets include accelerometers, magnetometers, gyroscopes and barometers.

In keeping with the trend for continuous integration where possible the idea of integrating multiple MEMS sensors is attractive. However, one unanswered question confronting today's MEMS component suppliers and system designers is: "Who will determine the sensor architecture, where the processing will reside and the motherboard-level sensor fusion architecture?"

While some companies may integrate all these sensors in a single monolithic device and wrap everything in smart components (although not an easy feat), Sensor Platforms has chosen another approach: offer sensor fusion in software that's hardware agnostic.

The company says that its single code-base software can be used across platforms. It can be run in its entirety on an apps processor, on a sensor hub, or spread over the system.

That gives one clear advantage to Sensor Platforms' software-based sensor fusion, said Chen: flexibility. "Our software allows system designers to pick and choose different supply sources for each sensor. The flexibility in sourcing is critical since these sensors come at different price and performance points."

Another advantage of Sensor Platforms' software lies in the conservation of sensor power, according to the company.

Throwing more sensors into a mobile device is one thing. But how to minimize the associated power consumption is another.

Chen noted, "Up to 10mW is added in power consumption when sensors are in use." Sensor Platforms' software library, called "FreeMotion Library," comes with a proprietary algorithm that can "turn off power hungry sensors, like the gyroscope, and emulate its function with lower power sensors when user movements are slow." That translates into "dropping sensor power consumption by 90 percent," he added.

Then, there is the issue of reliability. Although not broadly advertised, some smart phones' compass calibration can be off by 90 degrees, according to Chen. "All sensors require frequent calibration to maintain their data quality," he noted. Sensor Platforms' FreeMotion Library is built on an architecture that supports reliable sampling, and ongoing cross-sensor calibration to assure reliable sensor information – both for application developers and end users, the company said.

In sum, just designing a number of MEMS sensors into one's system is hardly enough to improve a system's power consumption, flexibility in system designs, sensor data or reliability and apps' performance.

Tony Massimini, chief of technology at Semico Research, noted: "Now with all this data, how do the system designers fully utilize it? We may be just scratching the surface." Further, he acknowledged, "The industry is at an early stage. System designers, many new to MEMS, need software development tools."

The need for SDK is not limited to systems designers. It extends to apps developers, who are trying to leverage motion data – collected by sensors in a mobile device – in their new apps.

Chen said Sensor Platforms is rolling out the FreeMotion library's API, so the data produced by its sensor calibration and sensor fusion provides apps developers robust data with better accuracy. Further, Chen said that "apps need information and context about the user, not just the user's location or changes in his motion or direction." The FreeMotion software development kit offers "a foundation to extend the type of information that applications can gain from sensor data," according to Sensor Platforms.

Competitive landscape

Sensor Platforms' key competitors are likely to be MEMS sensor component suppliers, who are developing their own sensor fusion software.

Earlier this year, Freescale Semiconductor, for example, introduced its own sensor fusion algorithms called Xtrinsic for electronic compass. Electronic compass applications combine magnetometer-provided headings with corrections from inertial sensors that compensate for stray magnetic fields. Freescale is offering its sensor fusion algorithms as a free download for its MEMS sensor users.

Meanwhile, STMicroelectronics last fall rolled out its own sensor fusion algorithms called iNEMO Engine Sensor Fusion Suite. According to ST, its iNEMO Engine can be combined with ST's iNEMO Inertial Modules to create complete and customizable hardware/software multi-axis MEMS sensor solutions for enhanced motion and accurate heading recognition.

These MEMS sensor vendors use proprietary libraries to lock customers into their products, explained Sensor Platforms' Chen, in contrast to his company's hardware-independent sensor fusion software.

Semico's Massimini, describing sensor fusion as "still at early stages," expects "more innovation as it draws more attention." While the competitive landscape remains far from being defined, Massimini mentioned Movea as a potential competitor.

"Movea has been delivering solutions for several years while Sensor Platforms is a startup just hitting the market," he said. Movea is offering motion-responsive software, firmware, and semiconductor IP for markets such as mobile and tablets, Interactive TV and sports and eHealth. Massimini noted, "Movea has developed a system that allows system developers to implement their algorithms using Movea IP blocks. Movea is working with a CAD vendor so the output of this tool can be used to design an ASIC."

Panel predicts MEMS boom, silicon to win slots

The consumer electronics industry is going to continue being a driver for rapid expansion in MEMS volume shipments with established equipment being loaded with more sensors and actuators even as equipment sales expand and new equipment comes on to the scene. That's according to the final panel discussion at the MEMS Executive Congress Europe held in Zurich, Switzerland, on Tuesday March 20. In the mobile phone and tablet computer expect to see silicon MEMS being used for camera autofocus mechanisms, for tunable RF circuits, audio speakers and chemical sensors, creating increasing opportunities, said panelist Jean-Christophe Eloy, founder and president of market research organization Yole Developpement,

Tehro Lahtinen, innovation manager at sports watch maker Suunto, was excited by the opportunities for MEMS of many types in sports equipment, in clothes, in the Internet of Things and wireless sensor networks. Andre van Geelen, general manager at Epcos Netherlands BV said his company will be looking to offer RF and timing circuits based on MEMS to help maximize bandwidth in mobile phones.

Eloy argued that whatever mechanical devices could be rendered into silicon would be, and hence the imminent take off of RF MEMS, MEMS for cameras and audio speakers. On top of that automotive penetration would continue and medical applications, with notoriously arduous qualification cycles, were starting to come through, creating a happy situation for MEMS makers and MEMS users alike. The "big bang" in MEMS consumer applications is generating a wave that is washing back into automobile infotainment and sports and well-being applications have similarities to medical without some of the stricter testing and clinical trials requirements.

But Sauli Palo, principal specialist in component quality at Nokia Oy, revealed the other side of the coin, pointing out that as the volumes go up the price must come down and requirements can become tougher. "MEMS have become commoditized. The key is to find the good applications. It is up to the apps developers to sort out what can be done," he said. He also argued that MEMS components, both inertial sensors and microphones are too fragile and that companies that could address these issues would do well.

A second topic picked up by the panel was whether a fabless-foundry could become successful in the MEMS sector where the technology base is so diverse. "Helping the fabless to success [in MEMS] is the most important thing we can do," said Eloy.

Eloy argued that two types of MEMS foundry would co-exist. The higher volume offerings would come from IC foundries such as TSMC, UMC and Globalfoundries, while the traditional MEMS specialist foundries, such as Dalsa and Micralyne, would act as development partners and support lower volumes. "They are different supply chains that are not competing. You could start with one before moving to another one."

From the floor the observation was made that startup companies cannot afford to invest in a wafer fab and that foundry services were clearly in demand but that it remains unclear whether MEMS companies yet have the discipline to work within strictly delineated process limitations.

For van Geelen it was clear that each application usually requires a unique process, something that also works against multiproject wafer runs.

Nokia's Palo was asked how the mobile phone maker felt about using fabless suppliers "We started with IDMs [integrated device makers] but we have gone to fabless in other areas [apart from MEMS]. It does raise questions," he said.

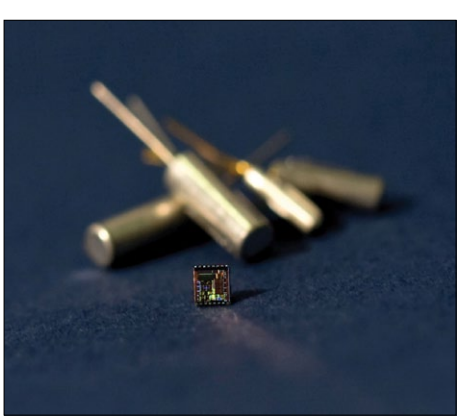
eoSemi aims big with quartz crystal replacement

UK startup eoSemi is aiming to take a significant share of the market for quartz crystals in high volume applications such as mobile phones with its all-CMOS oscillator changes the way systems are designed. Because its devices can be made using standard semiconductor manufacturing technology, eoSemi's products are cheaper, smaller, easier to integrate, more robust and consume less power than competing offerings.

The company will ship its own products based on the 180 nm ATOC (Accurate Timing Oscillator Circuit) technology to replace 32 kHz quartz crystals on printed circut boards, but it is also offering a manufacturing licensing to large semiconductor companies that supply mobile phone makers. The temperature compensation in ATOC removes the need for a thermistor and two capacitors and allows the timing source to be integrated into a system in package (SIP) that includes the other chips for a mobile phone. This dramatically simplifies the design of the phone, making it cheaper to make and more reliable, says Ian Macbeth, CEO of eoSemi. It is this key advantage that will see the technology take off, he says, particularly as sourcing quartz crystals is a key problem for many manufacturers and a single source of failure in a design.

The design includes key calibration circuitry to minimize the impact of the process technology, and the algorithms to calibrate the device are provided as binary code to the manufacturing partners to ensure the design is protected. "If any one reverse engineers it they don't have a calibrated part and the algorithms for that are part of the production flow," said Macbeth. " We provide these algorithms as pieces of executable code that are secure, not source code," he said.

The company is now looking at dual frequency devices with an oscillator in the MHz range that would be tunable at the manufacturing stage or by the user. "We could



have a programmable output that could even e user selectable," he said.

Early silicon has been shipped to partners from TSMC and is undergoing life testing with commercial launch towards the end of the year. The device draws just 8 µA of supply current in active mode with accuracy down to ±30 ppm across the operating temperature range of -40 to +85°C.

Developing compact antenna couplers for TransferJet wireless data-transfer technology

By Nobuaki Satomi, Senior Product Engineer, RF and Antenna Products, Murata Europe

TransferJet is a close-proximity or 'touch' wireless transfer technology developed by Sony that enables the high-speed transfer of large data files, such as music, images and videos, between TransferJet-compliant electronic devices. The technology is expected to function as a new communication interface to provide more speedy and efficient communication between mobile terminals, such as a mobile phone and a digital camera, and between a PC or TV and a mobile terminal.

TransferJet technology enables data transfer at a peak speed of 560 Mbps with an effective throughput up to 375 Mbps – although the system can adjust the transmission rate depending on the wireless environment. The maximum range of operation is in the order of a few centimeters and the network topology is always point-to-point between two active (powered) devices. The technology has been described as fast data transfer with the ease of using a USB cable – just without the cable.

A key aspect of TransferJet is the close proximity required for data transfer. If two TransferJet devices are more than a few centimeters apart, then they should not connect or even detect each other. But it is not necessarily simple to restrict operation to such a short range. This is a difficult task for a conventional antenna, as a typical antenna device is designed to radiate a signal as far as possible. Therefore an important element of TransferJet concerns the development of antenna coupler technology. An antenna coupler is a device that transfers signals between couplers by using electric field induction, working like an antenna in general wireless devices. However, the antenna coupler characteristically achieves a high gain at close range and shows rapid attenuation when it departs from an antenna coupler in another electronic device.

The short range makes it possible to operate in the 'near field' of the radio signal using very little transmit power – in fact less than -70 dBm per MHz is required on average – which in conjunction with the point-to-point network topology helps to minimize overall power consumption. Additionally, as the antenna coupler's coupling electrode generates non-polarized longitudinal electric field waves, two TransferJet-compliant devices do not have to be precisely oriented to achieve a good connection and fast data transfer. Table 1 shows the TransferJet wireless technology specifications.

Over many years, Murata Manufacturing has developed a variety of different antennas for mobile phones and other wireless communication devices – focusing on the miniaturization of electronic components and making it possible for high-density board packaging, resulting in the development of highly advanced, multi-functional devices. The company's antenna coupler products have been developed based on this miniaturization concept; and specifically for TransferJet applications, Murata has developed the LDA5M_L series of antenna couplers (see Figure 1), which are believed to be the smallest in the industry. See Table 2 for series specifications.

Two key products in the series have been selected to meet a broad range of needs: the first, measuring 5.4- x 4.5- x 1.5-mm, is a low-height device intended for mobile terminals; the second, measuring 5.4- x 4.5- x 2.0-mm, is suitable for mobile terminals and for large couplers that require more advanced functionality. In developing the series, Murata has also made full use of simulation technologies to find an optimal design based on the unique electrode structure, in addition to developing wider design variations suitable for more diversified market requirements.

These devices have been developed using Murata's unique high-frequency design technology and multi-layer technology, which makes use of advanced low-temperature co-fired ceramic (LTCC) technology, which the company has continually refined in the development of its multi-layer products. The technology enables a highly reliable structure and stable temperature characteristics over the -40 to +85 °C range. In addition, using innovative ceramic dielectric material that offers a high dielectric constant, Murata has achieved a compact and low-profile design that allows large attenuation outside the bandwidth of 4.2 to 4.76 GHz used by TransferJet, while keeping flat and high-level coupling characteristics within the required bandwidth.

The recommended specifications for antenna couplers are described in the standard developed by the TransferJet Consortium, in the form of the degree of coupling with a standard coupler specified by the consortium. Figure 2 shows the coupling characteristics

Table 1: TransferJet wireless technology specifications.

Centre Frequency	4.48GHz (4.2 to 4.76 GHz)
Transmission power	-70dBm/MHz or less (average power)
Transmission rate	560Mbps(MAX) / Effective rate: 375Mbps
Transmission distance	Several centimeters
Topology	1-to-1 (point-to-point)

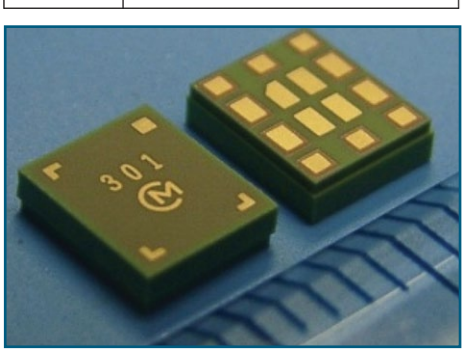


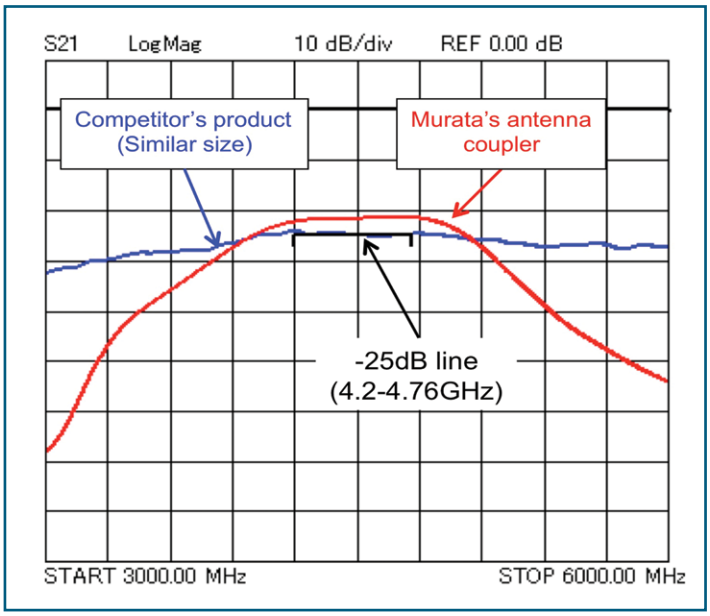
Figure 1: External view of LDA5M_L series.

Product name	LDA5M4G4815L-301	LDA5M4G4820L-302
Dimension	5.4x4.5x1.5mm (Max)	5.4x4.5x2.0mm (Max)
Footprint on Board	5.8x4.9mm²	5.8x4.9mm²
Coupling Characteristics S21*1(4.48GHz) >-25dB (Spec)	-22dB*2	-20dB*2
In-band deviation*1 (4.2GHz-4.76GHz) <3dB (Spec)	0.8dB*2	0.5dB*2

*1: Coupling characteristics with standard coupler (position x:0, Y:0, Z:15)
*2: Central value

Table 2: LDA5M_L series specifications.

Figure 2: Coupler characteristics.



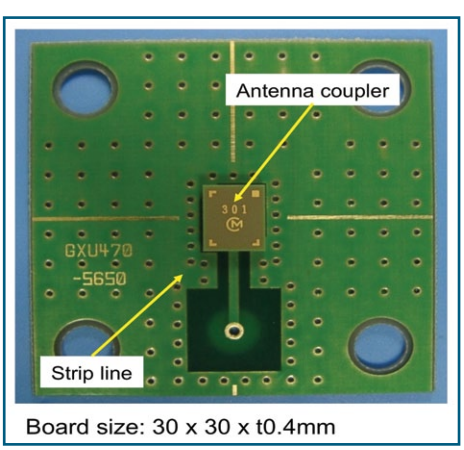


Figure 3: Mounted on standard board.

of the series when mounted on a standard board, shown in Figure 3, and placed face to face with the standard coupler at a distance of 15 mm. The product satisfies the recommended specifications and shows good performance compared to a competitive product with a similar size.

The series controls attenuation using its unique electrode structure, thereby making it possible to keep flat coupling characteristics within the 4.2 to 4.76 GHz bandwidth, while simultaneously delivering high attenuation outside of the required bandwidth. This ability complements the functionality of the filters used in the front-end radio-frequency part of TransferJet.

As was previously mentioned, an antenna coupler transfers data by using the electric induction field between couplers. However, if a metal material is adjacent to the coupler then the input impedance and parasitic capacitance will vary and, as a result, change the coupling condition. In addition, the GND condition of the internal layer of the mounting board will change the coupling condition. To deal with this issue, Murata has a considerable amount of application data based on assumable conditions for actual devices, which it can make available for customers and which the company believes can help make a significant contribution to improve design efficiency in the early phases of the design process.

Beyond the development of the LDA5M_L series, Murata continues to develop leading-edge compact and low-profile antenna-coupler products to help customers get to market quickly with new multi-functional and highly advanced electronic devices that utilize the fast emerging TransferJet technology.

Expanding the use of aerial downlinks

John Payne IV, IMT Chief Technology Officer

Today, airborne downlinks are no longer limited to strategic command applications. More and more, first responders, fire departments, EMS, CBP and others are employing airborne downlinks to meet a diverse array of needs. Through the use of digital downlink technology, these systems are easier to use, eliminating the need for highly trained technical personnel to operate them. They also now have full-featured infrared cameras and secure digital COFDM transmitters, allowing users to share the video intelligence, surveillance, and reconnaissance information across multiple organizations and agencies.

At Integrated Microwave Technologies, LLC (IMT) we developed a turnkey approach to aerial downlinking for military and government users who need IP streaming and receivers for decoding and encoding, as well as installation and troubleshooting.

The situation

Whether the downlink platform is a fixed-wing aircraft, helicopter, unmanned aerial vehicle (UAV) or even a rapidly deployable blimp, these vehicles carry with them an arsenal of high-quality imagers. These imagers can be daylight cameras, infrared cameras or other sensors capable of chemical or biological detection. Infrared imagers are able to see through smoke from an industrial fire or track a perpetrator under the cover of darkness. Depending on your operational need, these platforms can be positioned far away from the situation — covertly spying on a perpetrator — or right on top of it.

The equipment

The video from the aerial platform has a tremendous value to operations. Sharing this effectively requires a digital downlink transmitter. The transmitter accepts the high definition video from the imager or other onboard sensor and compresses the video so that it can be transmitted in an effective manner. The compressed digital video is then encrypted using a universal standard AES encryption method known as BCRYPT. The encrypted signal is then applied to a COFDM RF modulator and transmitter, which takes the data intended to be transmitted and converts it into a format optimized for aerial downlink transmission. The transmitter is set to transmit at a specific RF frequency; typically between 6.4 GHz and 6.5 GHz, and is divided into twelve discrete channels. It is important to understand that these bands require a license and often require coordination with a local frequency coordinator.

Once the signal is prepared for transmission, the RF output of the transmitter is connected to an antenna system. This system can be composed of a single omni-direction antenna, or a more complex hybrid-directional or a downward-facing antenna. Several factors dictate the type of antenna system needed for a specific application. The terrain of the area will determine the best type of system, as mountainous and city locations require a different solution than a more rural area. Also, the distance between receive sites is a major factor.

The results

Once the video has been transmitted, several individuals can review it simultaneously. Sharing real-time video minimizes the need for voice instructions over a two-way radio. The video is typically transmitted back to a strategic command center, where it is displayed on a display wall and archived for forensic use. This type of video is especially useful for tactical operations. Video can be shared with such ground personnel as, for example, a firefighter looking to position water for optimal effect, a policeman in a squad car helping to identify suspects during a drug intervention or even first responders needing video surveillance during a rescue.

The downlink feed can be used more effectively with the deployment of the right type of system. With the correct camera, encoding, BCRYPT AES encryption and COFDM digital transmission, video can be shared without bounds. Proprietary systems will limit the ability to share feeds, ultimately costing additional money and potentially the loss of valuable aerial platform during budget tightening. With the universal COFDM standard, a multitude of receivers are available, ranging from a small body-worn application to a county- or state-wide system.

The products

IMT's SkymasterTX aircraft transmitter features both MPEG-2 and MPEG-4 encoding, BCRYPT AES encryption and COFDM modulation. All this is packaged in an airframe-friendly NVG ARINC fast-deployable rugged chassis, intended to be mounted directly into an aircraft's console. SkymasterTX is designed for any application requiring reliable video downlink from an aircraft. Fire departments find SkymasterTX to be specifically useful due to its effectiveness with infrared cameras, as they can view a fire from the air and see where all the hotspots are, without having to send personnel into a dangerous situation. Law enforcement also finds this system useful in monitoring a potentially dangerous system from above.

For small, light-weight applications, the STx transmitter is an MPEG-4/COFDM transmitter that delivers HD/SD output at 250 mW, occupies less than five cubic inches at 0.16 lbs and can be mounted on virtually any small vehicle.

IMT also designs a broad range of receivers. For example, police receiver applications differ from those for firefighters: today's police cars are filled with technology, basically functioning as a mobile command center. In contrast, the typical fire truck is usually equipped with a standard two-way radio, with its command center set up on site. Law enforcement customers typically have several central receive sites overlapping each other, with a control center for the whole network. For firefighting applications, most of their work is done outside of the truck, requiring a more mobile solution. This way, regardless of where you are in relation to the fire, you have access to the video feed from the helicopter above.

The Mobile Tactical Receiver is a diversity COFDM receiver that will receive the downlinked transmission and stream the video directly to the police car's in-board computer system device, where the video is decoded and displayed.

The Mobile VIEWER is a self-contained receiver and decoder with a display unit. This is suited for viewing downlink video on a self-contained package. It is specially designed to function under the rigorous environment requirements of a firefighter.

The Portable Suitcase Receiver (PSRx) is a remote strategic command-post receiver. It features a large-format display (23 inches) daylight readable monitor, and a multiband diversity receiver with a DVR and dismountable antennas for improved range.

Testing carrier aggregation in LTE-Advanced network infrastructure

By Dr. Stamatis Georgoulis, Aeroflex Test Solutions

For LTE-Advanced, 3GPP Release 10 introduced several new features to augment the existing LTE standard, and these are aimed at raising the peak downlink data rate to 1 Gbps and beyond, as well as reducing latency and improving spectrum efficiency. Targets have also been set enabling the highest possible cell edge user throughput to be achieved.

If the high data rate targets are to be met, LTE-Advanced will require a channel bandwidth that is much wider than the 20 MHz currently specified for LTE. This will not be possible with just a single carrier in the limited spectrum bands available to most operators. Consequently, carrier aggregation—the ability to combine multiple carriers scattered around the spectrum—will be a key measure to achieve the wider effective bandwidth that will be required, typically up to 100 MHz. This means that multiple carriers comprised of either contiguous or non-contiguous spectrum need to be added together to allow these wider channel bandwidths—and thus faster data rates—to be achieved. Implementing carrier aggregation in a network will mean that operators and infrastructure vendors will require a test mobile equipped with carrier aggregation, ahead of real mobile terminals becoming available.

Evolution to LTE-Advanced

The aim of the 3GPP program for LTE-Advanced is to meet or exceed the requirements of IMT-Advanced within the time frame laid down by the International Telecommunications Union Radiocommunication Sector (ITU-R).

The key targets of IMT-Advanced are: 100 MHz bandwidth, a data rate of 1 Gbps in the downlink and 500 Mbps in the uplink, with 8x8 MIMO and 4x4 MIMO, respectively, in the downlink and uplink. C-plane latency will be a maximum of 50 ms, while U-plane latency will be less than or equal to 5 ms. Table 1 compares these targets with the specification for LTE Release 8 and for LTE-Advanced.

The evolved standard will offer a higher average spectrum efficiency and cell edge user throughput than Release 8 LTE, with greater spectrum flexibility due to newly allocated bands. Self-organising networking and deployment will be an integral part of LTE-A, because the network complexity will make manual optimisation unfeasible. It is envisaged that there will be a smooth and low cost transition from LTE (Release 8) to LTE-A over the intervening period.

Furthermore, LTE-A will need to coexist with LTE, with a progressive development in infrastructure and gradual upgrades to terminals. Functionality will also need to be scalable.

Bandwidths

As the spectrum is already crowded it is difficult for the regulatory bodies to allocate a non-fragmented part of the spectrum with 100 MHz bandwidth. Likewise the majority of the bands already assigned for LTE (see Tables 2(a) and (b)) are not broad enough on their own to provide the 100 MHz bandwidth specified for LTE-A. There is also an issue with legacy systems, where bandwidth is occupied by standards that pre-date LTE Release 8. Hence there is a need to combine the available spectrum bands in one of a number of prescribed ways, a technique collectively known as carrier aggregation.

Carrier aggregation is a means of flexible spectrum allocation in order to achieve wider bandwidth transmission. A complete system bandwidth of up to 100 MHz may consist of between two and five basic frequency blocks called component carriers (CC). At least some of the CCs are backward compatible with Release 8 LTE, and the aggregated bandwidth may be made up from either CCs from the same band (intra-band CA) or CCs from different bands (inter-band CA). LTE-A supports both contiguous and non-contiguous spectra for intra-band CA. Some examples are given in Figure 1.

The first diagram in Figure 1 shows the case of contiguous intra-band carrier aggregation, where 100 MHz bandwidth is obtained by aggregating five component carriers from adjacent bands. The

		Release 8 LTE	LTE-Advanced	IMT-Advanced target
Peak data rate	Downlink	300 Mbps	1 Gbps	1 Gbps*
	Uplink	75 Mbps	500 Mbps	
Peak spectrum efficiency [bps/Hz]	Downlink	15 (4x4 MIMO)	30 (up to 8x8 MIMO)	15 (4x4 MIMO)
	Uplink	3.75 (64QAM SISO)	15 (up to 4x4 MIMO)	6.75 (2x4 MIMO)

*100 Mbps for high mobility and 1 Gbps for low mobility.

Table 1: 3GPP LTE-Advanced specification compared with LTE Release 8 and IMT-Advanced targets.

Table 2(a): Band designations for LTE FDD.

LTE BAND NUMBER	UPLINK (MHZ)	DOWNLINK (MHZ)	MAIN REGIONS OF USE
1	1920 - 1980	2110 - 2170	Asia, Europe
2	1850 - 1910	1930 - 1990	Americas, Asia
3	1710 - 1785	1805 -1880	Americas, Asia, Europe
4	1710 - 1755	2110 - 2155	Americas
5	824 - 849	869 - 894	Americas
6	830 - 840	875 - 885	Japan
7	2500 - 2570	2620 - 2690	Asia, Europe
8	880 - 915	925 - 960	Asia, Europe
9	1749.9 - 1784.9	1844.9 - 1879.9	Japan
10	1710 - 1770	2110 - 2170	Americas
11	1427.9 - 1452.9	1475.9 - 1500.9	Japan
12	698 - 716	728 - 746	USA
13	777 - 787	746 - 756	USA
14	788 - 798	758 - 768	USA
17	704 - 716	734 - 746	USA
18	815 - 830	860 - 875	Japan
19	830 - 845	875 - 890	Japan
20	832 - 862	791 - 821	Europe
21	1447.9 - 1462.9	1495.5 - 1510.9	Japan
22	3410 - 3500	3510 - 3600	

LTE BAND NUMBER	ALLOCATION (MHZ)	MAIN REGIONS OF USE
33	1900 - 1920	Asia (not Japan), Europe
34	2010 - 2025	Asia, Europe
35	1850 - 1910	Americas
36	1930 - 1990	Americas
37	1910 - 1930	
38	2570 - 2620	Europe
39	1880 - 1920	China
40	2300 - 2400	Asia, Europe
41	2496 - 2690	USA

Table 2(b): Band designations for LTE TDD.

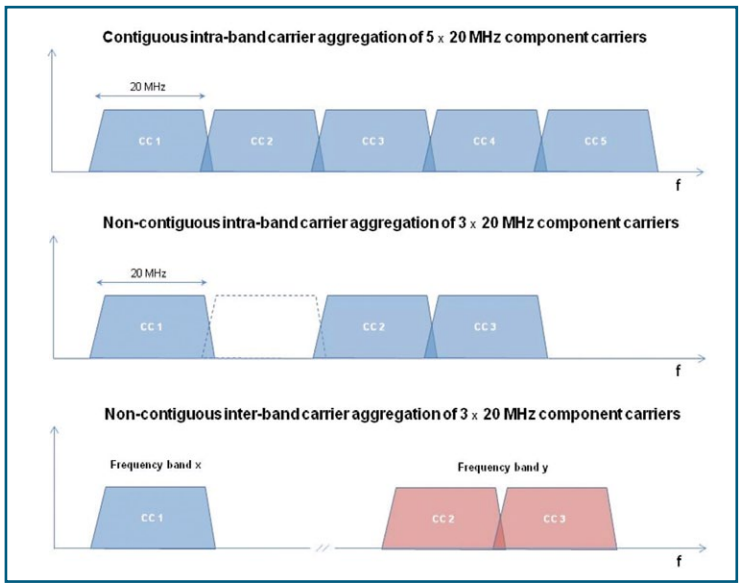


Figure 1: Examples of carrier aggregation.

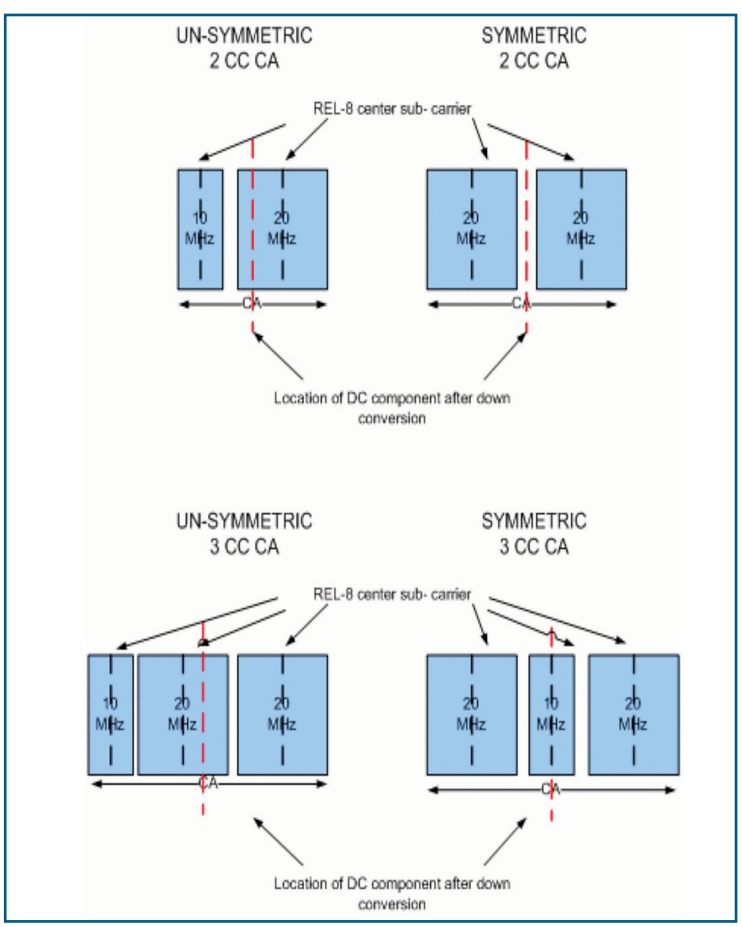


Figure 2: Intra-band symmetry.

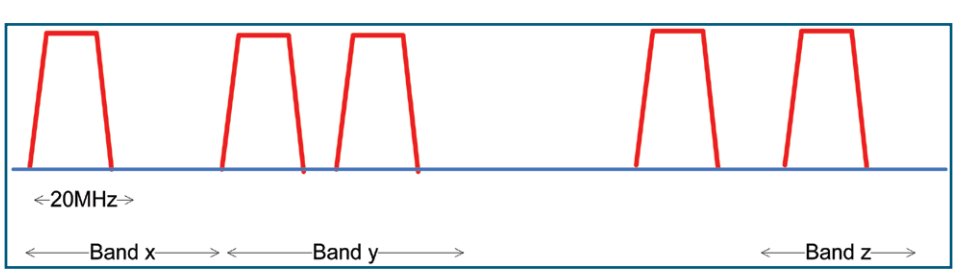


Figure 3: Five non-contiguous component carriers.

second diagram shows the non-contiguous intra-band carrier aggregation case. It can be seen that there is fragmented bandwidth in between the CCs. The final diagram shows inter-band carrier aggregation: the inter-band carrier aggregation is clearly non-contiguous as there is a fragmented bandwidth between the component carriers.

For Frequency Division Duplexing (FDD), asymmetric bandwidth may be supported for uplink and downlink. Symmetric operation is defined as the case where there are equal numbers of CCs for the downlink and uplink, while asymmetric operation uses a larger number of CCs for the downlink than for the uplink. In Time Division Duplexing (TDD), the uplink and downlink are always symmetric because they share the same carrier. A further consideration is intra-band symmetry, as shown in Figure 2, which relates to whether or not the aggregated carriers form a mirror image across the aggregate bandwidth.

For LTE-A (3GPP Release 10), carrier aggregation is assumed to be symmetrical within the band, unless an exception is stated. The advantage of symmetry is that for a zero-IF receiver it avoids the data resource element (RE) overlapping at the DC point.

3GPP has specified a range of carrier aggregation scenarios for initial investigation for LTE-A, with architecture using up to three transceiver chains, which can operate anywhere in the range 300 MHz – 6 GHz. This poses some huge design problems for both eNodeBs and user equipment (UE). In the future all five of the CCs will be allowed to be non-contiguous, as shown in Figure 3, which further increases the number of transceiver chains.

Applications

A pair of component carriers is called a serving cell. One of the serving cells is designated the primary cell, while the rest are known as secondary cells. The primary cell is the most important, and manages the CA configuration. RACH procedure is not allowed in a secondary cell. When a cell is configured, it is given a 'serving cell index', which denotes its relative importance – the smaller the serving cell index, the more important the serving cell will be. The serving cell index for the primary cell is always equal to zero.

The versatility of carrier aggregation makes for much easier network deployment, because the second component carrier can be used either to boost the data rates close to the eNodeB, to eliminate weak coverage at the cell edge, or to serve hot spots where

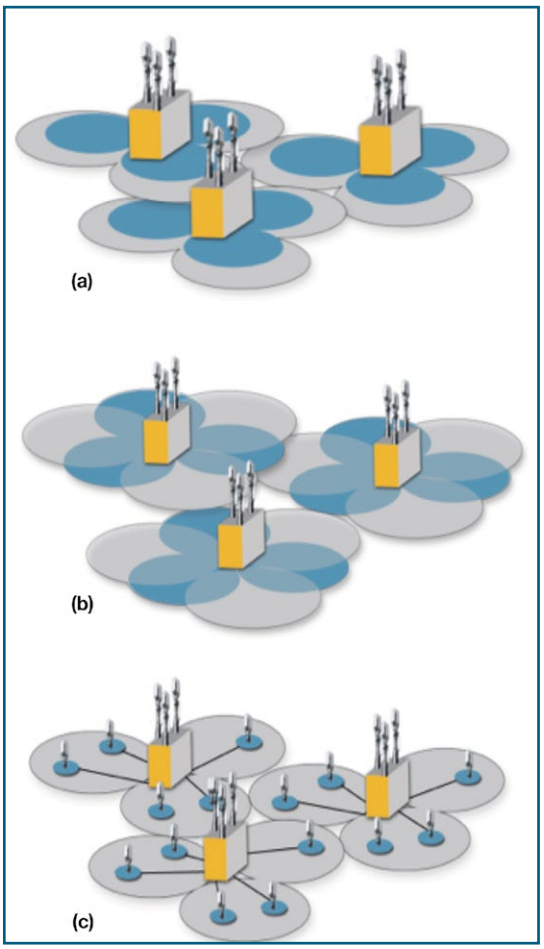


Figure 4: Three of the many possible LTE-Advanced carrier aggregation application scenarios, where in each case frequency f1 is shown in grey and f2 is shown in blue: (a) f1 is used to increase coverage and f2 is used to boost the data rate (f2 > f1); (b) Both frequencies are used to increase cell throughput; and (c) f1 provides macro coverage and f2 is used to boost throughput in hotspots.

peak rates are very important. Figure 4 shows examples of each of these applications, which were identified by 3GPP during its feasibility study. Two further applications scenarios (not shown) use remote radio heads (RRH) for non co-located cells, which will be supported in Release 11.

Demonstration

The Aeroflex TM500 Test Mobile was a key component in an early demonstration of LTE carrier aggregation at the 2011 Mobile World Congress, successfully combining 800 MHz and 2.6 GHz spectrum. This enabled a leading network infrastructure vendor to deliver a huge LTE data "pipe" that combined the capacity of both frequency bands while maximizing the benefits of the superior propagation capability in the lower frequency band.

A type of carrier aggregation had already been provided on the TM500 for 3G, making use of the availability of dual-carrier HSDPA (DC-HSDPA). This feature is now available on the production model of the TM500 LTE Test Mobile, the de facto industry standard for testing LTE base stations or eNodeBs.

Conclusion

Carrier aggregation of contiguous and non-contiguous spectrum bands has been identified as one of the most crucial aspects in the evolution towards LTE-Advanced, and has also been recognized as presenting a major challenge to the design of user equipment and eNodeBs. Cellular infrastructure vendors need a reliable test mobile to test their networks ahead of the availability of real terminals and handsets, and providing them with carrier aggregation capability at this early stage is proving essential to the development of the eNodeBs that will be used to roll out LTE-Advanced.

Selecting PCB Materials for High-Frequency Applications

Choosing circuit materials for high-frequency printed-circuit boards is a matter of weighing the electrical performance required by the end application against the ease or difficulty of fabricating circuits with those materials.

By John Coonrod, Rogers Corporation, Advanced Circuit Materials Division

Choosing a circuit material for a high-frequency printed-circuit board (PCB) is generally a tradeoff, often between price and performance. But PCB materials are also selected by two key factors: how well they meet the needs of an end-use application and what kind of effort is required to fabricate a desired circuit with a particular material. These two factors may not mesh: one material may be well suited for a particular application but may pose challenges in terms of circuit fabrication, and vice versa. There is no foolproof, step-by-step procedure for selecting a PCB material. But by relying on some tangible guidelines designed to evaluate a material in terms of its suitability for circuit fabrication and for meeting the requirements of an application, the process of selecting a PCB for a particular application can be simplified. The approach will be demonstrated with some of the more popular high-frequency PCB materials, and where each stands in terms of fabrication qualities and suitability for end-applications.

Commercial high-frequency PCB materials can be categorized as one of seven generic material types, as shown in Table 1. High-performance FR-4 is included in Table 1 because it is often used in combination with other high-frequency materials for certain applications and requirements. However, in terms of electrical performance, FR-4 is not considered a true high-frequency circuit material.

Choosing materials based on circuit fabrication issues

A number of different mechanical processes are required as part of high-frequency PCB fabrication. In general, the most critical of these would be drilling, plated-through-hole (PTH) preparation, multilayer lamination, and assembly. The drilling process is typically concerned with creating clean holes, which will later be metalized to form viaholes for electrical connections from one conductive layer to another. Some concerns with the drilling process include smear, burring, and fracturing of the material. Smearing can be lethal to PCB fabrication using a PTFE based material, since there is no way to remove the smear. Fracturing can be fatal for some of the nonwoven glass hydrocarbon materials; however, most of the woven glass hydrocarbon materials do not have this concern.

The PTH preparation process is relatively well defined and straightforward for most non-PTFE materials, although special processing is required when forming PTHs for PTFE-based materials. Ceramic-filled PTFE-based materials offer PTH preparation options which are more forgiving. However, non-ceramic-filled PTFE materials require a special process which can limit final circuit yields.

Fabricating multilayer PCBs presents many challenges. One is the fact that dissimilar materials are often being bonded together, and these dissimilar materials can have properties which complicate drilling and PTH preparation processes. Also, a mismatch between certain material properties, such as coefficient of thermal expansion (CTE), can lead to reliability problems when the circuit is thermally stressed during assembly. A goal of the material selection process is to find a good combination of circuit materials for a multilayer PCB which enable practical fabrication processing while also meeting end-use requirements.

Designers and fabricators have many choices of materials used to bond together the copper-clad laminates that ultimately form a multilayer PCB. As Table 2 shows, the materials differ in terms of dielectric constant, dissipation factor, and processing temperatures. In general, lower

Table 1: Typical circuit material types used in the high-frequency PCB industry.

Material	Ease of Circuit Fabrication	Electrical Performance
PTFE with micro glass fiber	Difficult	Excellent
PTFE with woven glass	Difficult	Good
Ceramic-filled PTFE	Moderate	Excellent
Ceramic-filled PTFE with woven glass	Moderate	Good
Ceramic-filled Hydrocarbon	Difficult	Good
Ceramic-filled Hydrocarbon with woven glass	Easy	Good
High Performance FR-4	Easy	Poor

Table 2: Bonding materials used for fabricating high-frequency multilayer PCBs.

Bonding Material	Dielectric Constant	Dissipation Factor	Lamination Temperature (°F)	Preparation for PTH	Re-melt Temperature (°F)
FEP	2.10	0.0010	565	Special	520
Ceramic-filled PTFE,Dk=3	3.00	0.0013	700	Special	640
Ceramic-filled PTFE,Dk=6	6.15	0.0020	700	Special	640
LCP	2.90	0.0025	554	Special	520
3001	2.30	0.0030	425	Special	350
Ceramic-filled PTFE,Dk=10	10.80	0.0023	700	Special	640
Thermoset Hydrocarbon	3.90	0.0040	350	Standard	N/A
FR-4	4.50	0.0180	360	Standard	N/A

Table 3: Typical CTE values for materials commonly used in high frequency PCBs.

Material	CTE (ppm/°C)	Electrical Performance
PTFE with micro glass fiber	220	Excellent
PTFE with woven glass	200	Good
Ceramic-filled PTFE	25	Excellent
Ceramic-filled PTFE with woven glass	50	Good
Ceramic-filled Hydrocarbon	20	Good
Ceramic-filled Hydrocarbon with woven glass	35	Good
High Performance FR-4	50	Poor

lamination temperatures are to be preferred. But if a PCB must undergo soldering or some other form of thermal exposure, it will be necessary to use a bonding material with high reflow (re-melt) temperature, one which is thermally robust and does not reflow at the elevated processing temperatures.

The greatest concern during PCB assembly is due to the effects of thermal stress from soldering. Other sources of thermal stress during PCB assembly are from solder rework or exposure to multiple thermal cycles. In terms of circuit materials, effects from thermal stress can typically be projected by comparing the CTE values for different materials, as shown in Table 3. In general, a circuit material with a lower CTE will be more robust and handle the thermal stress of PCB assembly better than a material with a higher overall CTE. This is one reason why multilayer PCBs typically use more than one type of circuit material. Materials which might provide good electrical performance may have characteristics (such as high CTE) that make them less than robust to handle the thermal stress of PCB assembly. By using a combination of materials, some with good electrical properties and others with lower overall CTE, a robust multilayer PCB construction can be designed and assembled. Such a construction is known as a hybrid multilayer PCB, which can provide cost as well as performance benefits. More information about hybrid multilayer PCBs can be found on a paper presented at PCB West 2010. [1]

In general, a circuit material with CTE value of 70 ppm/°C or less is considered robust for PCB fabrication and assembly. As Table 3 shows, however, one of the materials with the best electrical performance alsohas the worst CTE. This is one reason why ceramic-filled PTFE laminates were formulated. They combine excellent electrical performance with very good CTE. Unfortunately, they exhibit poor dimensional stability, since the material is soft and circuit dimensions can be easily distorted. To provide good electrical performance and CTE with improved dimensional stability, ceramic-filled PTFE laminates with woven glass reinforcement were developed.

When making a choice in high-frequency circuit materials based on fabrication issues, the clear-cut favorite would be ceramic-filled hydrocarbon material with woven glass. These materials feature a low dissipation factor typically on the order of 0.003 and are robust in terms of most circuit fabrication processes. If better electrical performance is required, the choice would be ceramic-filled PTFE with woven glass. These materials typically have a dissipation factor in the range of 0.002 and are generally fabrication-process friendly. The major concernsin fabricating PCBs with these materials relate to drilling and PTH preparation. For the best electrical performance, the choice is micro fiber glass PTFE, although this material can be difficult in terms of fabricating more complex circuit constructions. The material, which is nearly pure PTFE, is often used for simple high-frequency circuitry such as microstrip filters and couplers. Additionally this material is often used in a hybrid multilayer circuit, in which it supports critical functions, while other materials more friendly to circuit fabrication processes are used for the remainder of the multilayer PCB.

Choosing materials based on end-use applications

There are several different concerns for choosing materials for high frequency applications. A good example in chart form is given from the Rogers Corporation Product Selector guide on the website and a portion of this is shown in Table 4.

Table 4 provides a quick comparison of different circuit materials based on key electrical performance parameters, including dielectric constant (Dk), dissipation factor (Df), thermal conductivity, and CTE. Two values of Dk are listed for each material: process and design. The process Dk refers to the value determined by industry-standard IPC test method, IPC-TM-650 2.5.5.5c at 10 GHz. This value is used as a process control for making the substrate. The test method is reliable and well proven, but the Dk value is specific to that test methodology and that test frequency. The test method uses a clamped stripline resonator and is a fixture mechanism allowing large volumes of materials to be tested, which is necessary for a laminate manufacturer. However, the fixture is not representative of an actual stripline circuit or a microstrip circuit, and the use of process Dk values in computer-aided-design software simulation tools has been known to yield erroneous results. In some cases, process Dk values may not be ideal for design purposes. For that reason, a second set of Dk values, the design Dk numbers shown for each material in Table 4, were determined using actual microstrip transmission line circuits, across a wide frequency range. These values are more appropriate for circuit design and modeling.

Table 4 also lists tolerance values for Dk for each material. Some high-frequency applications have very tight specifications for impedance control and the Dk tolerance is a good indicator of how well this material may be suited for those applications. In addition, Table 4 shows values for Df for each material, which is related to dielectric losses. For an application that requires low-loss performance, a material with lower Df value would be a logical choice, although this choice should also be weighed against the ease or difficulty of PCB fabrication with that material.

In addition to dielectric losses, conductor losses are important when comparing circuit materials. Especially for thin circuits, conductor losses can be more significant than dielectric losses. Conductor losses can be impacted by circuit design, circuit configuration, and the thickness of conductive metals, as well as the surface roughness of the copper conductor layers. An excellent paper discussing this issue [2] has shown that conductor losses are higher for materials with higher amounts of copper surface roughness, compared to materials with smoother copper conductor surfaces. When comparing measurements by this parameter, the surface roughness measurement of concern is the root-mean-square (RMS) roughness of the copper surface. A smooth copper conductor layer such as rolled annealed copper will typically have surface roughness RMS values around 0.3 microns. A low-profile electrodeposited (ED) copper conductor layer will typically have a surface roughness of around 0.8 microns, with standard ED copper at about 1.8 microns and high-profile copper at about 3 microns.

Figure 1 shows how increased copper surface roughness can result in increased loss. The same substrate — RO4350BTM laminate from Rogers Corp., — was used in both cases. This circuit material is a common ceramic-filled hydrocarbon woven glass. The higher-loss performance with frequency is plotted for this material with standard high-profile ED copper, while the lower loss results from using the same material with low-profile copper having a much smoother surface.

Referring back to Table 4, another material property of interest is thermal coefficient of dielectric constant, or TcDk. Often overlooked in material comparisons, this is a measure of how much the dielectric constant (Dk) will change

Table 4: A tabular format for comparing high-frequency materials.

Product	Dielectric Constant, Dk ε_r @ 10 GHz (Typical)		Dissipation[11] Factor TAN δ @ 10 GHz (Typical)	Thermal[12] Coefficient of ε_r -50°C to 150°C ppm/°C (Typical)	Volume Resistivity Mohm • cm (Typical)	Surface Resistivity Mohm (Typical)	Moisture[13] Absorption D48/50 % (Typical)	Thermal[20] Conductivity W/m/°K (Typical) 80°C ASTM C518
	Process[11]	Design[12]						
RO3003™ PTFE Ceramic	[7] 3.00 ± 0.04	3.00	0.0013	11	10^{12}	10^{11}	0.05	0.50
RO3006™ PTFE Ceramic	6.15 ± 0.15	6.50	0.0020	-160	10^{3}	10^{3}	0.02	0.79
RO3010™ PTFE Ceramic	10.20 ± 0.30	11.20	0.0022	-280	10^{12}	10^{11}	0.05	0.95
RO3035™ PTFE Ceramic	3.50± 0.05	3.60	0.0018	-50° to 10°C -34 10°C to 150°C -11	10^{7}	10^{7}	0.08	0.50
RO3203™ PTFE Ceramic Woven Glass Reinforced	[7] 3.02 ± 0.04	3.02	0.0016	-75	10^{7}	10^{7}	0.06	0.48
RO3206™ PTFE Ceramic Woven Glass Reinforced	6.15 ± 0.15	6.60	0.0027	-212	10^{7}	10^{7}	0.05	0.67
RO3210™ PTFE Ceramic Woven Glass Reinforced	10.20 ± 0.50	10.80	0.0027	-459	10^{4}	10^{4}	0.13	0.81
RO4003C™ Hydrocarbon Ceramic	[8] 3.38 ± 0.05	3.55	0.0029	+40	1.7×10^{10}	4.2×10^{9}	0.04	0.71
RO4350B™ Hydrocarbon Ceramic	3.48 ± 0.05	3.66	0.0037	+50	1.2×10^{9}	5.7×10^{9}	0.05	0.69

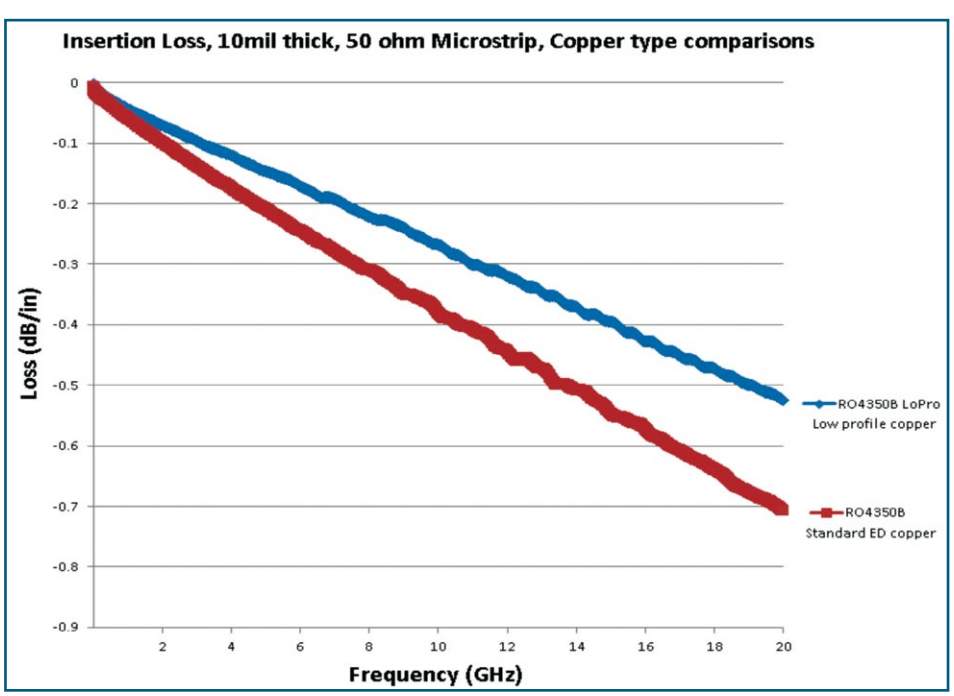


Figure 1: These plots of Insertion loss with frequency compare the same ceramic-filled hydrocarbon glass woven high-frequency laminate with standard ED copper and with smoother, low-profile copper.

with changes in temperature. Given as changes in relative dielectric constant, ε_r, in parts per million (ppm) for changes in temperature (in °C), large values of TcDk can be an indicator that circuits which perform well under ideal laboratory conditions may not fare as well under less controlled conditions, notably with large swings in temperature.

Another important material parameter In Table 4 is thermal conductivity, or the capability to move heat through a circuit material. This parameter is important to consider for high-power applications in which a large amount of heat must be dissipated. A substrate with high thermal conductivity can assist the thermal management issues with these applications. Many standard PCB materials have thermal conductivities in the range of 0.25 W/m/K. Additionally, some materials with typically good electrical performance, such as micro fiber PTFE materials, also have thermal conductivities around 0.20 to 0.25 W/m/K. By adding a ceramic filler, the thermal conductivity of a circuit material can be improved. Table 4 shows that the ceramic-filled high-frequency materials have significantly better thermal conductivity than most standard PCB materials, generally with two to three times better thermal conductivity. This improvement can help solve many thermal management issues in high-power PCB designs.

Another material parameter listed in Table 4, moisture absorption, can also be important to consider for high-frequency applications. In an environment with high humidity, a circuit material that absorbs a high amount of moisture will exhibit increases in Dk and loss, both impacting PCB performance. Circuit materials with high moisture absorption may not suffer degraded performance in controlled environments, but performance can be quite variable in more hostile operating environments. Many standard PCB materials have moisture absorption in the range of 1%. As Table 4 shows, however, most materials formulated for high-frequency applications are characterized by moisture absorption that is considerably less than 1%. For most high-frequency applications, laminates with moisture absorption values of less than 0.25% are considered acceptable.

There are many issues to consider when choosing a circuit material for high-frequency PCB applications. Some are related to fabrication issues for producing the most robust PCB possible, and some to achieving the best electrical performance possible for a given application. Because of various tradeoffs, the material for fabricating the most robust PCB may not be the same one for the highest electrical performance for an application. Multilayer hybrid PCBs represent one way to choose a blend of materials to combine robustness and good electrical performance. By using charts of material properties such as Table 4, it is easier to compare the critical properties of different high-frequency materials and to simplify that choice when striving for the best tradeoff between ease of fabrication and best electrical performance.

References

[1] John Coonrod, "High Frequency PCBs Using Hybrid and Homogenous Constructions," PCB West 2010, September 2010.

[2] J.W. Reynolds, P.A. LaFrance, J.C. Rautio, and A.F. Horn, III, "Effect of conductor profile on the insertion loss, propagation constant, and dispersion in thin high frequency transmission lines,"DesignCon 2010.

Universal wireless communications toolkit

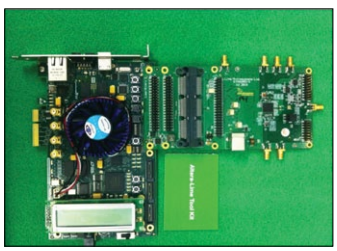
includes flexible M2M and white space systems

Lime Microsystems and Altera have teamed up to develop a Universal Wireless Communications Toolkit that allows developers to create wireless protocols of almost any complexity, including flexible M2M and white space systems.

The Toolkit uses Lime's configurable transceiver board linked to an Altera FPGA design kit via a purpose-built high speed mezzanine connection (HSMC) interface board.

The combination of Lime and Altera boards enables almost any wireless application to be easily created, from consumer and enterprise broadband equipment through to bespoke white space, military and GNU radio applications.

Lime's LMS6002D is a fully integrated multi-band,



multi-standard single-chip RF transceiver for 3GPP (WCDMA/HSPA and LTE), 3GPP2 (CDMA2000) and WiMAX applications. It can be digitally configured to operate in 16 user-selectable bandwidths up to 28 MHz.

Communication system designs can be quickly implemented in Altera's portfolio of 28 nm FPGAs, which are tailored to meet a variety of system requirements.

www.limemicro.com

Broadband time delay/phase shifter

targets both clock and data lane alignment

Hittite Microwave has expanded its broadband time delay/phase shifter portfolio adding the HMC911LC4B, which is ideal for 10G, 40G RZ-DQPSK, 100G DWDM RZ Carver clock chain and skew adjustments in the fiber optic domain.

The HMC911LC4B is a DC to 24 GHz broadband time delay product that provides a continuously variable delay from 0 ps to 70 ps while maintaining a constant differential output voltage swing. The device accepts either single-ended or differential input data, while the differential output swing is adjustable from 150 mVp-p to 800 mVp-p. The modulation bandwidth is 1.6 GHz, which is the highest phase modulation bandwidth available in the market.

Suitable for both clock and data retiming applications, the HMC911LC4B features internal temperature compensation and bias circuitry to minimize delay variations with temperature. All RF input and outputs of the device are internally terminated with 50 Ohms to Vcc, and may either be AC or DC coupled. Output pins can be connected directly to a 50 Ohm to Vcc terminated system.

www.hittite.com

Fully programmable universal GNSS receiver

improves performance, reduces cost

Maxim Integrated Products has introduced the MAX2769B and MAX2670, next-generation high performance ICs designed to address Global Navigation Satellite System (GNSS) applications. The flexible devices are capable of operating over the navigation standards, GPS, GLONASS, Galileo, and Compass and have completed PPAP and AEC-Q100 approval.

The MAX2670 is a dual stage low noise amplifier typically located in or close to the antenna module, while the MAX2769B resides within the dashboard as the receiver. The MAX2769B boasts the industry's lowest noise figure of 1.4 dB, a critical element that dominates the overall receiver sensitivity and enables faster satellite locking. The MAX2670 is a versatile design that allows external filtering between first and second stage, providing flexibility for system optimization. Its high integration eliminates large, expensive, discrete transistor components.

The MAX2769B completely eliminates the need for external IF filters by implementing on-chip monolithic filters and requires very few external components to implement a low-cost GNSS RF receiver solution. In addition, its integrated ADC, which is programmable from 1 to 3 bits.

www.maxim-ic.com

Wideband power sensors

for widespread RF measurements

Bird Technologies Group have extended the WPS range of wideband power sensors with five new models, giving users an even greater choice of sensors to match their applications.

The devices are expected to find widespread use in the design, installation and maintenance of radio frequency systems including analogue and digital cellular, 3G, 4G, GSM, GPRS, EDGE, UMTS, HSDPA, Tetra, APCO/P25, WiMAX and WLAN, CDMA, TDMA and WCDMA, as well as in specialised systems.

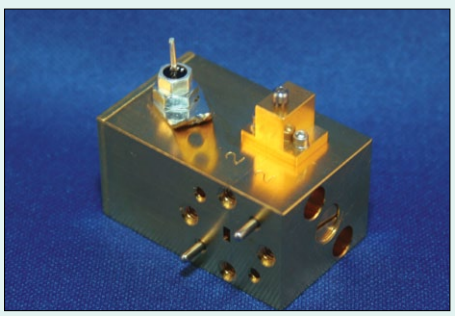
Using the classic and well proven Bird Thruline design concept, coupled with the latest advances in digital signal processing technology, the WPS range provides superior performance.

The WPS range is now exclusively available in the UK

and throughout Europe from specialist distributor, Aspen Electronics. The five latest models cover a frequency range from 25 MHz to 4 GHz and a power measurement range from 25 mW to 500 W average power. Models include the 5012A with a frequency range of 350 MHz to 4 GHz and a power range of 150 mW to 150 W average, 400 W peak and the 5018 with a frequency range of 150 MHz to 4 GHz and a power range of 25 mW to 25 W average, 60 W peak.

www.aspen-electronics.com

Gunn oscillators
cover 7 to 150 GHz frequency range



The HGM and HGV series Gunn oscillators cover the 7to 150 GHz frequency range. A wide variety of designs provide solutions for most applications. Units are available with mechanical and/or electrical tuning, providing many possible tuning configurations. Superior frequency and power stability are achieved using cavity designs and optimal diode selection. Heaters can be provided to achieve greater frequency stability.

GaAs and InP Gunn diodes are used depending on the frequency and performance requirements. Cavity designs are mated with the proper Gunn diode to maximize performance

www.hxi.com, www.rec-usa.com

Compact 8-way power dividers
cover 1.0 GHz to 18.0 GHz

KRYTAR has announced two 8-way power dividers offering high performance over the broadband frequency range of 1.0 to 18.0 GHz in compact packages. The dividers lend themselves to emerging wireless broadband designs and many test and measurement applications

Model 8010180 covers 1.0 to 18.0 GHz with 17 dB isolation and ±1.0 dB amplitude tracking. It exhibits insertion loss of 5.5 dB across the frequency range. Maximum input VSWR is 2.10 and output is 1.75. Phase tracking is ±15 degrees.

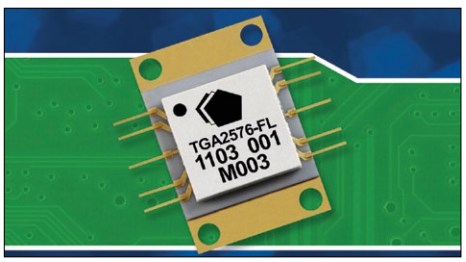
Model 8020180 covers 2.0 to 18.0 GHz with 17 dB isolation and ±1.0 dB amplitude tracking. It exhibits insertion loss of 5.5 dB across the frequency range. Maximum input VSWR is 2.00 and output is 1.75. phase tracking is ±15 degrees.

www.krytar.com

30-W, 2.5-6-GHz GaN PA
35% PAE for wide-ranging needs

TriQuint Semiconductor has released a packaged, 30 W wideband gallium nitride (GaN) power amplifier with high power and efficiency for communications, defense and related applications. The TGA2576-FL delivers 30 W of output power (45.5 dBm) across the 2.5-6 GHz frequency range.

The TGA2576-FL typically offers 35% PAE and 26 dBm of small signal gain.



Samples and evaluation fixtures for the device are now available.

www.triquint.com

750 W peak power Ku-band HPA

in a small rugged package

Comtech Xicom Technology has introduced a high efficiency, 750-W peak power, Ku-band traveling wave tube amplifier (TWTA) with the size, weight and prime-power consumption of standard 400-W amplifiers.

The model XTD-750KHE high power amplifier (HPA) is an antenna mountable TWTA designed for high linear power and very high efficiency for Ku-band SATCOM uplinks. The amplifier features a compact, rugged package weighing only 56 pounds. Drawing only 1450 W at

270 W of linear RF output power, the amplifier is ideal for transportable applications where high efficiency, light weight, and high ambient temperature operation are required.

www.xicomtech.com

Transmit/receive module

868-MHz/915-MHz ISM band

The RF6559 from RFMD is a front end module (FEM) for 915-MHz AMR systems. The module contains an integrated three-stage PA with 42 dB of gain and typical power output of 28 dBm. Further, it allows for Tx/Rx on a single antenna via 2 integrated SPDT switches.

Tx filtering, built-in Power Detector, and a two-stage LNA with typical gain of 32 dB are also included, packaged in a 28-pin, 6-mm x 6-mm laminate package with backside ground.

Applications include wireless automated metering, wireless alarm systems, portable battery powered equipment, and smart energy.

www.rfmd.com

In-building wireless antenna

ideal for LTE applications

Laird Technologies has expanded its in-building wireless product line with the release of the CMS69273 LTE ceiling mount broadband omnidirectional antenna.

For in-building wireless (IBW) solution providers, the CMS69273 offers the latest in next generation 4G solutions. The antenna provides indoor cellular coverage for GSM, DCS, UMTS and LTE/WiMAX standards in the 698 to 960 MHz, 1575 MHz and 1710 to 2700 MHz frequency ranges. It features a pattern specifically shaped to provide optimal performance and maintain integrity from a ceiling mount location. The pattern is uniform and symmetrical which enables system integrators to precisely determine cell size.

The antenna is available in a low profile, aesthetically neutral housing made with UL 94 V-0 materials.

www.lairdtech.com

LTE-Advanced basestation on a chip

allows OEMs to differentiate products cost-effectively

Freescale has developed two DSP and processor cores to support a single chip that can handle a complete basestation including the emerging LTE-Advanced standard.

The B4860 is built on a 28-nm process and uses four of the latest PowerPC cores, the dual threaded e6500, with higher memory bandwidth. These sit alongside six of the latest SC3900 Starcore DSP cores with 32 MAC/cycle baseband specific instructions, improved control code execution and up to eight instructions per cycle and up to eight data lanes vector in a single instruction (SIMD8).

Other advancements include high memory bandwidth, core clustering and full hardware cache coherency within the core and throughout the whole device. At 1.2 GHz, the SC3900 core registered a BDTIsimMark2000 performance score of 37,460.

Freescale has also developed the L1 software that supports the new cores and dedicated accelerators to get the performance for LTE-A. The B4860 is one of the first single-chip LTE base station products to support three sectors of 20 MHz, and is designed to replace today's channel cards that can include up to six discrete devices.

The MAPLE-B baseband acceleration platform, in addition to its support for FEC, FFT and UMTS chiprate processing, enables the development of advanced receiver algorithms such as parallel and successive interference cancellation techniques, single and multi-user MIMO, LTE relay and carrier aggregation for improved spectral efficiency.

Multicore cache-coherent fabric brings single core programming simplicity to the multicore SoCs. Industry standard interfaces ensure interoperability and built-in future-proof scalability with CPRI, Serial RapidIO, 10G Ethernet and PCI-express interfaces.

www.freescale.com

3G CMOS power amplifier family

enables a drop-in replacement for GaAs chips

Black Sand Technologies has extended its established BST34 series of CMOS power amplifiers (PAs) with two devices that complete its range of products for use in every common global cellular frequency band.

The latest BST3405 and BST3408, for use in Band-5 (824-849MHz) and Band-8 (880-915MHz) respectively, are drop-in replacements for the gallium-arsenide (GaAs) components traditionally found in every 3G mobile phone, tablet and datacard. Black Sand manufactures the BST34 series using an industry-standard CMOS semiconductor process – the same technology that is used to produce the majority of silicon chips in the world today. By replacing specialized 'boutique' GaAs process technology, customers can benefit from lower costs, enhanced product robustness and reliability, and an improved supply chain.

www.blacksand.com

Point to Multipoint mm-wave wireless backhaul

targets small cell networks

Bluwan has announced the availability of its Fibre Through The Air (FTTA) Point to Multipoint (PMP) millimetre wave backhaul. Particularly suited for providing greater RAN capacity to small cell network topologies in dense urban areas, the millimetre wave PMP backhaul provides a massive amount of cost effective capacity, up to 2 Gbps in each sector, for up to 20 cell sites at 100 Mbps each.

Operating in the 42 GHz band, the company's millimetre wave PMP backhaul is better suited to meet the demand for increased network capacity than traditional backhaul approaches. It provides the 100 Mbps needed for LTE that copper cannot accommodate, avoids the expensive trenching of laying cable, and is much more economical than Point to Point (PTP) wireless backhaul..

A single Bluwan millimetre wave PMP transmission hub can connect 20 cell sites at 100 Mbps, offering 20 times more throughput than existing PMP microwave solutions. As it operates in the 42 GHz bands, spectrum is much more cost effective. It also avoids the increased spectrum congestion and limited channel sizes increasingly faced by PTP wireless backhaul in dense, urban areas using sub-40 GHz spectrum. In addition, millimetre wave PMP only uses one sectoral antenna to serve a cluster of mobile base stations from a transmission hub, meaning it requires less equipment on a mast. This all correlates to more efficient use of limited cell tower space, lower site rental and lower maintenance costs.

www.bluwan.com

Radio filter

delivers LTE capacity gains of up to 65 per cent

Mesaplexx, a start-up company specialising in electromagnetic engineering and high performance filters, has announced xCube™, a revolutionary radio filter technology has the capability to radically improve the performance of active antenna systems (AASs), enabling increases in network capacity of up to 65 per cent.

AASs are capable of significantly increasing base station site efficiency and performance, dramatically improving network capacity and coverage. However, until now a number of technical obstacles have prevented AASs from achieving their true performance potential, all linked to one of the technology's smallest components – the radio filter. The current filters used with active antennas create significant loss, detracting from the benefits that active antennas can bring.

xCube, the company's high performance radio filter technology, eradicates these problems. The xCube is a cool running, low loss, high isolation filter that improves sensitivity and handles much more power. These benefits, combined with its compact size, enables AAS vendors to deliver 50 percent more power output for the same input, delivering significant increases in range and capacity.

www.mesaplexx.com

Low energy Bluetooth 4.0 IP

targets cost-efficient, single and dual mode applications

CEVA has announced its low energy CEVA-Bluetooth 4.0 IP, for both single mode and dual mode applications. Building on more than a decade of experience, CEVA-Bluetooth 4.0 extends the existing CEVA-Bluetooth IP product line.

CEVA-Bluetooth 4.0 incorporates Bluetooth Low Energy (BLE) functionality, significantly expanding the addressable market for Bluetooth connectivity to include a wide range of smaller, cost-efficient applications previously limited by the power consumption of older Bluetooth standards. CEVA-Bluetooth 4.0 is available both as Single Mode IP (CEVA-Bluetooth 4.0.SM) and Dual Mode IP (CEVA-Bluetooth 4.0.DM). CEVA-Bluetooth 4.0.SM is aimed at Bluetooth Smart products which require optimized Bluetooth Low Energy single mode operation for low rate data links.

CEVA-Bluetooth 4.0.DM is primarily aimed at next-generation, multi-radio connectivity chips for Bluetooth Smart Ready products. These products require both classic Bluetooth and Low Energy Bluetooth co-existing with other wireless functionality such FM, Wi-Fi and GPS, as is typical in smartphones, tablets and other mobile computing platforms.

www.ceva-dsp.com

CALENDAR

Microwave & RF
3rd - 5th April 2012
Pavilion 5, Paris Expo
Porte de Versailles
France
www.microwave-RF.com

CTIA Wireless
8th - 10th May 2012
Ernest N. Morial Convention Center
New Orleans, Louisiana, USA
www.ctiawireless.com

LTE World Summit
23rd - 24th May 2012
CCIB, Barcelona
Spain
http://ws.lteconference.com

MTT-S International
Microwave Symposium
17th - 22nd June 2012
Palais de Congrès de Montréal
Montréal, Canada
http://ims2012.mtt.org

IBC Exhibition
6th - 11th September 2012
RAI Amsterdam
The Netherlands
www.ibc.org

European Microwave Week
28th Oct - 02nd Nov 2012
RAI Amsterdam
The Netherlands
www.eumweek.com

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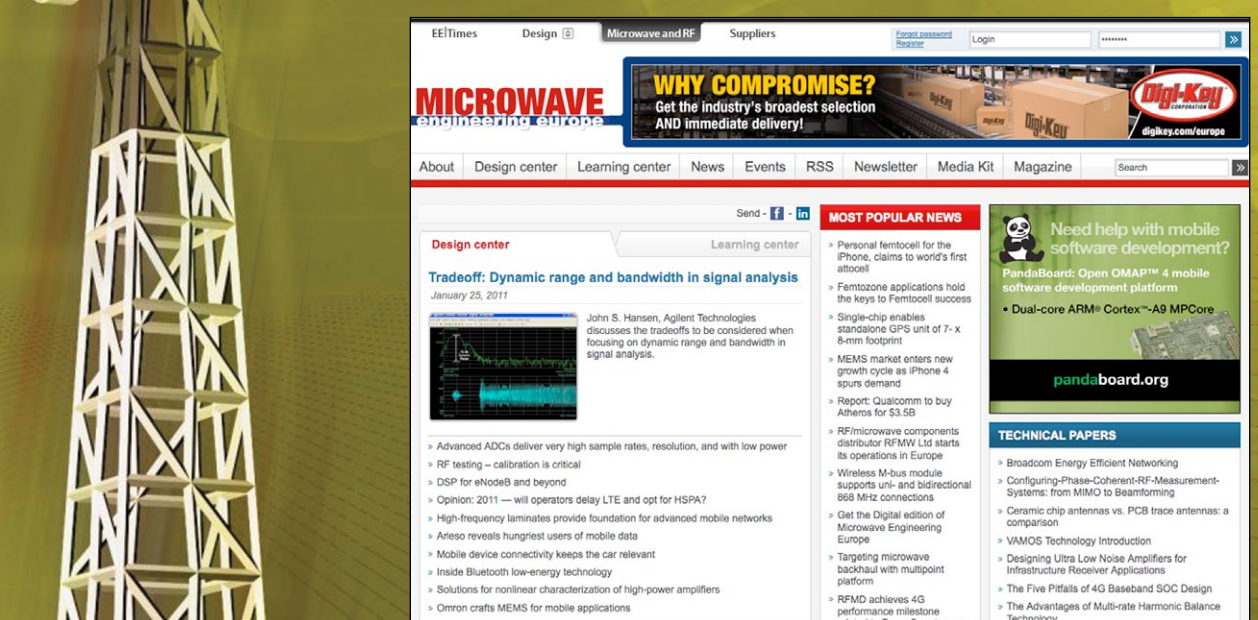

www.microwave-eetimes.com

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