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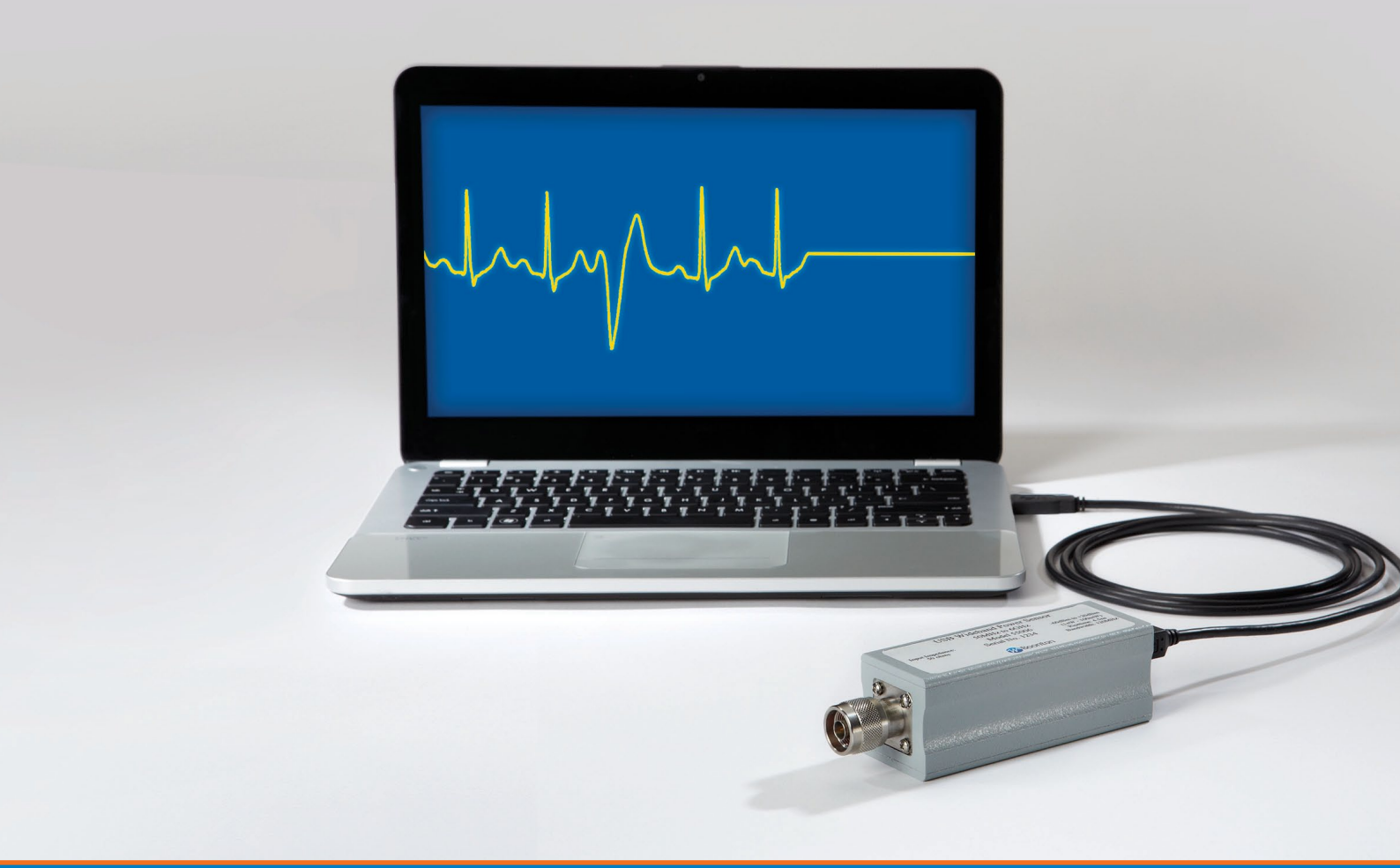

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VAT Registration: BE 461.357.437
RPM: Nivelles
Company Number: 0461357437

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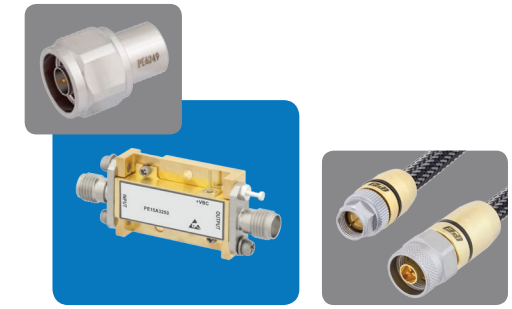

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Could Li-Fi be the next big thing

As we roll out 4G and focus on 5G all sorts of ideas on getting significantly faster data rates are popping up. One the more intriguing is Visible Light Communications (VLC) or Li-Fi, primarily for the short range personal or room area. However, each LED modulated source could act as a node transferring data from room to room or even down streets. This in conjunction with optical fibre would create a powerful optical network.

Key to this becoming reality is silicon photonics and the drive for pervasive data. The IoT could deliver this drive as costs are driven down by optics on a chip. LED light bulbs that communicate with each other, with smart objects, and with the Internet could alter the way devices communicate.

A pioneer in Li-Fi, pureLiFi raised £1.5 million in January this year in the company's latest round of investment as it shipped what is claimed to be the first full wireless Li-Fi networking system.

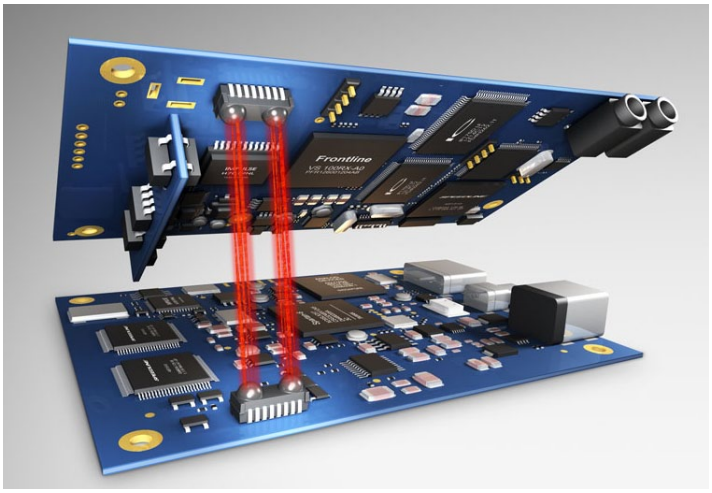
Li-Fi – a term coined by pureLiFi's Chief Science Officer (CSO), Professor Haas – is a technology based on VLC that provides full networking capabilities similar to Wi-Fi but with significantly greater spatial reuse of bandwidth.

In Q4 of 2014, the pureLiFi team launched and shipped the world's first Li-Fi network product – Li-Flame – to industry customers worldwide. The system turns off-the-shelf light fixtures into Li-Fi access points that can simultaneously communicate to a plurality of users in a bi-directional fashion. The system consists of the world's first battery powered Li-Fi mobile unit which is attached to a laptop screen and allows user roaming within a room, or indeed an entire building. Li-Flame continues to see strong demand in Q1 of 2015. The Li-Fi industry is forecast to grow to over $9 billion by 2020.

Talking about the IoT, Scientists at Disney Research and the Swiss Federal Institute of Technology (Zurich) have created a VLC networking technology that enables LED lights to communicate in a way that is compatible with Internet protocols. These advances, say the researchers, could allow VLC to play a significant role in the Internet of Things.

"Communication with light enables a true Internet of Things as consumer devices that are equipped with LEDs but not radio links could be transformed into interactive communication nodes," says Stefan Mangold, head of the wireless research group at Disney Research, Zurich. "We're not just talking about sensors, smartphones and appliances. This easily could include toys that have LEDs, creating an Internet of Toys in which toys can be accessed, monitored and acted on remotely."

For their prototype, the researchers used commercial off-the-shelf LED bulbs modified to transmit and receive visible light signals. The modifications included an Atheros AR9331 SoC running the OpenWrt embedded Linux operating system, a VLC controller module, and an additional 3.3-V power supply for the SoC and controller.



The controller acts like an Ethernet interface, offering compatibility with Internet protocols such as TCP and UDP. The system was able to create networks that were able to communicate at up to 1 kbit/s.

While the scientists a Disney focused on a low data rate network, Li-Fi has the potential for very high data rates as the available bandwidth at visible light or infrared frequencies is huge compared to radio frequencies.

Recently researchers at the University of Oxford claim to have reached a Li-Fi milestone by achieving bi-directional speeds of 224 Gbps.

The Oxford University researchers published their research work in the IEEE Photonics Technology Letters journal and described an indoor optical bidirectional wireless link with an aggregate capacity over 100 Gb/s. The link operates across approximately a 3 m range at 224 Gb/s (6 x 37.4 Gb/s) and 112 Gb/s (3 x 37.4 Gb/s) with a wide field of view (FOV) of 60° and 36°, respectively. The researchers believe it is the first demonstration of a wireless link of this type with a FOV that offers practical room-scale coverage. The performance achieved by developing specialised broadcast LEDs and receivers operating with different fields of view and bands that affect the data transmission speeds.

The researchers believe optical fibre communication networks have the potential to provide terabit aggregate capacities to buildings and offices within modern cities and point out that existing practical wireless systems are orders of magnitude below the capacity possible with Li-Fi technology.

As Li-Fi is short range in nature it could also find use as a replacement for wires and connectors in electronics. To this end, Scientists at the Fraunhofer Institute for Photonic Microsystems IPMS in Dresden are aiming to use Li-Fi communication modules to replace wired fieldbus systems or HF connectors that are subject to wear.

The scientists claim that for moving or movable plant components the Li-Fi interconnect technology offers greater reliability and security.

Optical technology makes it possible to transmit data in both half and full duplex modes at speeds of up to 12.5 Gbs over short distances. The transceiver replaces cable or plug connections and operates up to ten times faster than currently available wireless solutions. Other advantages include negligible bit error rates ($<10^{-11}$), and low energy consumption. The unique transceiver is especially suitable for industrial applications in which large amounts of data need to be transmitted very quickly and where plug connections no longer meet requirements or provide the necessary level of reliability.

As we can see, VLC has potential to change the way we think about communications and advances in silicon photonics will enable this technology to follow Moore's law in bringing costs and size down.

Dialog snaps up Atmel

Dialog has agreed to acquire Atmel in a cash and stock transaction for total consideration of approximately $4.6 billion. The combined company is expected to address an attractive, fast growing market opportunity of approximately $20 billion by 2019, including mobile power, IoT and automotive. Dialog will leverage Atmel's established sales channels to significantly diversify its customer base.

The rationale for the transaction we are proposing today is clear - and the potential this combination holds is exciting. By bringing together our technologies, world-class talent and broad distribution channels we will create a new, powerful force in the semiconductor space. Our new, enlarged company will be a diversified, high-growth market leader in mobile power, IoT and automotive. We firmly believe that by combining power management, microcontrollers, connectivity and security technologies, we will create a strong platform for innovation and growth in the large and attractive market segments we serve, said Jalal Bagherli, Dialog Chief Executive Officer.

www.diasemi.com

Startup gets $5.5 million for smart IoT batteries

Roost Inc., (Sunnyvale, CA), a startup that is trying to retrofit IoT functions and connectivity into consumer electronics by including them in a battery form factor, has raised $5.5 million in a Series A round of financing. This brings the amount raised by Roost to $6.5 million.

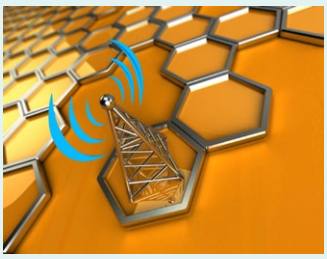
The company was founded by CEO Roel Peeters and CTO James Blackwell, who were both previously with Ozmo Devices Inc., in 2014. Ozmo was acquired by Atmel Corp. at the beginning of 2013.

The company has developed a PP3 format 9-V battery for smoke alarms that also houses a computer node that can link to a smoke phone via Wi-Fi. An application on the smartphone can be used to switch off false alarms and it can be used to alert the owner to smoke alarm activity. The unit still functions as a battery and can last for five years and will warn of low battery status via the app. The Roost battery is priced at $34.99.

www.getroost.com

Partnership enables field-deployable private cellular 4G 'bubbles'

Quortus and Horsebridge Networks Ltd have announced that they are partnering to deliver 4G cellular communications systems to the military and public safety sectors.The partnership will allow the Horsebridge Defence and Security Division to use the EdgeCentrix software-based network technology from Quortus, enabling agile 4G systems for in-field deployable communications and delivering high-bandwidth, reliable, secure communications for high-mobility users.



The EdgeCentrix product for the tactical communications market is ECX Tactical, a complete system for field-deployable private cellular 4G 'bubbles' with features including multicast/broadcast, in-session mobility, relay-station functionality and ad-hoc meshing. ECX Tactical is optimized for embedding directly onto partner 4G radios creating a 'network-on-a-chip', allowing deployment in space and power-constrained environments, such as vehicles, drones or in backpacks.

Horsebridge provide world-class communication network and security infrastructure currently deployed in over 120 countries from offices in the UK, UAE, Kenya and Malaysia.

"We have been working closely with Quortus and are delighted to be part of a collaboration which aligns with our own efforts and goals. Frontline public safety and military communications are notoriously difficult to maintain and security must always be at the forefront. By combining efforts with Quortus we are able to provide rapidly deployable private communications to enable these authorities to do the best job possible," said Geoff Smith, Director, Horsebridge Network Systems.

www.quortus.com
www.horsebridge.net

Unlocking 3-D vision from ordinary digital camera technology

Engineers from Duke University have unlocked a previously unrecognized 3D imaging capability of modern cameras by simply repurposing its existing components.

This capability was successfully demonstrated in a proof-of-concept laboratory experiment using a small deformable mirror – a reflective surface that can direct and focus light. The research demonstrates how the equivalent technology in modern digital cameras, the image stabilization and focus modules, could be harnessed to achieve the same results without additional hardware.

The purpose of the experiment was to extract depth-of-field information from a "single shot" image – rather than traditional 3D imaging techniques that require multiple images – without suffering any trade-offs in image quality. When integrated into commercial cameras and other optical technologies, this visualization technique could improve core functions, like image stabilization, and increase the speed of autofocus, which would enhance the quality of photographs.

"Real scenes are in three dimensions and they're normally captured by taking multiple images focused at various distances," said Patrick Llull, Duke Imaging and Spectroscopy Program (DISP), Duke University. "A variety of single-shot approaches to improve the speed and quality of 3D image capture has been proposed over the past decades. Each approach, however, suffers from permanent degradations in 2D image quality and/or hardware complexity."

The research team, led by David Brady, a professor at Duke, was able to overcome these hurdles, developing an adaptive system that may accurately extract 3D data while maintaining the ability to capture a full-resolution 2D image without a dramatic system change, such as switching out a lens.

http://dx.doi.org/10.1364/optica.2.000822

Contextually smart mobile services coming to consumers

By the end of the year, contextually smart mobile services will be available to consumers and professional drivers as Cinia, Multiprint, Vediafi and Technical Research Centre of Finland VTT Ltd commercialise new smart mobile services that are currently being piloted.

New services will be used for producing and receiving contextually local voice and information services on vehicle operation, services, weather conditions and traffic disturbances, for example. Smart mobility refers to improving services related to smooth traffic, safety and services that are connected to traffic with the help of information and communications. With the help of vehicle sensor technology, mobile applications and background system logic, the group of companies called Cosmos has developed innovative smart mobile services that will be available on the GoSmart smart mobile website. The development has been carried out as part of the Digile IoT project that is funded by Tekes.

By the end of 2015, the operators who are part of the Cosmos group, Cinia, Multiprint, Vediafi and VTT, will commercialise services that are currently being piloted. Drivers will be offered traditional positioning services and added value services related to safety and smooth mobility, such as traffic and authoritative notices, weather information and information related to safe travelling and service connections.

Authorities will receive a service that will enable rapid identification of sudden and unexpected traffic disturbances. Through the interface of the service, drivers will be able to produce site-specific disturbance information, for example, on temporary slipperiness, animals, people, obstacles or frost on the road, accidents, short-term roadworks, poor visibility...

www.vtt.fi

Researchers develop small, inexpensive high frequency comb signal generator

Researchers from the Italian National Research Council (SPIN-CNR) and the National Enterprise for nanoScience and nanoTechnology (NEST-CNR) in Italy have devised a novel, inexpensive way to turn low frequency signals into higher frequencies.

The approach makes use of a Nobel Prize-winning device called a Josephson junction. Josephson junctions consist of a thin layer of insulator sandwiched between two superconducting layers. Under the right conditions, electrons can travel from one superconducting layer to the other with no resistance through the insulator in the middle. When the current reaches a critical level, however, a finite resistance suddenly appears and a voltage develops across the device.

Paolo Solinas, a physicist at the Italian National Research Council, was experimenting on Josephson junctions with his colleagues at NEST-CNR when they noticed an unusual behavior. They found that Josephson junctions placed in an oscillating magnetic field produced voltage pulses. The researchers turned to theory to analyze and explain the behavior.

They found that an oscillating magnetic field produced a sudden jump in a quantum mechanical property of the superconductor layers called a phase. The phase jump in turn produced the voltage pulse. The researchers also found that a regularly time-dependent magnetic field would produce voltage pulses that contained hundreds of harmonics of the original driving frequency, including frequencies thousands of times higher.

"The output of a single device is small, but you could build an array of devices to turn low power intrinsic of a single junction into higher output power," Solinas said. The team calculated that stringing together 1,000 Josephson junctions made from niobium and aluminum oxide could convert a 100 MHz input frequency into a 100 picowatt signal at 50 GHz.

http://scitation.aip.org/content/aip/journal/jap/118/11/10.1063/1.4928679.

University of Surrey opens 5G Centre

Housing over 170 researchers and attracting over £70 million of investment, including £12 million from the Higher Education Funding Council for England (HEFCE), the 5GIC is the world's largest academic research centre dedicated to next generation mobile and wireless connectivity.

The Centre brings together leading academic expertise and major industry partners to define and develop a global 5G network. Through their work, they have already developed a technology that enables speeds of one terabit per second (Tbps) - more than 1,000 times faster than the highest 4G speed, and filed over 15 patents.

Professor Rahim Tafazolli, Director of the 5GIC, said: "While we have already achieved record-breaking speeds, 5G is not only about delivering faster mobile internet. It is a transformative set of technologies that will radically change our private and professional lives by enabling innovative applications and services."

www.surrey.ac.uk

Many organisations form IoT Security Foundation

The Internet of Things Security Foundation has been formed with a large list of associate members having sprung out of discussions held at the UK's National Microelectronics Institute. The organization already has the backing of over 30 organisations including: Broadcom, Freescale, Imagination Technologies, Inside Secure, Tokyo Electron, Vodafone, uBlox and many others. The organization has been formed to response to concerns over the security of IoT systems and how those concerns could limit an economic impact that is likely to measured in trillions of dollars globally and be disruptive and transform society.

The groundwork for the formation of the IoTSF was laid at an IoT Security Summit held earlier this year at Bletchley Park. The IoTSF security can only be addressed by working internationally and with other IoT alliances and standards bodies.

www.iotsecurityfoundation.org
www.nmi.org.uk

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Preparing for 5G: The vital role wireless backhaul technologies will play in supporting next-generation connectivity

Dr. John Naylon, founder and CTO, CBNL

There is undoubtedly a lot of hype surrounding 5G. According to Huawei and Samsung, this next-generation connectivity is only a few years away, with both stating their aim of having trial networks ready for deployment by 2018. However, despite this seeming momentum, 5G still poses substantial challenges with many unknowns.

These will arise partly as a result of the Internet of Things (IoT), which looks set to dramatically impact the industry's approach to 5G. Cisco have predicted that there could be as many as 50 billion connected devices by 2020, and demands from these applications will be very different to the handset/smartphone-oriented experience gained in 3G and 4G. As such, these requirements are not currently well-understood, making it vital that the industry develops a greater understanding of the anticipated 5G ecosystem before its introduction. Only by gaining this insight will it be able to ensure it is developing the backhaul technology and business models to support its success.

INTRODUCING NEXT-GENERATION CAPABILITIES TO EXISTING BACKHAUL NETWORKS

Current operator networks, built for voice and data transport, are already creaking under the weight of mobile data traffic. This is set to be compounded by the surge in connected devices, which will put further strain on already struggling networks. However, despite this strain, operators are unlikely to invest in wholly new networks to carry IoT traffic. The revenue stream created by this multitude of low power, low cost devices—while attractive—will not justify such an investment.

Finding a way to re-use and extend existing network and backhaul capabilities to ensure every bit of data can be delivered at the lowest possible cost, will therefore hold the key for operators looking to roll out 5G networks. To achieve this, operators must not only ensure their backhaul is meeting capacity demands, but lowering total cost of ownership (TCO) to create a profitable business case.

We've seen through our own work, in providing backhaul for seven of the world's top ten largest operators, that efficiency and performance is of paramount importance; 5G will be no different. Although fibre backhaul is the logical choice for certain use cases, wireless is still the world's most common—and most cost-effective—backhaul technology. Greater cost efficiency, faster deployment times and increasing capacity will see wireless maintain this position, so it will be vital 5G can integrate seamlessly into this existing infrastructure.

The most common wireless networking paradigm overall has become point-to-multipoint (PMP) due to its ability to provide very cost-effective coverage. For example, mobile base stations aggregate traffic from multiple consumers to a single base station radio; similarly a single Wi-Fi hotspot is shared amongst multiple terminal devices; both are examples of multipoint systems. The increased number of base stations and hot-spots needed to support 5G, and the smaller footprint each will serve, make PMP more attractive not just for the access network but also in the microwave backhaul segment. PMP is therefore forecast to further gain market share from point-to-point for this application.

A single PMP microwave hub provides multiple sectors of coverage that can each backhaul multiple base stations and hot-spots, meaning it offers a more cost-effective and scalable strategy. Operators using PMP microwave can make significant cost savings on equipment and installation compared to PTP or fibre, whilst quickly rolling out the high capacity services demanded by 5G across a wide area. This innovative approach not only creates TCO savings of up to 50 percent compared to fibre or PTP, providing the ability to maintain profitability in an increasingly competitive market, but also makes the network more flexible and extensible.

OUTDOOR SMALL CELLS TO PLAY A ROLE

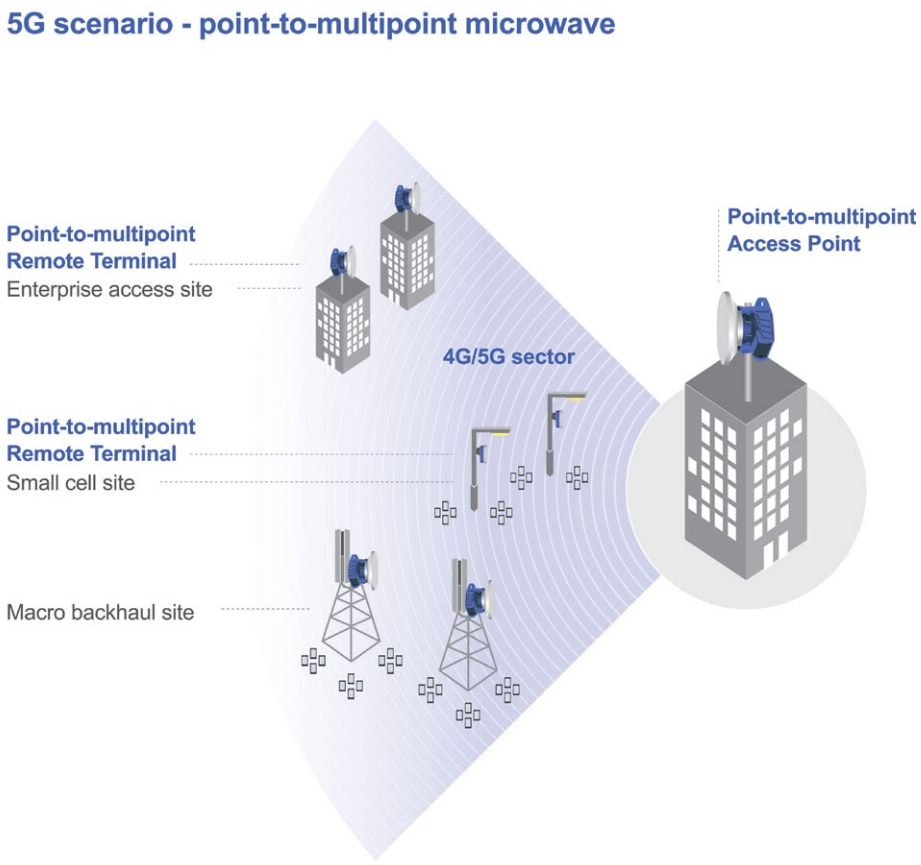
A key component of the growing landscape of 5G looks likely to be outdoor small cells. While there have been limited deployments to date, outdoor small cells will play an important role in providing cost-effective capacity for traffic 'hot spots', or those 'not spots' that suffer limited or no coverage.

CBNL has seen, in our previous role as Chair of the Backhaul Group for the Small Cell Forum, that the challenges of small cell backhaul have become much better understood and the industry has made great strides in removing barriers to adoption, including advances in technology.

Operators say that two key criteria for small cell backhaul are the ability to integrate with the existing macro layer, and the ability to support rapid deployment. PMP microwave, like CBNL's VectaStar platform, scores well on these criteria because a small cell's backhaul can leverage infrastructure already in place to serve existing macro

sites. In such a case not only can the backhaul be provisioned very quickly, but the business case is very appealing, because the small cell backhaul runs as a virtual network 'hosted' by the macro backhaul network. The latest VectaStar platform offers up to 14.4Gb/s per hub site and can easily accommodate small cells in existing macro backhaul sectors. Simple, scalable and cost-effective approaches such as this will become essential elements to successful 5G backhaul strategies.

Although the pace of adoption for outdoor small cells has been slower than initially anticipated, 5G is expected to build their momentum. In fact, a recent report from ABI Research predicted a 43 percent compound annual growth rate for the outdoor small cell market from now until 2020.



UNLOCKING NETWORKS' FULL POTENTIAL

Despite only being a few years away, much uncertainty still surrounds 5G. What is clear, however, is that the 5G ecosystem will differ from 3G and 4G before it, and operators will need to quickly adapt their business models and strategies to succeed. To achieve this, innovative backhaul solutions such as PMP microwave will be key—not only to address the technical challenges but to also create more scalable and profitable business cases. By combining these benefits with an exceptionally fast time to market, operators can unlock the full potential of their networks and secure future revenues for their business.

Health effects of Wi-Fi networks addressed by eBrief

There is little hard evidence that Wi-Fi network and other radio wave "pollution" is harmful to your health, but a new GoNet Systems eBrief looks at how this pollution can be reduced, to ease consumer concerns.

Titled "Are Wi-Fi Networks Harmful to Your Health?" the eBrief looks at the proliferation of Wi-Fi networks and cellular coverage, and concludes that users and others have a legitimate interest in reducing the volume of radio waves.

"Health is going to become a major concern especially as more Wi-Fi networks are installed in schools," said Merom Harpaz, head of sales for GoNet Systems. "Parents may not be worried about their health, but they will likely think twice when it comes to the radio waves their children get exposed to during the school day."

The eBrief also looks at how beamforming technology limits radio wave exposure. It uses an omnidirectional antenna only briefly, and once it picks up a signal, switches over to directed beams aimed at the user's device. Other approaches rely on radio waves broadcasting in all directions at all times.

GoNet Systems is a provider of Wi-Fi solutions to cellular operators and wireless service providers for 3G data offload and Wi-Fi access applications. Its Wi-Fi systems use directed beamforming technology, which delivers more efficient coverage and capacity and reduces the amount of radio waves in the coverage area.

For service providers, GoNet Systems equipment provides high-quality coverage with less equipment and a lower cost. As David Ackerman, head of business development for North America, pointed out, "Using the GoBeam Wi-Fi access points family can save up to 70 percent on CAPEX and OPEX."

The company's GoBeam access points are designed for optimal bandwidth-intensive Wi-Fi access in enterprise networks as well as large-scale 3G/4G data offload deployments. Its dual radio architecture supports beamforming in both the 2.4 GHz and 5 GHz bands.

www.GoNetworks.com

Open source code may unite IoT – networking project spawns IoT middleware

By Jim Ballingall, Executive Director, Industry-Academia Partnership

A high profile open source project working on software-defined networks has given birth to what could become an important standard for bringing unity to the fragmented Internet of Things.

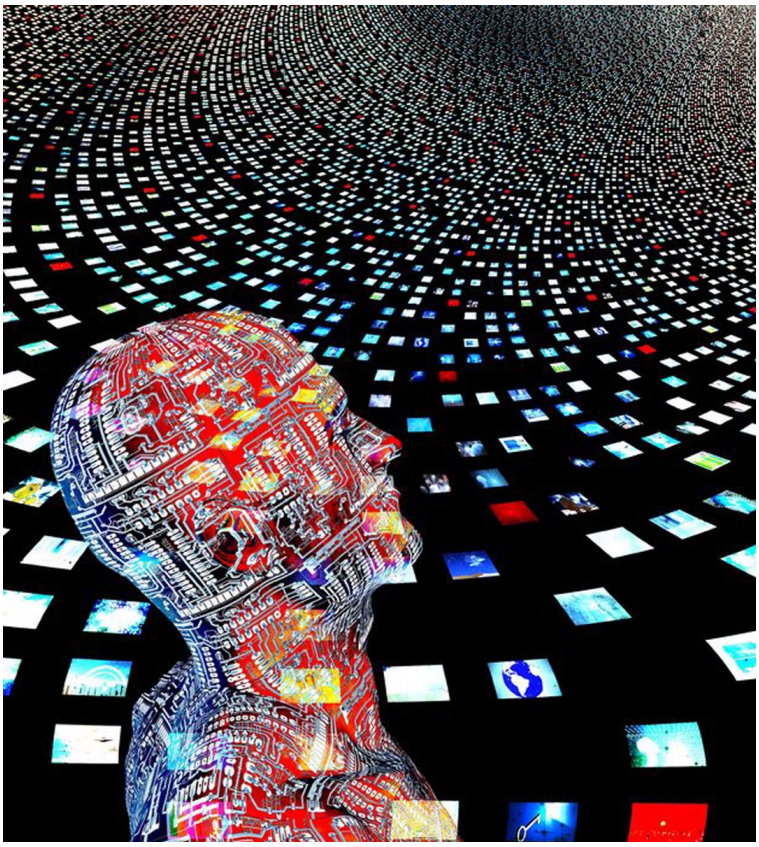
A robust middleware platform can unlock innovation and fulfil the promise of the Internet of Things. Such an approach is the IoT Data Management (IoTDM) project, an open source middleware solution recently started at the Linux Foundation under the auspices of the OpenDaylight project.

OpenDaylight is the leading open source platform for software-defined networking (SDN). Its latest release is expected to be embedded in over 20 commercial products, and it is being embraced by other open source projects including the Open Platform for Network Function Virtualization (NFV) and OpenStack.

The core OpenDaylight software allows computer networking applications to intelligently access and configure hardware network elements. Similarly, IoTDM provides a service layer that acts as an IoT data broker and enables authorised applications to post and retrieve IoT data uploaded by any device.

IoTDM is compliant with the oneM2M effort which provides an architectural framework for connecting disparate devices via a common service layer where a given application can be associated with a dynamic network of users, devices and sensor data. The service layer allows users and operators to control, for example, how often a remote sensor captures data or to reconfigure devices with a needed security update. The oneM2M project is backed by more than 200 technology companies, standards bodies and government agencies.

The IoTDM platform can be configured for the needs of various use cases. It can deliver only IoT data collection capabilities where it is deployed near IoT devices and its footprint needs to be small; or it can be configured to run as a large, distributed cluster with IoT, SDN and NFV functions enabled and deployed in a big data centre.



The ease of use of this middleware platform was recently proven when a group of Boston University students used IoTDM along with common mobile development languages and server-side tools, to build a pair of Smart Cities apps. Their work was showcased in the DevNet Zone for IoT hosted by Cisco at its annual Cisco Live event in San Diego in June.

These applications provided visualisations of mobile device positions on interactive maps of both indoor facilities and aerial/satellite imagery. They combined signals acquired from disparate things including Bluetooth low energy beacons, Internet routers, and GPS signals. To speed development, the students made extensive use of open source software including iOS and Android mobile location apps, as well as sigma.js and node.js to support the browser-based functions.

One application allowed users to search for other registered users on their mobile devices and view a heat map that displayed real¬time people traffic and historical data. The other app provided visualization of the IoT network nodes and data including the applications, users, devices, and the aggregated IoT sensor data. Users could directly edit the graphical representation of the network, using a cursor to select specific nodes on their display for editing, as well as creating new nodes, or searching for nodes not displayed. In this way, users could easily add, update or delete data.

These applications were written by students and required 600 and 1,000 person-hours of work each. They are representative of future IoT applications that will easily combine data from multiple and disparate sources, providing insights that enable smart decisions. The underlying technology solutions that can perform the required data aggregation, sensor service management, and application integration are maturing quickly.

Jim Ballingall *is executive director of The Industry-Academia Partnership, an association of university professors, students and industry leaders in pursuit of common goals in cloud computing education, research and product development.*

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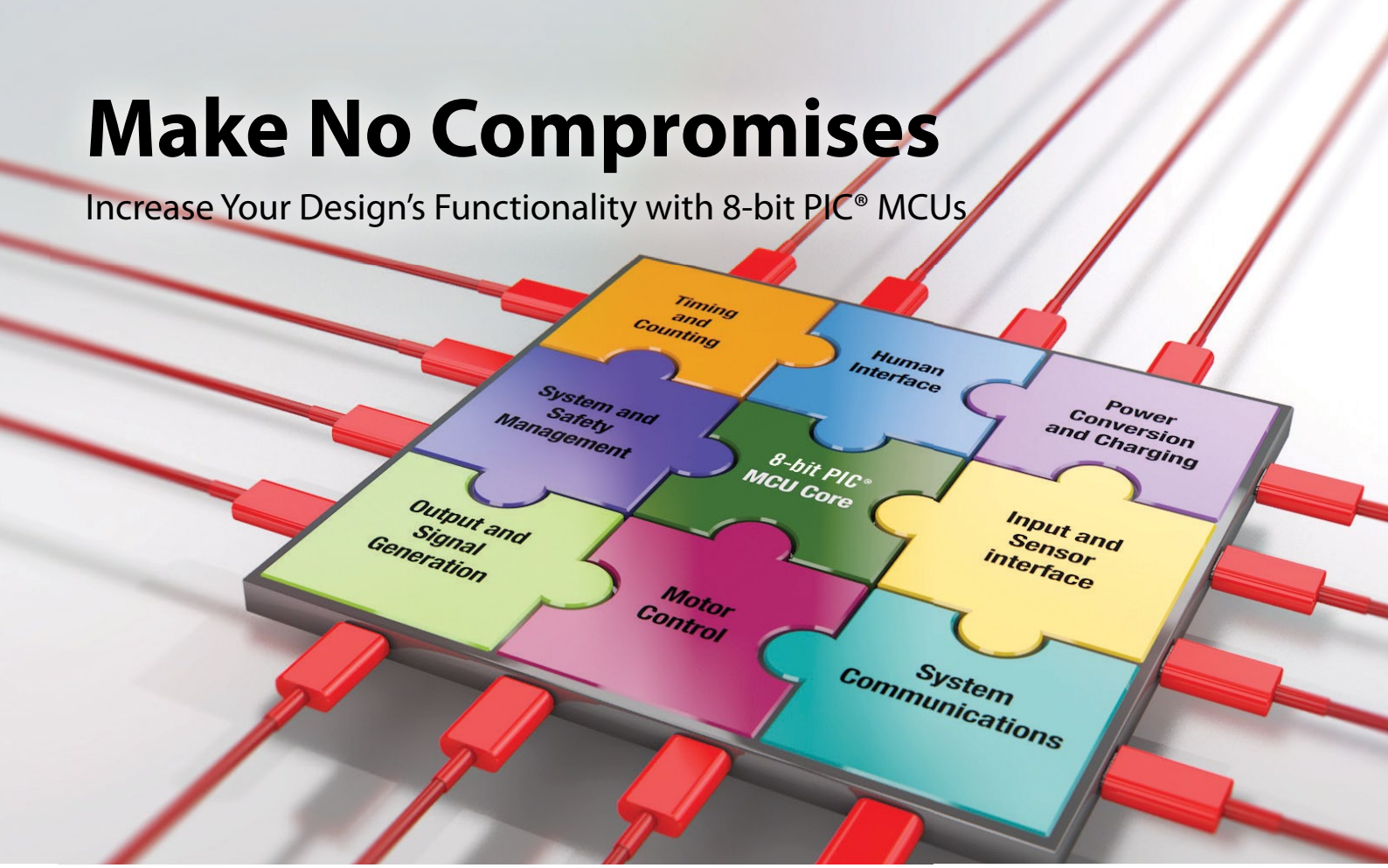

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Static and Dynamic Structure Spurs in Sigma Delta Modulator Fractional N

Akmarul Ariffin Bin Salleh, R&D CTD

Sigma Delta Modulator (SDM) based fractional N is widely used in RF instrumention to provide, fractional number division, scalable output frequency accuracy that does not depend on the reference frequency, and allow wider loop bandwidth for faster switching time. This article first explains the 2 types of structure spurs that can be generated in SDM Frac N; static and dynamic structure spurs. A method to properly simulate and calculate if structure spurs exist from SDM output will be shared.

I. INTRODUCTION

In a Phase Locked Loop (PLL), to get an output frequency resolution that is not a multiple of the reference frequency Fref, a non integer divider called Fractional N (FracN) is used. It is used in the feedback path, where its input is VCO signal Fout, and its output is a frequency "equals" to Fref, as illustrated in Figure 1.

The widely used method to generate fractional division is through a Sigma Delta Modulator (SDM) Frac N. SDM can be further defined by its order, which is the number of accumulators (digital) in the SDM engine. For example, 3rd order SDM means, there are 3 accumulators. Rarely, a 4th order SDM Fractional N (FracN) is used in a PLL, rather a 3rd order SDM FracN is more popular and widely used. 3rd order SDM will occupy 8 different instantaneous N (Ninst) integer values, in order to produce the fractional number N.F. This Ninst is sent to programmable dividers and typically, the type of dividers used are dual modulus prescaler or quad modulus prescaler.

So Ninst will pseudo randomly change among 8 different numbers around N, in order to produce N.F. However, 4th order SDM, on the other hand, requires 16 different Ninst, and would "stress" the divider more.

In addition to that, it will tend to limit the usable N from the divider. These are some of the reasons why 3rd order is more favorable.

II. STATIC STRUCTURE SPUR AND SPUR CORRECTION

For a certain fractional part number .F, the Ninst generated by SDM will not be completely random, but it will have some repetition, due to limit cycle, and this will manifest as spur sideband, at the output of the PLL. This spur is called a structure spur. In general, the higher the order of the SDM, the better it is in dispersing the structure spur, as Ninst can take more values, thus more randomization. In other words, 4th order SDM is better than 3rd order SDM, as far as structure performance. Nevertheless, at some rational .F, no matter how high the order of the SDM, the structure spur will present strongly.

Shown in Figure 2 are the plot of Ninst of N.F=0.25, comparing 2nd, 3rd and 4th order SDM. Take note that SDM can't really generate N.F=0.25, where N=0, as this will require negative divide number. N.F=0.25 in this example is just to illustrate how Ninst will change around N=0. Visual inspection on the Ninst in Figure 2 shows that Ninst pattern is structured, and this will result to structure spur.

One of the widely used methods to fix the structure spur as shown in Figure 2, is to add spur correction. Spur correction can be done by adding pseudorandom bit sequence (PRBS) at the input of the SDM engine. This can be explained through Figure 3.

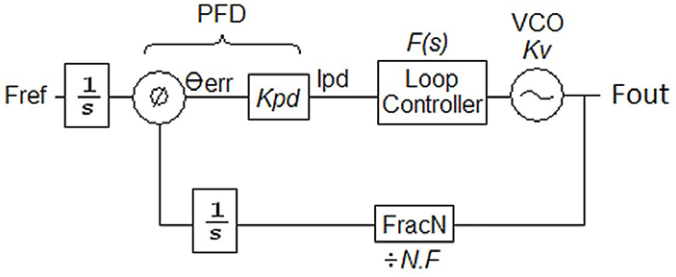

Figure 1: PLL Diagram.

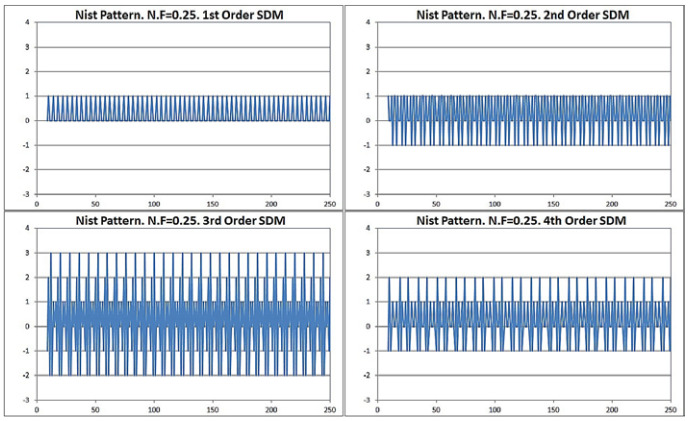

Figure 2: Ninst pattern for N.F=0.25. For 1st, 2nd, 3rd and 4th order SDM.

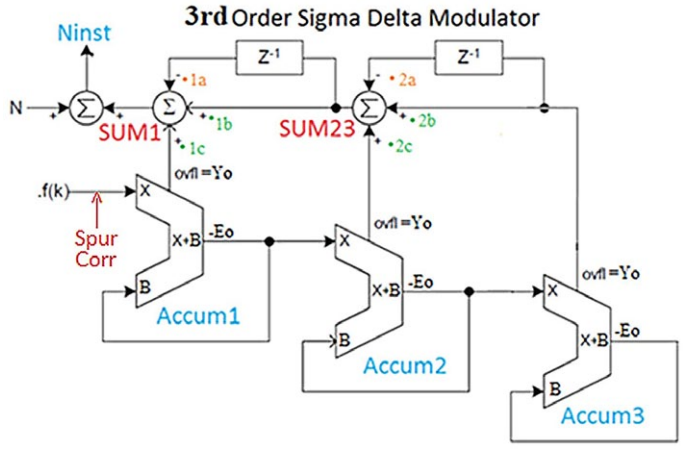

Figure 3: Diagram of 3rd Order SDM.

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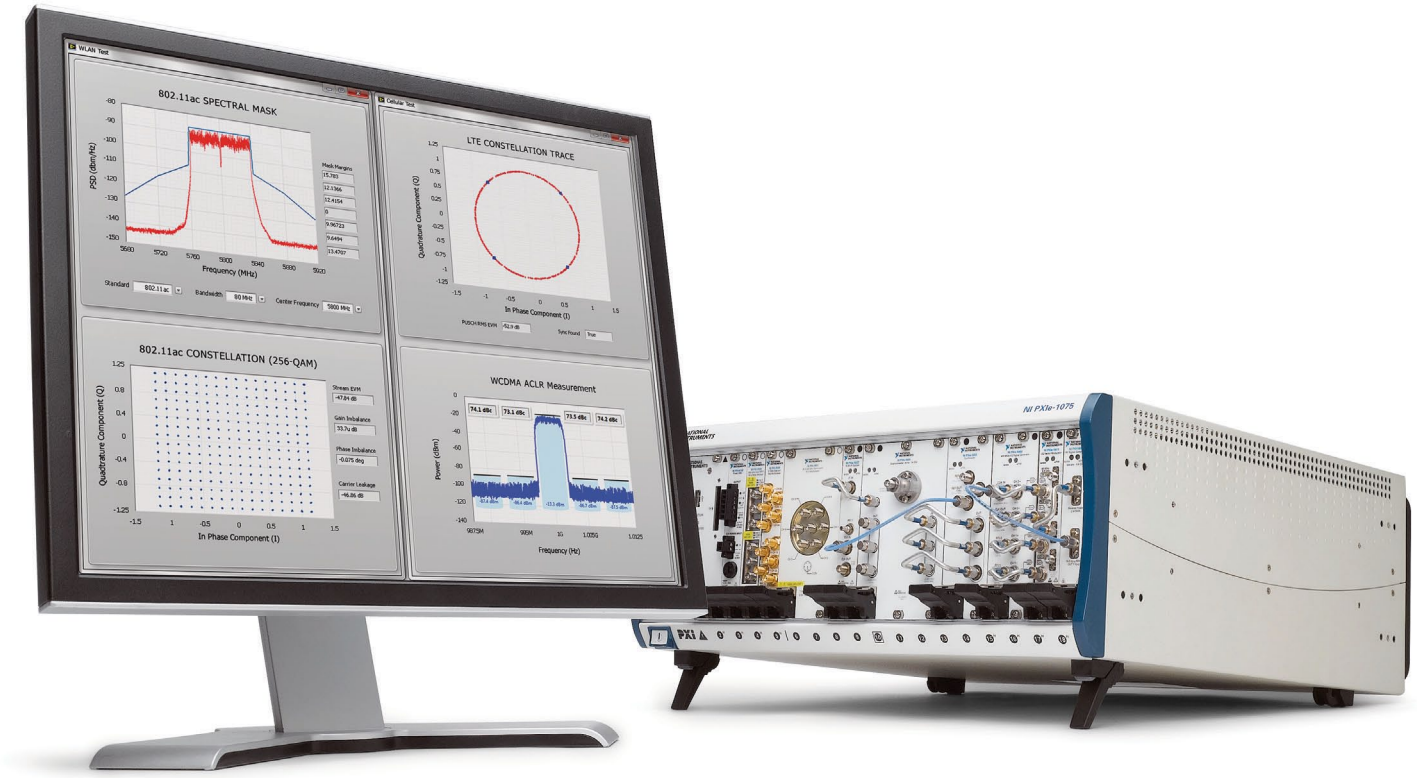

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SDM Stucture Spurs

Figure 3 shows the diagram of a 3rd order SDM using a multistage noise shaping (MASH) technique. Basically, it contains 3 accumulators, thus 3rd order, adders and delay elements. The inputs to the SDM engine are on the left side, N and .f(k). While, .f(k) represent the .F in N.F, and the k is the bit size of .f.

The higher the value of k, the smaller the frequency resolution at the output of the PLL, as depicted by eq1 below,

Freq_resolution=Fref/(2k) eq1

The spur correction PRBS (Spur Corr) can be added at .f(k) as shown in Figure 3. Say for example k=26 bit wide. Spur Corr is just a random sequence of 0 and 1, and if added directly to .f(k), it will just add to the LSB of .f(k). Most of the time, this is not enough to disperse the structure spur as in Figure 3. What can be done is to add the Spur Corr PRBS, somewhere in between the MSB and LSB of .f(k), say on 13th bit, out of k=26 bit wide. The closer the Spur Corr to the MSB, the more the structure spur will be dispersed, but the phase-noise noise profile will be degraded from ideal, at a low offset. This is shown in Figure 4. In Figure 4, the RED trace is the ideal profile of 3rd order SDM phase noise with no Spur Corr, where it slopes up at 40 dB/dec. The ORANGE and the BLUE traces are the degraded phase noise profile, where the Spur Corr is added 2bit below MSB and 3bit below MSB, respectively. In order to decide the best bit position for the Spur Corr, the SDM designer will need to strike a balance between structure spur dispersion and degraded synthesis phase noise that it can tolerate. There is no right or wrong answer.

Figure 5 shows the plot of Ninst pattern for N.F=0.25, as in Figure 2, but this time with Spur Corr added. Spur Corr is added at around 1/3 away from the MSB of .f(k). From visual inspection of Figure 5, we can conclude that Spur Corr is more effective at higher order SDM. Spur Corr virtually has no effect on dispersing the structure spur on 1st order SDM, and has the most dispersion on the 4th order SDM. The higher the order of the SDM, the more immune it is to structure spur.

1st order and 2nd order are rarely used in practice, if none. 3rd is the most widely used, since most of the time, its spur dispersion is good enough. 4th order are sometimes available as an option in some Fractional N ICs, but not as desirable as 3rd order. Some of the reasons are, 4th order occupy more Ninst states (16 states) than 3rd order (8 states). Due to this, 4th order has a limited range of N that can be selected. Say a dual modulus prescaler is used, and its divide number ranges from 12 to 30. With 3rd order SDM, the usable divide range is 15 to 26, since the Ninst can be as low as N-3 and as max as N+4. With 4th order SDM, the usable divide range is 19 to 22, since the Ninst can be as low as N-7 and as high as N+8.

There is another reason why 4th order is not that desirable, and it will be explained next. Shown in eq2 is the generalized SDM phase noise at its input. Fref is the reference frequency, the frequency at which the SDM is clocked, and n is the order of the SDM.

$$S_{\theta\_STD\_n\_th}(f, fref, n) := \frac{(2\pi)^2}{12 \cdot fref} \cdot \left(2 \cdot \sin\left(\frac{\pi f}{fref}\right)\right)^{2 \cdot (n-1)}$$

Figure 6 shows the phase noise plot of 3rd SDM versus 4th order SDM. The fref is at 90 MHz. 4th order SDM has a much superior phase noise at low offset but it slopes up at 60 dB/dec. This will make the synthesis noise filtering of 4th order a bit more complex than 3rd order. This synthesis noise filtering is usually placed in between the PFD and the Loop Controller as in Figure 1, and without it, the Loop Controller can impose some non linearity (through its slew rate for example), and degrade the ideal synthesis phase noise as in Figure 6. So the synthesis noise filtering will take care of this.

Another thing to note is, 4th order SDM has higher peak noise at 45 MHz, as in Figure 6. While most designers think that the synthesis noise filter will take care of it, turns out it might not be true. Typically, the prescaler output is of a very narrow pulse, in order to minimize the energy feed through, thus

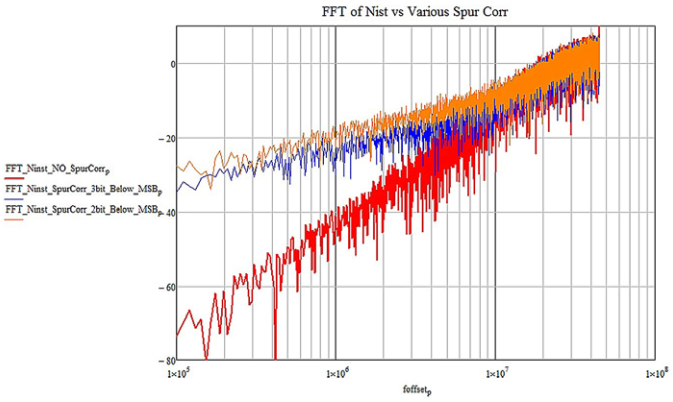

Figure 4: Degradation of 3rd order SDM phase noise profile, with respect to Spur Corr strength.

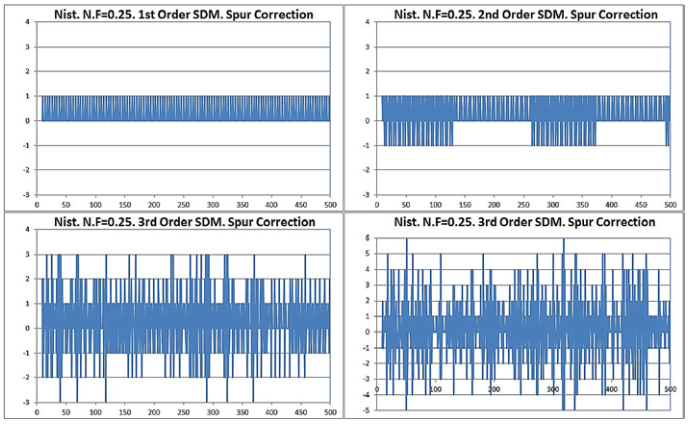

Figure 5: Ninst pattern for N.F=0.25. For 1st, 2nd, 3rd and 4th order SDM.

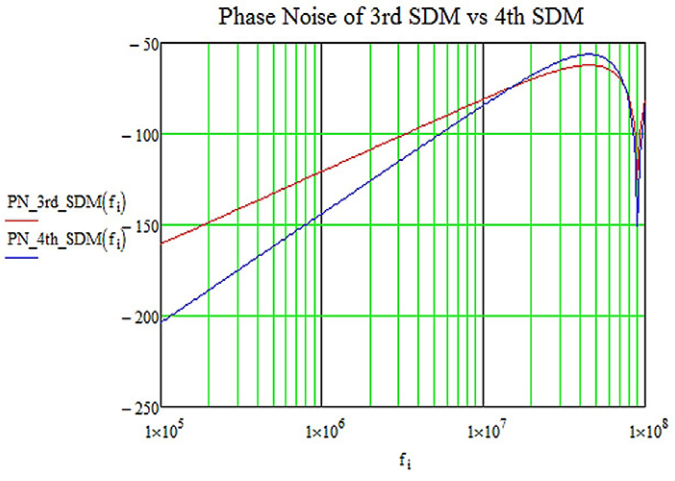

Figure 6: Phase noise of 3rd order SDM and 4th order SDM.

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better spur performance. The 10%-15% duty cycle pulse at the output of the prescaler is not that uncommon. In PLL analysis, most of the time we just assume that the output of the prescaler has average frequency of fref, and the phase noise of eq2 just riding on it. Eq2 is defined at the input of the prescaler. But due to the "non-linearity" in the prescaler where the input is converted to be a narrow pulse at the output, the 4th order peak noise at 45 MHz as in Figure 6, is folded in or aliased to the fref of 90 MHz. At the output of the prescaler, the output frequency is around the fref of 90 MHz. Instead of getting a phase noise around -200 dBc/Hz at offset 105 Hz for 4th order SDM as in Figure 6, you will get degraded phase noise, say -150 dBc/Hz.

Described and illustrated in Figure 2 and Figure 5 are static structure spurs, where the offset frequency of the spur from the carrier, are constant and fix.

There is another type of static structure spur where the spur offset frequency changes from tune to tune. Let's call this non-stationary structure spur. For example, say we are toggling between 2 different N.F, N.F=0.5 and N.F=0.7. There is a spur at N.F=0.5, and every time you retune to N.F=0.5, the spur offset will change per tune. In other words, per tune, the spur offset frequency could be fixed at 180 kHz, at another tune the spur offset frequency could be fixed at 45 kHz, and at another tune there might be no spur.

What is actually causing this is due to the initial content of the accumulators. Different initial values will result in a different spur offset frequency, or no spur at all. Figure 7 and Figure 8 shows the Ninst output, for N.F=0.5 and for different initial values in Accum1, Accum2 and Accum3 as in Figure 3. From visual inspection, the repetition rate of Ninst in Figure 7 is different than the repetition rate of Ninst in Figure 8. This will result to structure spurs with different offset frequency, even though N.F remains the same at 0.5.

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A solution was implemented during the development where it totally removed all the non-stationary spurs. This is shown in Figure 10. No more non-stationary spurs could be observed.

Dynamic structure spur, which will be explained next, is a type of structure spur, where the offset frequency of the spur from the carrier is not constant, and will sweep across the carrier frequency.

III. DYNAMIC STRUCTURE SPUR

For a certain N.F, a dynamic or non-stationary spur can be generated at the output of the SDM engine. In coherence with what has been explained in previous sections, the higher the order of the SDM, the more immune it will be even to this dynamic spur.

In general, a very small N.F will result in this dynamic structure spur. Shown in Figure 11 is the Ninst of a 3rd order SDM with accumulator size of 26bit. The N.F for illustration is N.F=500/(226).

From visual inspection, it can be seen that the pattern repetition frequency increases with cycle. This will result in a structure spur that will increase in offset frequency over time. From my analysis and experiment, the simple Spur Correction as in Figure 3 will not be able to

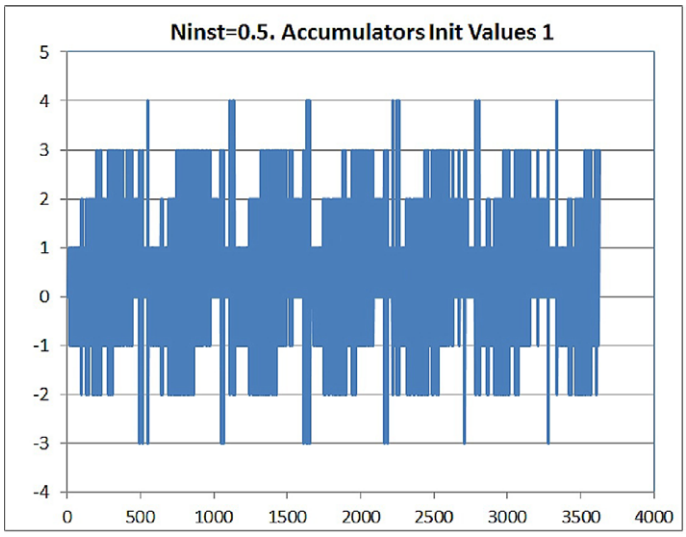

Figure 7: Ninst output with N.F=0.5. Accumlators value set 1.

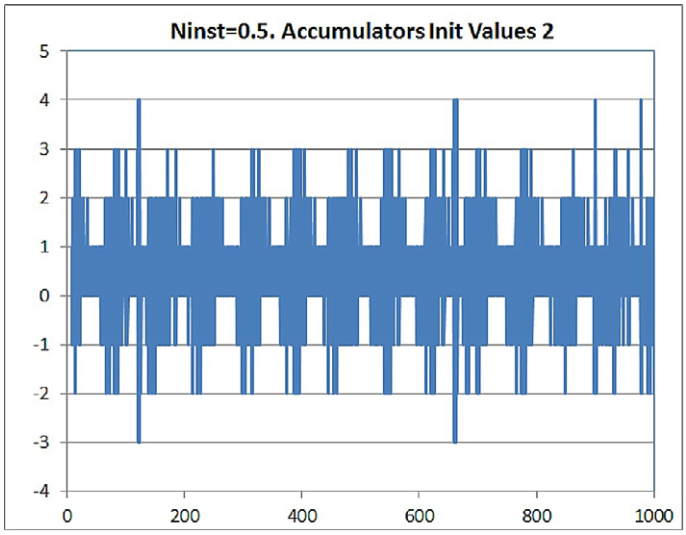

Figure 8: Ninst output with N.F=0.5. Accumlators value set 2.

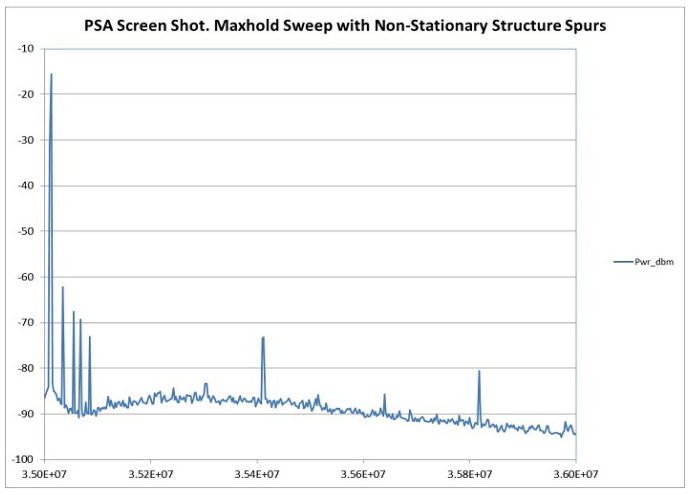

Figure 9: Maxhold sweep of under development N9918A LO1 frequency with non-stationary structure spurs shown.

disperse the spurs effectively. More sophisticated techniques, perhaps novel, need to be used.

IV. SIMULATION AND CALCULATION OF STRUCTURE SPUR

Up to this point, only visual inspection is used to point out that structure spur might be present, based on Ninst plot. For the Ninst plot in Figure 7, Figure 8 and Figure 11, it is quite obvious — and and the repetition pattern is very strong.

In some cases where the repetition is quite embedded in a pseudorandom Ninst plot, visual inspection is far from reliable and a more proper method is needed. Shown in Figure 12 is Ninst plot where N.F = 2/pi/100*0.98179 = 0.006250269... From visual inspection, it is a bit hard to give a verdict if there is a pattern repetition that would cause structure spur. Based on actual hardware measurement using a spectrum analyzer, there is a spur at 562 kHz offset, at the output of PLL. 562 kHz is roughly the N.F*Fref, and Fref used on the actual PLL hardware is 90 MHz.

To figure out if the Ninst in Figure 12 can cause structure spur, most engineers would take the FFT of the Ninst data sample in Figure 12, and conclude from there. The FFT in dB of Figure 12 is shown in Figure 13. Across the offset frequency, no spur can be observed.

Taking the direct FFT of Ninst will not yield the spur at 562 kHz offset frequency. The correct way is to first model the signal at the output of the prescaler, which is a voltage as a function of time. The output of the prescaler is typically a very narrow pulse, so the output should be a narrow pulse signal with a varying frequency, but have an average of Fref.

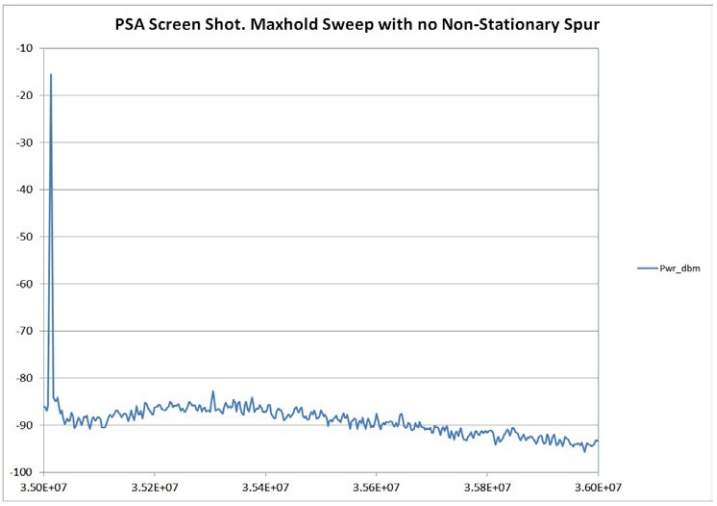

Figure 10: Maxhold sweep of shipping N9918A LO1 frequency with non-stationary structure spurs fixed.

The reason the instantaneous frequency of the prescaler output is not constant is because, the input to the prescaler is a constant RF frequency (assuming phase locked), but the divide number Ninst is not constant. This will generate an output with varying frequency.

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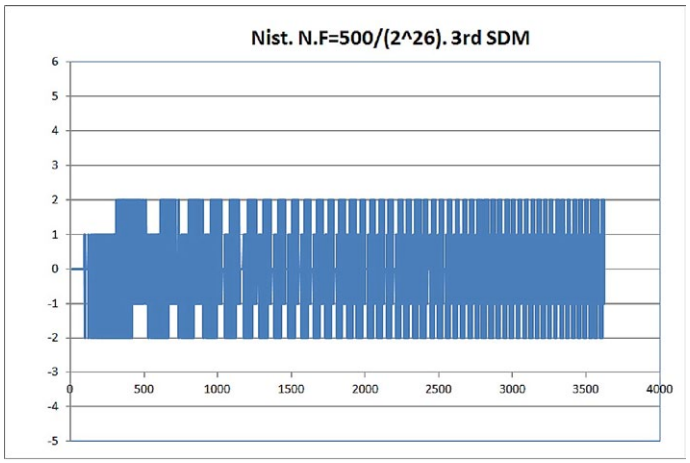

Figure 11: Ninst of 3rd order SDM with N.F=500/(2^26).

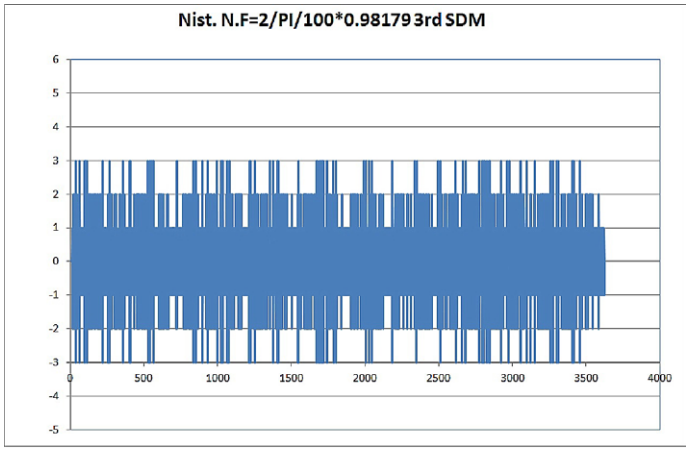

Figure 12: Ninst of 3rd order SDM with N.F=0.006250269.

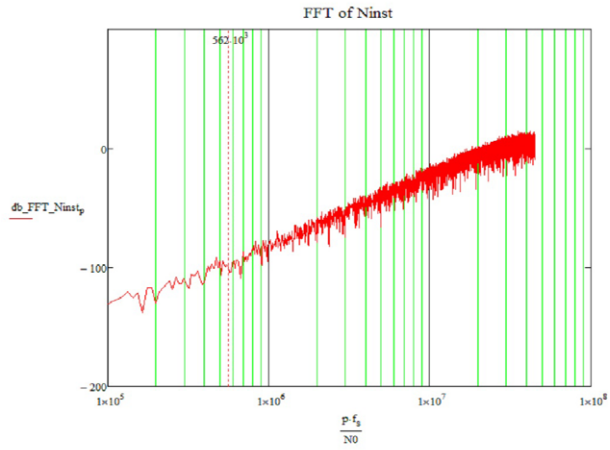

Figure 13: FFT in db of Ninst in Figure 12.

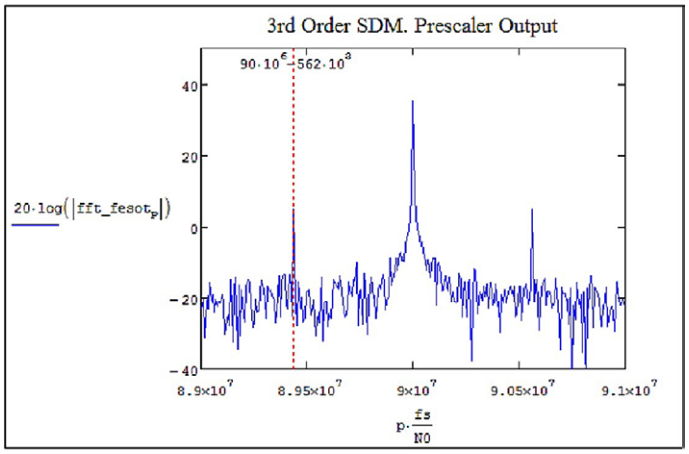

Figure 14: FFT of prescaler output.

Once the prescaler output is modelled, the FFT on the prescaler output can be done. As the prescaler output is of narrow pulse, the output needs to be sampled at a fast enough sampling rate so that you won't miss any sharp pulses. The FFT of the prescaler output signal is shown in Figure 14. The Fref in this example is at 90 MHz, and sure enough, you can actually see the structure spur at 562 kHz away from the carrier Fref.

V. CONCLUSIONS

The structure spur I SDM was explained, the static structure spur and the dynamic structure spur. It was illustrated that the higher the order of the SDM, the better it is at dispersing the structure spur, but at strong rational .F number. Regardless of the order of the SDM, a spur correction technique is required. Finally, a proper method to calculate and simulate the existence of structure spur, based on a given Ninst was proposed.

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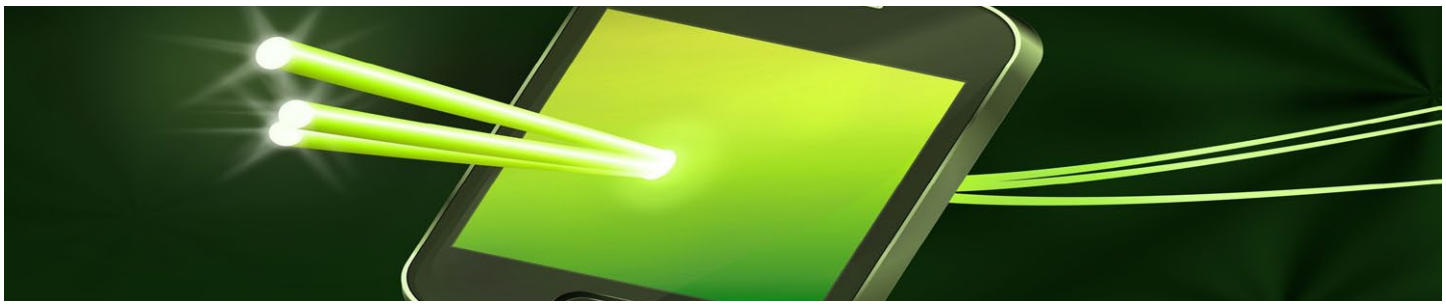

Ding.

Anaren's new line-up of RF energy components are an ideal fit for the next generation of solid-state "smart" microwave ovens or RF-based automotive, lighting, medical, and other applications. Contact us to learn more!

Our new family of ISM-band, RF energy components is done!

Count on Anaren's new line-up of RF energy couplers and terminations – whether you're developing a solid-state, "smart" microwave oven, automotive, or other applications – Anaren has once again cooked up a new family of Xinger®- brand couplers for the job. Comprised of two 3dB hybrids, one 30dB directional coupler, and a new flange-mounted AIN termination matched to all three – these parts offer very low loss, handle 300 to 600 Watts, operate in the narrow 2.4-2.5GHz ISM band, and are packaged in a low-profile form factor that saves you precious board space. **To learn more, download our intro-kit at www.anaren.com/high-energy-xingers**

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China: +86-512-62749282

Anaren®
What'll we think of next?®

Near-field probe

measures magnetic fields up to 10 GHz

The high measurement resolution of the SX probe heads from Langer EMV-Technik GmbH allows the developer to pinpoint RF sources of between 1 GHz and 10 GHz on densely packed printed circuit boards or on IC pins.

The handy compact pin shape of the EMC near-field probes provides the developer with convenient working conditions on the respective PCB.

High clock rates of 2 GHz, for example, may result in 5th order harmonics of up to 10 GHz. These harmonics are coupled out by RF sources on the PCB such as conductor sections, ICs and other components. They may stimulate other structural parts of the PCB to vibrate and generate emissions. In view of the high internal fundamental frequency of current PCBs, the measurement of harmonics of this frequency is an important step towards reliable EMC.

The latest SX1 near-field probe set contains three near-field probes with high resolution for measurements in the upper frequency range.

The SX-E 03 is an E-field probe for frequencies between 1 GHz and 10 GHz with an electrode on the underside of the probe head sized approx. 4 x 4 mm. This probe can be used to pinpoint small E-field sources such as conductors, individual components on a printed circuit board, etc. The head of the near-field probe is usually placed directly on the object of the measurement (high electric field strength).

The SX-R 3-1 is an H-field probe for frequencies between 1 GHz and 10 GHz with a very small probe head to identify even the smallest components as a source of interference. This small probe head is also ideal for carrying out measurements in hard-to-reach locations such as in the vicinity of IC pins.

www.langer-emv.com

RFID antenna adapts to customer applications

HARTING has developed a unique type of RFID antenna, the Ha-VIS LOCFIELD® antenna, which uses a coaxial travelling-wave concept to offer users a compact package with complete flexibility in the design of RF reading zones. Not only is the antenna adaptable to every customer application: it is also ideal for situations where space is at a premium.

Modern industrial RFID systems allow components and packages to be followed in real time, and offer a multitude of options for increasing process security and ensuring optimal transparency. However, there is generally very little space available around belt conveyors, and classical RFID antennas are limited in that they cannot map curved tracks: a factor that restricts the capability for customers to track and trace production history at every point in the process.

The Ha-VIS LOCFIELD® RFID antenna requires only a minimum of space, consisting only of an industrial-grade coaxial line. The antenna cable is mechanically flexible and can therefore be installed and laid in any given shape according to the requirements of specific customer applications. This includes the ability to lay it around the curves of conveyor belts.

www.harting.co.uk

IQ transmitter

with 40 GHz RF bandwidth

Coherent Solutions of Auckland, New Zealand has announced the launch of its 40 GHz IQ Transmitter (IQTX-40) at ECOC 2015 in Valencia, Spain.

The IQTX-40 is the first fully integrated laboratory optical transmitter with 40 GHz of RF bandwidth enabling R&D Engineers to generate coherent modulated signals at baud rate beyond 56 GBaud.

The IQTX-40 features an Automatic Bias Control (ABC) that optimizes the performance of the modulator irrespective of the modulation format being used. Engineers can now seamlessly change modulation formats and baud rates without any concerns for maintaining the modulator's bias stability. The ABC also provides unparalleled control, allowing the user to individually control the bias locations of all biases of the modulator, perfect for generating a wide variety of signals beyond coherent modulation.

As with all instruments available from Coherent Solutions, the IQTX-40 can be fully controlled remotely with SCPI/VXI11 commands making it easy to control from Matlab, Python, LabView or any other environment.

www.coherent-solutions.com

Digital radio data router delivers max security

Offering a good alternative to the use of cellular and fibre optics networks, the XT5 radio router from Satel delivers 5 W transmit power with a high-level of security based on encrypted data transmission in the private radio network.

Featuring a compact design, the XT5 enables data transfer rates "over the air" of up to 230 kbps. As a transmission medium for TCP/IP information the UHF radio band (320 MHz to 520 MHz) of the Satellar XT5, with a range of 20 km and more, is an excellent alternative to the use of cellular and fibre optics networks.

A private radio data transmission network that uses AES 128 encryption is immune to attacks from the Internet. Security, availability and quality of data transmission are not in the hands of unknown third parties, but instead fully conform to the requirements and specifications of the actual user.

Further, the Satellar XT5 is also the first choice when used as a secondary system. As a reliable, autonomous and secure backup system the radio router can run

as a hot standby featuring uninterrupted handover, with functions such as redundant routing and VRRP (Virtual Router Redundancy Protocol). If cellular connections break down due to overload, server problems, power outages lasting for days or destruction of fibre optics cables, a private radio data network provides a perfect, reliable and high-performance backup at any time and under any circumstances.

www.satel.com

Arbitrary waveform generator

high-speed, wide-bandwidth

Keysight Technologies has added a 92-GSa/s, 32-GHz modular instrument to its portfolio of arbitrary waveform generators. The high-speed, wide-bandwidth M8196A arbitrary waveform generator allows engineers to generate digital, multi-level (e.g., PAM-4, PAM-8, DMT) signal scenarios at 8 bits vertical resolution and test their electrical and optical links with complex modulated signals up to 64 GBaud. The instrument supports leading edge research for 100 Gb/s, 400 Gb/s and 1 Tb/s communication applications.

The M8196A arbitrary waveform generator supports high-speed and coherent optical transceiver and component testing with its four synchronized channels in one instrument, allowing deterministic emulation and predistortion of two independent I/Q signals; R&D tests in the development of new physical layer standards exceeding 100 Gb/s with the instrument's unmatched flexibility which also allows de-embedding of a channel's S-parameters, in-situ calibration and signal stress conditioning; as well as generation of any mathematically defined arbitrary waveforms, ultra-short yet precise pulses and multiple GHz chirps.

www.keysight.com

E-band radios

deliver fibre-like performance

Siklu Inc., has released the EtherHaul-2200F and EtherHaul-2200FX mmWave radios to create bandwidth-rich and interference-free connectivity for wireless networks. The products are based on the company's ground-breaking, all-silicon EtherHaul platform, and deliver scalable 2-Gigabit capacity to wireless networks in the fastest and most cost-effective way.

With radio variants in the 60, 70/80 GHz frequencies delivering 1 to 2 Gigabit capacity, Siklu's product portfolio encompasses a full range of connectivity systems – rooftop and street-level, for boosting capacity and facilitating network expansion. The latest 2-Gigabit radios enhance the aggregation, backhaul and connectivity of multiple urban and commercial vertical markets, such as business and residential broadband, video surveillance, Wi-Fi and mobile backhaul.

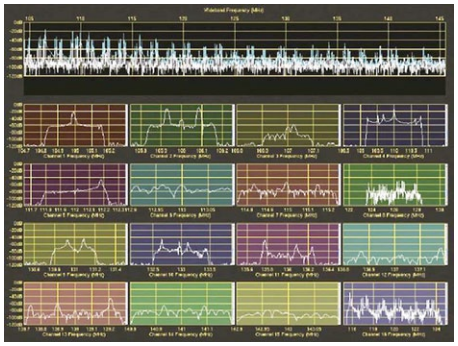
The carrier grade radios are small, and swiftly integrate into mobile networks expediting modifications and expansions. Diminishing latency and efficiently utiliz-

ing the narrow beams in the abundant mmWave spectrum, the radios pave the way for excellent interference-free, high-capacity service.

www.siklu.com

Advanced channeliser IP core

RFEL has launched the latest version of its advanced channeliser IP core, ChannelCore Flex™.



The latest version, ChannelCore Flex 3.1 has many new features that ensure it continues to provide highly versatile, state-of-the-art solutions for a wide range of demanding channelisation applications such as communications, intercept, electronic warfare, security, industrial applications, COMINT, SIGINT, sonar, radio astronomy, research and software-defined radio.

Dr Alex Kuhrt, RFEL's CEO, explained, "The secret to the many years of ChannelCore Flex's success is that the design delivers a very large number of channels – scalable to 1000s of channels – from a very small FPGA resource utilisation."

To further assist customers with evaluation of ChannelCore Flex 3.1, a fully functional but time limited version is provided on RFEL's recently announced, qu-IQ™ signal processing development platform.

The channels can be programmed in real-time with centre frequency, bandwidth, gain and filter response. A powerful fractional rate resampler and adjustable overall gain helps make ChannelCore Flex a unique solution.

www.rfel.com

50 GHz DPDT switch series

RLC Electronics has introduced a DC-50 GHz DPDT transfer switch that provides extremely high reliability and outstanding electrical performance.

The switch boasts low insertion loss and VSWR over the entire frequency range (1.2 dB maximum and 2:1 maximum, respectively, at 50 GHz), while maintaining high isolation (50 dB).

Additional options include operating mode (failsafe or latching), control voltage and logic (TTL), indicator functionality, arc diodes and special power/mating connectors.

www.rlcelectronics.com

100-W GaN on Silicon wideband transistor

M/A-COM Technology Solutions has announced its 4th generation 100-W GaN on Silicon wideband transistor. Built using the company's proprietary 4th generation GaN on Silicon (GaN on Si) process, the 100-W part (MAGX-100027-100C0P) is optimized for DC to 2.7 GHz operation and is aimed at defense communications, land mobile radio, avionics, wireless infrastructure, ISM applications and VHF/UHF/L/S-band radar.

It supports CW, pulsed, and linear operation with output power levels up to

100-W (50 dBm). Operating from 50 V, the device support continuous wave operation with a 18.3 dB gain at 2.45 GHz, and 70% drain efficiency.

According to the company, such parts deliver a performance that rivals expensive GaN on Silicon Carbide at a projected volume production cost structure below that of incumbent LDMOS technology, and thus its Gen4 GaN technology could finally bring GaN to the mainstream market, on silicon, while enabling a power density more than four times that of LDMOS.

The company is sampling its 100-W parts now, with 200-W and 300-W devices soon to be announced, but that's not all. It has big plans to ramp up its production, from today's 4-inch wafers to 6 or 8" silicon wafers.

www.macom.com

Direct conversion radio receiver Ics

CML Microcircuits has released the CMX994A and CMX994E direct conversion receiver (DCRx) ICs. These RFICs feature I/Q demodulators with low power consumption and high performance.

The devices are targeting the next generation of narrowband and wideband software defined radios (SDR) for wireless data and two-way radio applications. Their design provides the optimum route for high integration, allowing a small RF receiver to be realised with a minimum of external components in zero-IF, near zero-IF and low-IF systems.

The ICs build on the success of the popular CMX994 and are the first devices to use the company's PowerTrade™ technology. PowerTrade™ enables the devices to dynamically balance power consumption and performance characteristics to suit varying operating requirements. Very low power consumption can also be achieved in standby mode whilst looking for an RF signal, using intelligent control of power cycling, phase control and I/Q channel selection.

The CMX994A delivers a very low power DCRx device while the CMX994E also includes the low power mode of the CMX994A but in addition, offers a high performance mode with improved IP3 performance.

The CMX994, CMX994A and CMX994E DCRx ICs offer excellent RF performance, exceptional IP2 from I/Q mixers and are suitable for modulation schemes including: QAM, 4FSK, GMSK and pi/4-DQPSK. Key features of the device include on-chip VCO for VHF applications, on-chip LNA, precision baseband filtering with selectable bandwidths and the smallest PCB area, typically less than 50% of a dual superhet.

www.cmlmicro.com

GaN power amplifiers

offer high power and gain up to 7.5 GHz

Pasternack has expanded their range of gallium nitride (GaN) coaxial power amplifiers. The high power density of gallium nitride semiconductor technology dissipates heat more effectively which results in amplifier designs that have significantly higher output power levels over broadband and narrowband frequencies.

These rugged connectorized designs have the advantage of high output load impedance that offers easier impedance matching over wider bandwidths using lower loss components. Applications include commercial and military radar, jamming systems, medical imaging, communications and electronic warfare.

Pasternack's range of RF amplifiers includes GaN-based models that feature very high gain levels from 43 to 60 dB across mostly broad frequency bands ranging from 30 MHz to 7.5 GHz. Saturated output power levels range from 10 W to 100 W with 20 to 35% Power Added Efficiency (PAE). The thermal efficiency of GaN technology enables these assemblies to be integrated into smaller more compact coaxial packages with the same level of high reliability.

All of the high power GaN amplifiers from Pasternack have single voltage supplies which are internally regulated. The 50 ohm input/output matched designs are adaptable to a range of power and modulation requirements. These PAs also show impressive harmonic response (-15 to -20 dBc) under worst case conditions.

www.pasternack.com

IoT processor

offers support for Bluetooth® v4.1

Toshiba America Electronic Components has rolled out the latest addition to its TZ1000 series of ApP Lite™ processors targeting Internet of Things (IoT) applications. Targeting smart wearable products, the TZ1041MBG was developed to meet the increasing market demand for IoT devices that can support multiple external sensors, providing a versatile communication environment that makes use of the extended hub features of Bluetooth®.

The TZ1041MBG, like the other products in the TZ1000 series, integrates an ARM® Cortex®-M4F processor with 8Mbit Flash memory and Bluetooth functionality in a single package. Specifically, the latest processor incorporates a Bluetooth v4.12 controller and processor capable of capturing data from external sensors connected via various I/Os (e.g., UART, I2C, SPI and ADC), and incorporates flash memory to save data.

Data processing and storing of multiple sensing targets required for IoT devices are executable simultaneously by the processor. In addition, the TZ1041MBG uses Low Duty Cycle Directed Advertising (LDCDA), a new function supported by Bluetooth v4.1 that enables automatic reconnection when a known device comes within the communication area covered by a hub. The TZ1041MBG can thus serve as a Bluetooth hub for collecting, processing and storing data, while the LDCDA function improves user system operating efficiency and usability.

www.toshiba.co.jp/index.htm

RF coupler transfers video, images and music at up to 375 MBits/s

Antenova Ltd is launching a coupler using TransferJet™ wireless technology for the very high speed data transfer of large files. The company will demonstrate a TransferJet™ system using hardware from RF design specialist Icoteq at the CTIA Supermobility show in Las Vegas.

TransferJet™ is a close-proximity wireless transfer standard, recently created in Japan, that provides a simple way to transfer large data files such as photos, videos and music, between mobile devices, at data rates as high as 375Mbits/s, simply by placing the devices close together. It has the advantage of operating in unlicenced bands in the USA, Japan, Korea and EU countries.

Antenova's TransferJet™ system uses a brand new SMD coupler, named Zoma, (Antenova's part number SR4TO14), which the company has developed to be an RF coupler for TransferJet. The latest coupler operates in the 4.48 GHz band, and transfers data over distances up to 30 mm.

Antenova has chosen to work with a TransferJet™ development platform from a partner company, Icoteq, which uses Freescale's iMX6 quad core processor, comes with a variety of hardware interfaces, and measures just 100-mm x 100-mm.

Antenova is a member of the TransferJet™ consortium, a group of companies who are co-operating to develop the technology.

www.antenova-m2m.com
www.icoteq.com

Waveguide directional couplers

operate up to 110 GHz

Fairview Microwave has introduced a family of precision waveguide directional couplers, comprising 28 models covering a frequency range from 18 GHz to

110 GHz in seven popular frequency bands including K, Ka, Q, U, V, E and W bands.

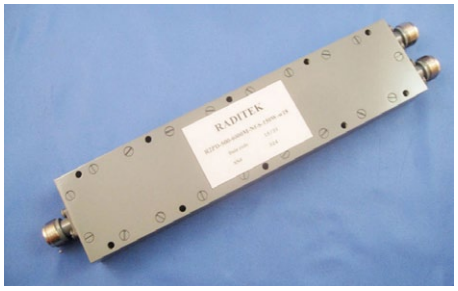
The waveguide couplers are available in waveguide sizes from WR-42 up to 18 GHz all the way to WR-10 up to

110 GHz. These directional couplers are offered with 10 dB or 20 dB coupling values and have high directivity of 30 dB typical with insertion loss is as low as 0.6 dB in certain models. Available in both standard and split block configurations as well as available in both E-Bend and H-Bend designs, the waveguide couplers utilize a multi-hole design that provides optimal power reflection measurements and consistent performance.

The millimeter wave waveguide directional couplers are widely used in applications such as on-the-bench testing scenarios, radar systems, satellite communications, point-to-point backhaul, signal sampling and other general purpose applications in wireless transceivers. These waveguide couplers are constructed using high quality brass copper and are gold plated for added precision and accuracy.

www.fairviewmicrowave.com

Wide-band 2-way power divider



The R2PD-500-6000M-Nf-150W-w18 wide-band power divider from Raditek can operate at 500 MHz to 6.0 GHz at 150 W.

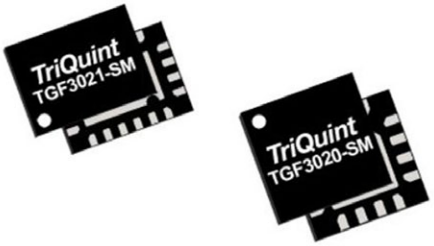
It comes standard with N-female straight connectors and measures 8.5- x 2.0- x 0.9-inches (21.6- x 5.1- 2.23-cm). Operating temperature ranges from -10 to +70°C. Adequate heatsinking is required for continuous use at full power.

www.raditek.com

GaN on SiC RF input-matched transistors

Richardson RFPD has announced the availability and full design support capabilities for two GaN transistors from Qorvo.

The 5-W TGF3020-SM and 30-W TGF3021-SM input-matched transistors enable high linear gain and power efficiency in low-cost, space-saving surface-mount plastic QFN packages. The integrated input matching network enables



wideband gain and power performance, and the output can be matched on-board to optimize power and efficiency for any region within the band.

The TGF3020-SM covers 4.0 to 6.0 GHz with P3dB output power of 6.8 W at 5 GHz, PAE of 59% and linear gain of 12.7 dB at 5 GHz. The TGF3021-SM covers 0.03 to 4.0 GHz and delivers a P3dB output power of 36.0W at 2 GHz with 72% PAE and linear gain of 19.3dB at 2 GHz.

www.richardsonrfpd.com

LTE/cellular octa-band embedded antenna for M2M and IoT

Ethertronics is further expanding its Prestta™ line of antennas with the Prestta™ P822601 LTE/cellular octa-band embedded (surface mount) antenna. The off-the-shelf, octa-band antenna, which

boasts an ultra-small keep-out area, is ideal for a wide range of M2M and IoT applications, including automotive, automatic meter reading, healthcare, point of sale, tracking and many more.

By leveraging the company's patented Isolated Magnetic Dipole (IMD) technology, which enables high performance and isolation characteristics, the P822601 antenna is capable of providing a robust radio link and minimal interference across all major bands – 700, 750, 850, 900, 1800, 1900, 2100 and 2700 MHz – requiring fewer SKUs for global LTE coverage.

Optimized for MIMO configuration, this antenna meets an important LTE requirement. As the next generation of the company's renowned P522304 (penta-band) antenna design, this latest octa-band antenna additionally supports fallback for 2G and 3G networks, providing ubiquitous coverage for Internet of Things (IoT) applications. IMD antenna technology additionally provides superior RF field containment, resulting in less interaction with surrounding components, lower program development risk and yielding a quicker time-to-market.

www.ethertronics.com

Intelliconnect launches own brand of semi-flexible cables

The Cable Assembly division of Intelliconnect (Europe) can now provide customers with its own brand of semi-flexible 0.085-inch (I405) and 0.141-inch (I402) cables

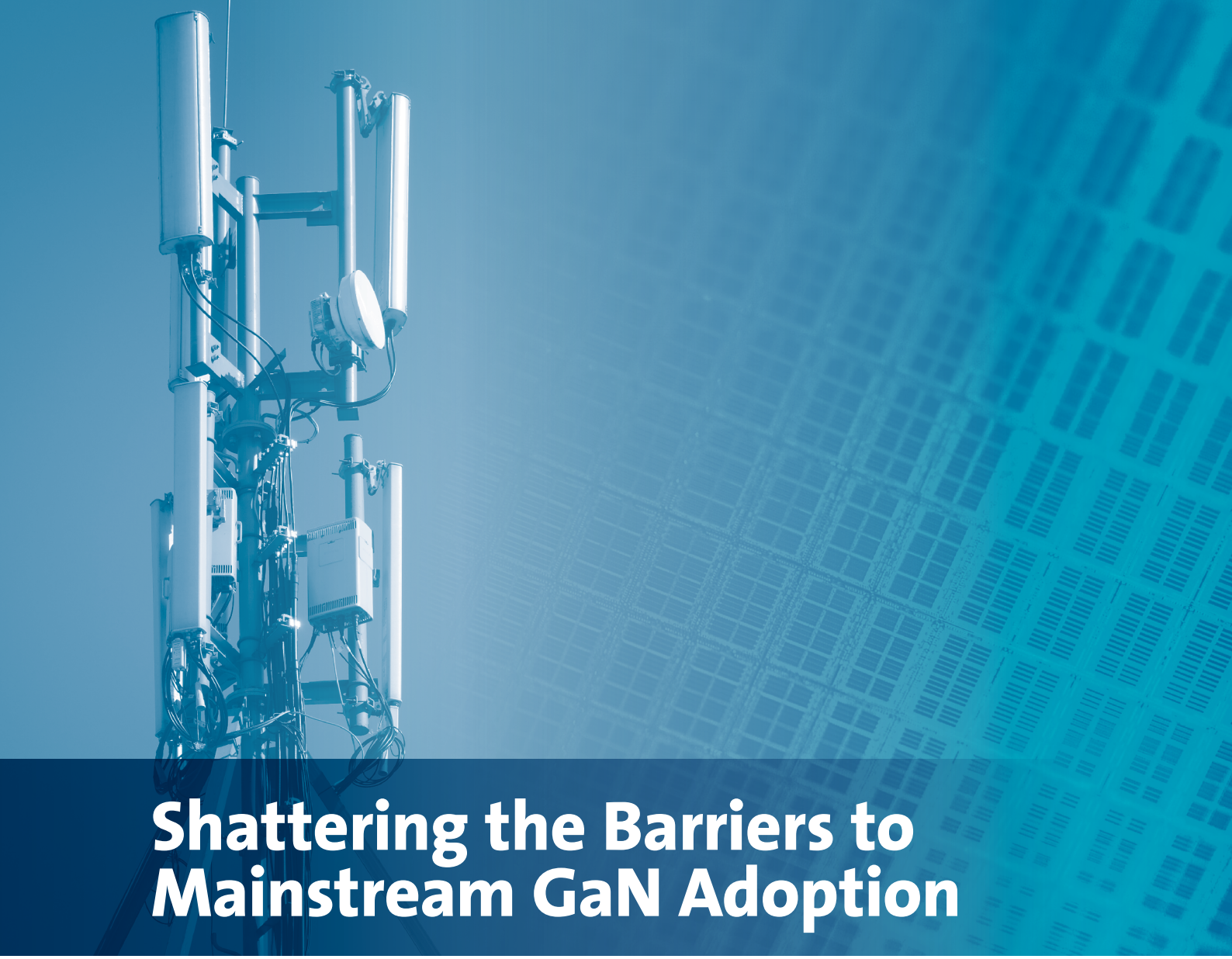
designed to compete with Multiflex, T-Flex and Flexiform cables. The own brand cables are suitable for industrial, defence, security and test system applications.

Intelliconnect semi-flexible cables offer a lighter, more flexible alternative to semi-rigid types making system assembly and interconnection easier. Any small reductions in performance compared with semi-rigid cables are more than compensated for by competitive pricing and compatibility with standard semi-rigid cable connectors.

Similar to TFLEX 402/405, the Intelliconnect "Spiral Strip" shielded coaxial cables are flexible alternatives to semi-rigid coax and the unique shielding configuration offers a cost effective, low attenuation option. The use of strip/round braid composite shields results in low transfer impedance levels.

The 50 ohm construction exhibits the same attenuation characteristics as M17/130-RG402 and M17/133-RG405 cables. All the Intelliconnect Spiral Strip Shield coaxial cables have VSWR characteristics that meet or exceed similar size flexible constructions. The I402 and I405 cable types have been designed with diameters over the outer braids of 0.141-inch and 0.086-inch and have an operating temperature range of -55 to +200°C.

www.intelliconnect.co.uk



Shattering the Barriers to Mainstream GaN Adoption

Only MACOM offers the portfolio, partnerships & people to fully leverage GaN technology in a wide range of commercial applications

We're shattering the final barriers to mainstream GaN adoption with an industry-leading portfolio of cost-effective RF power devices available in Si and SiC. Our GaN transistors and amplifiers improve upon the high-power handling and voltage operation of LDMOS with the high-frequency performance of GaAs.

Our growing product family delivers the cost, bandwidth, density and efficiency advantages of GaN in a variety of form factors—5W-90W Pk transistors in DFN and SOT-89 plastic packaging, up to 1000W ceramic packages and L-, S-band fully matched modules. We also offer ceramic GaN on silicon transistors up to 200W, DFN packages from 5W to 25W and TO-272 plastic packages from 50W to 200W.

For over 40 years, MACOM engineers have been redefining RF power and are now applying their GaN expertise to an array of commercial, industrial, scientific, medical and wireless backhaul applications. Only MACOM delivers GaN performance at silicon cost structures to drive adoption.

MACOM™

Partners from RF to Light

www.macom.com/gan

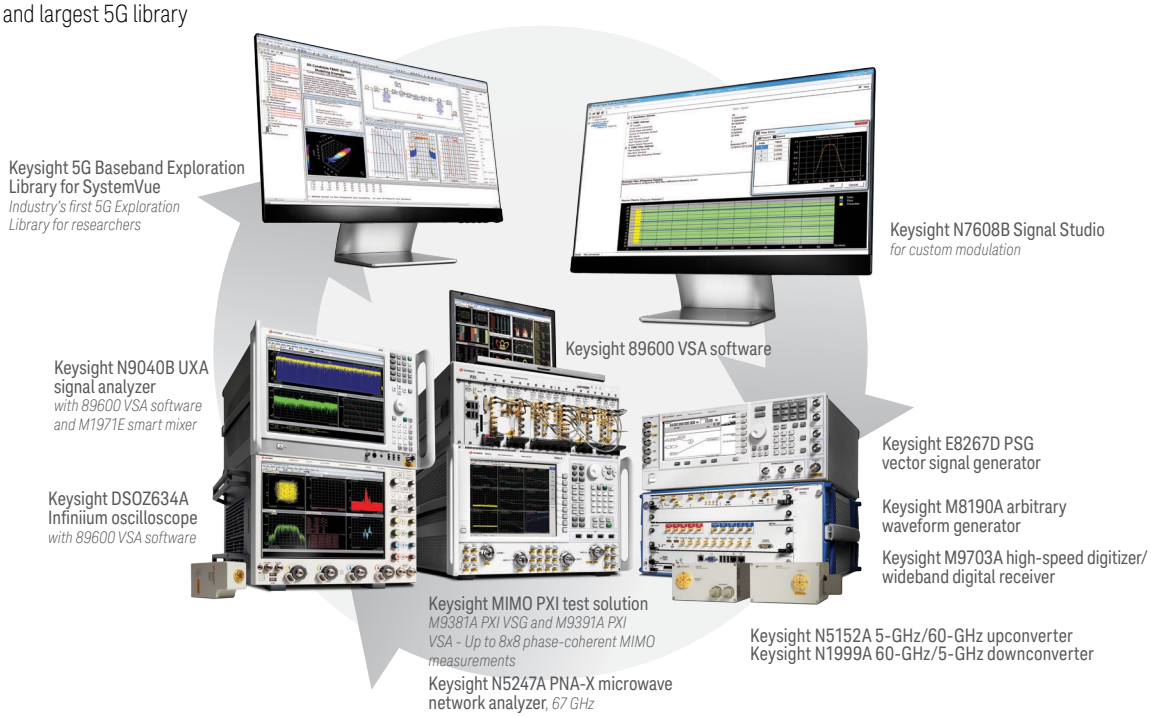
There's a 5G moment of discovery out there.

We're here to help you find it.

In just a few years, the fifth generation of wireless communications will be a reality. It will allow data to be transmitted up to 100 times faster than today's 4G networks. But getting to that speed won't be easy. You'll need genuine insights to overcome enormous technical challenges. We can help. We have the industry's first and most comprehensive 5G software library. It can significantly streamline design feasibility because it incorporates an iterative design sequence with every piece of Keysight 5G test equipment.

HARDWARE + SOFTWARE + PEOPLE = 5G INSIGHTS

- Designed for testing 5G simulation to verification
- Software platforms and applications that work seamlessly across our 5G instruments
- Incorporate iterative design and rapidly move between stages of your 5G development flow
- Industry's first and largest 5G library



Download our white paper *Implementing a Flexible Testbed for 5G Waveform Generation and Analysis* at www.keysight.com/find/5G-Insight

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

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