SEMICONDUCTOR Times

Radar Scope

Silicon MicroGravity

Silicon MicroGravity (SMG) was spun out of University of Cambridge in September 2014 to commercialize a novel sensor technology used by oil companies to enhance oil recovery. The company has received initial funding of $3 million from Imperial Innovations Group and Cambridge Enterprise, together with grant funding from the UK government. The company has raised £1.5m to date and plans to seek up to £5m in additional capital in Q2'17.

Gravity sensing is a well-established surface exploration technology; however, it is not easily available in the borehole. SMG's sensors, developed in partnership with BP, are sensitive enough to measure one billionth the level of Earth's gravity and are small and robust enough to be sent deep into boreholes to distinguish oil from water. SMG estimates that the technology could improve yields on conventional reservoirs by up to 2%, representing significant increases in production and revenues.

The sensors are based on MEMS technology. The Company's MEMS technology uses a highly sensitive resonant frequency sensing methodology, which provides improved performance at low frequencies relative to other MEMS seismic sensors based on capacitive or optical sensing. The sensing methodology provides breakthrough sensitivities compared to commercial MEMS accelerometers, enabling high-resolution gravity measurements. MicroG LaCoste has a borehole gravity system; however, SMG argues that its MEMS-based solution offers numerous advantages.

A team of Cambridge scientists, led by Dr. Ashwin Seshia, of the University's Department of Engineering, has been working with BP to develop the sensors. Design work began in 2010 and has resulted in several generations of prototypes. A successful test was conducted in 2012 prompting BP to fund a follow-on project to address further optimization and pursue large-scale manufacture of the sensors. The first field trial in a production well is scheduled for 2017.

SMG's MEMS implementation can be used to develop a high performance rate gyro for inertial navigation applications. The company is focused on the oil and gas market, but is looking for corporate partners to fund research to enable inertial systems to be used in other markets. The high performance gyro requires 3 to 5 years of substantial research and has very wide market applications.

Paul Vickery, Chairman and co-founder (experienced Board Director and founder of four university spin-outs)

Dr. Ashwin Seshia, Chief Scientific Officer and co-founder (A Reader in Microsystems Technology at University of Cambridge and a Fellow of Queens' College)

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SIA Global Sales ($B)
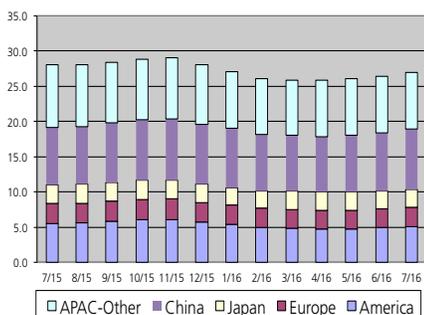
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Startup Profiles

Avogy

Avogy (see 11/13 issue) was founded in 2010 "to revolutionize power electronics with technology solutions utilizing GaN on GaN discrete semiconductor devices, modules, and systems that increase efficiency and reliability of power conversion systems while dramatically reducing their cost, size, and weight." The company's vision is "to create the smallest, lightest, most cost-effective power conversion systems in the world." In Sept. 2014, Avogy closed $40 million in Series B funding led by new investor Intel Capital with participation from existing investor Khosla Ventures.

To reduce the size of SMPS (primarily the inductors and capacitors), high frequency operation is required. However, silicon-based switches can only operate in the 100kHz range. The material properties of GaN allow it to operate at higher voltage and lower currents to further lower conversion losses. The Baliga Figure of Merit (BFOM) of GaN is over 1000x better than Si and nearly 3x better than SiC.

Gallium nitride (GaN) devices can be created on GaN layers that are heteroepitaxially grown on different substrates like silicon (Si) and silicon carbide (SiC) or homoepitaxially grown on GaN substrates. Lattice mismatch between GaN and Si or SiC leads to stress-induced dislocations that alter and degrade the electrical properties of GaN and are the source of lower breakdown voltages and poor reliability.

In the case of GaN-on-GaN, both lattice and CTE are perfectly matched. As a result, very thick layers of GaN can be epitaxially grown on bulk GaN substrates, which enables the fabrication of high breakdown voltage devices. Avogy is focused on developing vertical power semiconductor devices built in homoepitaxial GaN layers formed on bulk GaN substrates. The company has more than 20 patents and 40 patent applications in vertical GaN semiconductor technology, power topology and controllers that enable disruptive innovation in power systems. Avogy has established licensing and supply agreements with multiple GaN substrate vendors.

No other material system currently matches the performance of Avogy's True GaN technology, according to the company. True GaN technology unlocks the full potential of the superior material properties of GaN as it is based on homoepitaxially grown GaN on GaN substrates. For the same RDS_{ON}, the True GaN die size is 4X smaller than GaN-on-Si HEMT for BV=600V and 7X smaller for BV=1200V. The True GaN VJFET has avalanche capability that allows reverse-biased voltage to exceed the maximum BV value for a specified energy and current limitations. The True GaN VJFET also does not suffer from current collapse phenomenon.

Avogy's resonant circuit topologies and control circuits are designed to achieve lossless switching by fully exploiting the benefits of True GaN technology. The True GaN platform makes it possible to build the smallest, lightest and most efficient power systems, according to the company.

This platform is the foundation of Avogy's first product, the Zolt Laptop Charger Plus, an ultra-small, super lightweight, 3-in-1 one universal laptop charger. At 4X smaller and 3X lighter than standard laptop chargers Zolt is the world's smallest, lightest and most efficient laptop charger available. This platform will also be extended to design modules for other stages of power conversion.

- Dinesh Ramanathan, Ph.D., President and CEO (previously EVP at Cypress where he managed the Programmable Systems Division and the Data Communications Division)
- Poonacha Kongetira, VP, Systems Engineering (previously held senior engineering management positions at Sun Micro, Afara Websystems (acquired by Sun) and Nvidia)
- Bert Bruggeman, VP, Global Operations (previously founder and CEO of SVTC Technologies, VP of Solar Wafering Operations at SunEdison, and held senior operations and engineering roles at Cypress and Silicon Light Machines)
- Chris Loeper, VP, Global Sales & Marketing (previously led worldwide sales and marketing organizations at Roxio, Rovi and Napster)
- Narayanan Karu, VP, Finance (previously VP Finance at Shashi Group, held CFO and VP Finance roles at iSmart Panache, and held Controller positions at Cypress)
- Isik Kizilyalli, Ph.D., Founder (previously held technical and mgmt positions at Bell Labs, Agere, Nitronex and Alta Devices)

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Kolo Medical

Kolo Medical was founded in 2012 to develop semiconductor ultrasound transducer technology for medical ultrasound imaging.

The ultrasound transducers used in medical ultrasound systems are typically based on a ceramic material known as PZT. The production of PZT transducers relies on outdated man-

ufacturing methods, which result in poor yields and uniformity. The intrinsic shortcomings of PZT also include low bandwidth and heat production, which limits performance.

With diagnostic imaging moving towards high-frequency and 3D/4D imaging, a new approach is needed. Kolo claims to be the first company to offer a practical alternative to traditional PZT ultrasound transducers. Combining advanced semiconductor fabrication technology with Kolo developed and patented SiliconWave technology, Kolo is able to deliver a new level of diagnostic performance not attainable with traditional PZT.

With its line of SiliconWave transducers, Kolo is the first company to offer capacitive micromachined ultrasound transducer (CMUT) technology. SiliconWave transducer technology delivers an unprecedented level of performance in the area of ultra-high resolution and ultra-wide bandwidth clinical diagnostic imaging. Kolo transducers are compatible with and provide significant performance improvements to current and next generation ultrasound systems. The company has 40+ patents.

SiliconWave transducer arrays are fabricated on a silicon wafer and incorporated into the transducer giving superior acoustic response that forms the basis for better ultrasound images. The technology used in SiliconWave transducers overcomes the fabrication limitations of bulk piezoelectric transducers. High-frequency, high-resolution transducers are easier to fabricate with SiliconWave technology, making ultrasound available for a wider range of applications.

The development of CMUT technology was initiated years ago by a team at Stanford that included the Kolo Medical founders. Kolo's SiliconWave transducers overcome many initial CMUT limitations such as sensitivity. The devices are fabricated in a commercial MEMS foundry. With the ability to control the vertical geometries of the transducer, such as thin-film thickness with nanometer accuracy, Kolo attains sub-micrometer lateral resolution with ease. Combining innovative designs and superb fabrication capabilities, SiliconWave transducers are proven to reach unprecedented yield, uniformity, and performance standards, according to the company.

The L15-5 linear array transducer is designed for vascular, small parts, and deep MSK imaging. The L22-8 linear array transducer is designed for MSK and small parts imaging and has improved spatial resolution with excellent penetration when compared with PZT transducers. The L38-22 linear array transducer enables high performance superficial imaging in the emerging application of Dermatology and can also be used to image superficial tendons and nerves as well as joints of the wrist, hands, and feet. The L30-14 linear array transducer can be used for Neonatal, Pediatric, and MSK applications.

The M17-4 1.5D array transducer is the ultrasound industry's first single-probe solution and is able to replace multiple linear array transducers for imaging small parts to deep vascular applications. The new M17-4 is based on Kolo SiliconMatrix technology and can deliver unprecedented imaging performance.

Kolo Medical is working with several OEM partners to test SiliconWave transducers with commercial ultrasound systems. The company has been collaborating with Verasonics, a leader in research ultrasound, to refine the design and performance of one of Kolo Medical's transducers.

Dr. Yongli Huang, Co-founder, President & CEO (key technologist for CMUT, 20+ years MEMS experience)
Steve Zhuang, Ph.D., Co-founder & VP Engineering (previously Senior Scientist at Achieva Medical)
Lee Weng, Ph.D., Chief Strategy Officer (previously an executive at Mindray Medical, the largest medical product company in China)
Danhua Zhao, Ph.D., VP Ultrasound Imaging Technology (former CTO of Chison and former manager of U-System (GE) and Siemens)
John Easton, Director of Sales and Business Development (previously a Sales Manager at Siemens Healthcare and GE Healthcare)

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Teramount

Teramount was founded in 2015 to extend the fabless semiconductor model to silicon photonics. The company has secured funding from private investors and plans to seek additional capital in 2017. Teramount has 5 employees and is hiring.

Most existing solutions for silicon photonics packaging are based on active alignment processes, which require non-standard packaging flows and non-standard and expensive equipment. In addition, since silicon photonics packaging is non-standard, there is no clear separation between design, manufacturing and packaging, making it challenging for fabless semiconductor companies to enter the silicon photonics arena.

Teramount has developed the patent-pending Photonic-Plug for

Startup Profiles

(Continued from page 3)

connecting optics to silicon. The Photonic-Plug enables passive alignment and is based on a patented self-alignment technique. This enables high volume packaging through standard CMOS assembly lines, thus improving throughput and lowering cost. It can be used to connect any optical element to silicon, including single-mode fiber. It also offers better thermal management than competing solutions.

The Photonic-Plug enables standard CMOS semiconductor manufacturing processes and packaging flows in silicon photonics, thus enabling any fabless semiconductor company to expand into silicon photonics while working with traditional foundries and OSATs. By leveraging standard silicon packaging flows and equipment for silicon photonics, the Photonic-Plug significantly lowers capital and operational expenses. It improves silicon photonics manufacturing throughput by two orders of magnitude compared to current methods, according to the company.

Teramount is targeting solutions for 100/400G connectivity in data centers. The market opportunity is tens of millions of units in the next few years, according to the company. By developing working prototypes that demonstrate its technical claims, the company recently accomplished a significant milestone. Teramount is currently building an ecosystem for its Photonic-Plug and is engaging with strategic partners and customers in the silicon photonics value chain.

Hesham Taha, Ph.D., CEO & co-founder (previously R&D scientist, sales & marketing manager at Nanonics Imaging)

Avi Israel, Ph.D., Co-Founder & CTO (previously a physicist at Nanonics Imaging)

Raanan Gewirtzman, Chairman (former CEO of BroadLight)

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USound

USound GmbH was founded in 2014 by three MEMS-industries veterans to "reinvent the audio industry in the digital era." Its mission is to develop audio systems for mobile applications based on MEMS micro-speaker technology. The company has secured five million euro in funding from Austria Wirtschaftsservice Gesellschaft, eQventure, and Science Park Graz, the business incubator of the Technical University of Graz, including leverages up, and is closing an additional two digit million euro round, including leverages, in October 2016. The company has 25 employees across three locations.

In 2014, USound hired experienced acoustic engineers when a major supplier of micro-loudspeakers in Vienna substantially reduced its workforce. Shortly thereafter, USound hired a group of engineers from IEM, a University in Graz, Austria renowned for acoustic engineering. Partners include X-Fab, Austria Technologie & Systemtechnik Aktiengesellschaft (AT&S), Fraunhofer Institute for Silicon Technology ISIT, and the Institute for Electronic Music and Acoustic.

USound is developing audio smart systems that integrate ASIC, MEMS micro-speakers and passive components in one device with thin and compact form-factors. The thin, light and compact form-factor, combined with complex 3D features (i.e. acoustic channels and cavities) enables easy integration in portable electronic devices, including smartphone, headphones and healthcare products such as hearing aids. Arrays of MEMS transducers for beam forming of acoustic waves (Personal Acoustic Space) enable smart systems for augmented reality devices.

USound is currently sampling two MEMS micro-speaker product families. Moon is a replacement for balanced-armature receivers with wide bandwidth. Today's balanced-armature receivers are coil-based speakers with small footprints and high-quality output, typically used in hearing aids or high-end earphones. Ganymede is a micro-tweeter with operation beyond 20kHz. The micro-tweeter is targeted at three segments: closed-back on-/over-the-ear for multi-driver systems, tweeter/receiver function in mobile phones, and ultrasound generation for proximity/motion sensing. USound eventually plans to offer complete system solutions, comprised of MEMS microspeakers, amplifier, codec, DSP, and firmware.

The global micro-acoustic market is forecasted to exceed $8 billion in 2016. Competitors include the tradition incumbent industry as well as companies offering MEMS-based solutions such as AudioPixel. Today's MEMS-based micro-speakers typically use the electrostatic actuation principle, which likely requires higher drive voltages than USound. Sound reconstruction is performed through an array of transducers, with likely requires more complex signal processing than USound's solution and requires more silicon area.

USound's technology is based on the piezoelectric principle, which

requires slightly higher voltages than standard electrodynamic solutions, but is still suitable for portable applications. It is based on a membrane-plate assembly for sound wave generation, which is compatible with sound-processing solutions. Ultimately, Usound believes its solution will offer thinner speakers with the lowest power consumption and excellent sound quality.

Prototypes are currently under evaluation by a variety of smartphone, hearing-aid and accessory manufacturers. Pre-production will start in October 2016, with commercial production expected in Q2'17. Future plans include the integration of MEMS speakers with MEMS microphones, as well as acoustic beamforming MEMS arrays.

Jörg Schönbacher (previously responsible for legal and IP at SensorDynamics, which was acquired by Maxim whereupon he became Regional Manager Europe for Maxim's Consumer and Automotive group and a site manager for Maxim's operations in Austria)

Andrea Rusconi Clerici, Co-founder & Managing Director (10+ years technical experience in the MEMS industry at Fraunhofer Institute, STMicroelectronics, Maxim and Sensordynamics)

Ferruccio Bottoni, Co-founder & Managing Director (previously VP operations at Sensordynamics)

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People

Amkor has promoted **Megan Faust** from SVP, Corporate Controller to Corporate VP and CFO, succeeding Joanne Solomon.

BaySand, a provider of application configurable ASICs, has appointed **John Kispert** to its Board of Directors. Kispert currently serves as Managing Partner of Black Diamond Ventures. He has served as CEO & President of Spansion, and President & COO of KLA-Tencor.

Cortus, a provider of 32-bit processor IP, has appointed **Philippe Descamps** as Director of Sales. Descamps previously held sales and marketing responsibilities at Atmel and Motorola. To date, approx. 900 million devices have been manufactured containing Cortus processor cores.

Dialog Semi has appointed **Mary Chan** to its Board of Directors, effective December 1, 2016. Chan previously served as President, Global Connected Consumers & OnStar Service USA, led Dell's Enterprise Mobility Solutions and Services business in the USA, and served as EVP of Alcatel-Lucent's US 4G LTE Wireless Networks business. Chan currently serves as an independent Director of SBA Communications. She is also the Managing Partner at VectoIQ, which serves companies in the smart transportation arena.

Exar has appointed **Gary Meyers** as Chairman. Meyers has been on Exar's board since 2008. He was President and CEO, and member of the Board of FusionOps, a provider of cloud-based supply chain analytics solutions, and VP and GM of Synopsys via the acquisition of Synplicity, where served as President and CEO.

imec announced that **Kris Myny**, one of its young scientists, has been awarded an ERC Starting Grant of 1.5 million euros to open up new research in the field of thin-film transistor technology. Myny wants to realize a breakthrough in TFT technology used to create large-area, flexible circuits that drive flat-panel displays. He wants to introduce innovations of unipolar n-type transistor circuits based on amorphous Indium-Gallium-Zinc-Oxide (a-IGZO). These are currently acknowledged as the most promising transistors for next-generation curved, flexible, and rollable electronic applications.

Immersion, a developer and licensor of touch feedback technology, has appointed **Nancy Erba** as CFO. Erba was most recently VP of Finance, Corporate Financial Planning and Analysis at Seagate.

Intel has appointed **Robert "Bob" Swan** as EVP and CFO, reporting to CEO Brian Krzanich. He replaces Stacy Smith, who is taking a broader role within Intel leading manufacturing, sales and operations. Swan previously served as an operating partner at growth equity firm General Atlantic. Prior to General Atlantic, he served nine years as CFO of eBay.

IXYS has promoted **Uzi Sasson** from President and CFO to CEO, a title he will share with Chairman and CEO **Nathan Zommer**. All manufacturing, sales, finance and legal departments will continue to report to Sasson. All R&D, product engineering, marketing and other technology functions will continue to report to Zommer.

Microsemi has appointed **Kimberly Alexy** to its board of directors. Alexy currently serves on the board of FireEye, Five9, CalAmp and VIZIO.

Rambus has appointed **Rahul Mathur** as SVP and CFO. Mathur previously served as SVP of finance at Cypress. Prior to that, he served as VP of finance at Spansion, which was acquired by Cypress.

Sequans has appointed **Nick Taluja** as VP of worldwide sales. Taluja was most recently VP of sales at SK Hynix.

People

(Continued from page 5)

Prior to SK hynix, he led the Americas' sales and marketing organizations at ST-Ericsson.

Skorpios, a fabless integrated silicon photonics SoC company, has appointed **Brian Griffiths** as CFO. Most recently, Griffiths was a senior managing director at Guggenheim Partners. Prior to that, he was a managing director at Credit Suisse in New York and London.

Skyworks has appointed **Kris Sennesael** as SVP and CFO. Sennesael previously served as CFO for Enphase Energy and Standard Microsystems. **Donald Palette**, who has been Skyworks' CFO since 2007, will serve in an advisory role for a transitional period.

Spectra7 has appointed **Raouf Halim** as CEO and a member of the Board, succeeding acting CEOs Cynthia Cole and Dave Mier, whom the Board appointed following the sudden passing of former CEO, Tony Stelliga. Halim will remain Chairman of icClarity, a company he co-founded to develop a 3D Video capture solutions. Prior to icClarity, he was CEO of Mindspeed.

SUSS MicroTec, a supplier of equipment and process solutions for microstructuring, has appointed **Dr. Franz Richter** as President & CEO. He previously spent 14 years working for SUSS MicroTec, the last six of them as its CEO until 2004. After serving as President of Semiconductor Equipment Division at Unaxis (now OC Oerlikon) in Pfäffikon, Switzerland, he set up Thin Materials AG and became its CEO in 2007. The company was sold to Nissan Chemical Industries in 2013.

ViXS has appointed **Philip Deck** to its board of directors. Deck is CEO of Extuple, currently a shareholder of ViXS (approx. 6%). **Brian Antonen,** a board member since its inception in 2001, has retired.

WISeKey has appointed **Bernard Vian** as GM of VAULT-IC France, its IoT semiconductor business segment recently acquired from INSIDE Secure. Vian previously served as EVP of IN-SIDE Secure Semiconductor Division, following the acquisition of the smart card division of ATMEL by INSIDE Secure. He joined INSIDE Contactless as VP of Business Development in 2002. At WISeKey, he will continue to lead the VAULT-IC team of 70 people and manage a business segment that is expected to generate approx. $34 million revenue in 2016. ∎

Funding

Celeno, a provider of smart managed Wi-Fi chipsets and software, has closed $38 million to drive growth and expansion. The round was led by Red Dot Capital Partners. Additional new investors are Poalim Capital Markets and OurCrowd. Existing investors including Liberty Global, Cisco, Pitango, 83North (formerly Greylock IL), Vintage and Miven also participated. Celeno's solutions continue to gain market traction with tens of millions of its Wi-Fi chipsets being deployed by top tier service providers in home gateways, routers and set top boxes.

Centec Networks, a provider of Ethernet switching silicon and SDN white box solutions, has closed a $47 million Series E funding round led by China Integrated Circuit Industry Investment Fund (CICF) and joined by existing investor China Electronics Corporation (CEC) through its China Electronics Innovations Fund, which led the prior round.

Founded in 2005, Centec supports an open-networking strategy that has become increasingly popular. The company has raised $30 million in previous funding rounds, developed four generations of switching silicon, and has achieved double-digit quarterly growth for the past 3 years.

EpiGaN, a European supplier of commercial 150mm- and 200mm-GaN-on-Silicon epi-wafers for 600V HEMT (High Electron Mobility Transistor) power and RF devices, announced that the ACAPITAL, a Brussels/Beijing-based European private equity fund, has joined the initial investors to fund the company's expansion in particular to Asian markets.

Evince Technology has raised £750,240 of new equity investment from business angels and other private investors. Evince is developing technologies to enable the manufacture of synthetic diamond-based electronics. This is the largest new investment since Evince restructured its business in 2013 to focus on development of a core technology and to expand its target applications, whereas previously the company had planned to develop and market its own products for the power and energy sectors. The new strategy will see the company work with partners to define products and target applications, then license its patented synthetic diamond processing technologies to their semiconductor manufacturing partners.

HMicro, developer of a SoC biosensor platform for medical devices, has closed $10.2 million in Series C financing. Investors included dominant strategic OEM partners who will be commercializing HMicro-enabled products in health care markets. Existing investors XSeed Capital, Seraph Group, and Uniquest also participated. The proceeds will be used to fund development and commercialization of its biosensor platform, which includes a chip having multi-sensor interfaces and multiple radios, disposable wireless patch and mobile and fixed location receiver devices.

MicroVision (Nasdaq: MVIS) has entered into an agreement with Lincoln Park Capital Fund, under which the Company has the right to sell up to $17.025 million of common stock to Lincoln Park. Proceeds will be used for general corporate

purposes. Lincoln Park will immediately purchase $2.025 million in shares. MicroVision is the creator of PicoP scanning technology, an ultra-miniature laser projection and sensing solution based on the laser beam scanning methodology pioneered by the company.

Phononic has raised $30 million from new investors GGV Capital and Lookout Capital, along with returning investors Eastwood Capital, Venrock, Oak Investment Partners, Tsing Capital, Huaneng Invesco WLRoss, Wellcome Trust and Rex Healthcare Ventures. Phononic combines high performance thermoelectric devices manufactured at its facility in Research Triangle Park, NC with fully integrated systems to deliver smart, sustainable and solid state-powered products that displace compressors, heat sinks and fans. The funding will be used to grow the company's sales and marketing organization.

Resonant (NASDAQ: RESN), a designer of filters for RF front-ends that specializes in delivering designs for difficult bands and complex requirements, is offering to sell shares of its common stock in an underwritten public offering.

Sequans announced the pricing of an underwritten public offering of American Depositary Shares (ADSs), representing 15,151,520 ordinary shares, at a price of $1.65 per ADS. The Company has also granted to the underwriters a 30-day option to acquire an additional 2,272,728 ADSs to cover overallotments. The Company expects to receive net proceeds of approx. $22.9 million and intends to use the proceeds for general corporate purposes. Canaccord Genuity is acting as the sole book-running manager.

Tempronics, a thermoelectric company, has closed a $9.5M series C round, led by **Lear**, a supplier of automotive seating and electrical systems, to provide a new generation of thermal comfort to the automotive seating

market. Other investors include Nth Power, the Desert Angels, management and individual investors. ∎

Mergers & Acquisitions

Analogix and **Shanhai Capital** have entered into a definitive merger agreement under which a consortium led by Shanhai Capital will acquire Analogix for over $500 million. China IC Fund is also one of the limited partners. Analogix is the market leader in providing end-to-end interface connectivity ICs for DisplayPort, including the SlimPort family of products, and an industry leader in mobile display controllers. Analogix is headquartered in Santa Clara, California, and the majority of its engineering operations are located in Beijing, China. Current investors include DCM Ventures, Globespan Capital Partners, Keytone Ventures, and the Woodside Fund.

Intel is acquiring **Movidius**, a company focused on "giving the power of sight to machines." Intel gains low-power, high-performance SoC platforms for accelerating computer vision applications. The Movidius VPU (Vision Processing Unit) for on-device vision processing combined with Intel's depth sensing solution (Intel RealSense Technology) will help autonomous machines see in 3D, understand their surroundings and navigate. Additionally, this acquisition brings algorithms tuned for deep learning, depth processing, navigation and mapping, and natural interactions, as well as broad expertise in embedded computer vision and machine intelligence.

ON Semi has completed the acquisition of **Fairchild** for $2.4 billion in cash. The acquisition is expected to be accretive on a GAAP EPS basis in 2H'17 and immediately accretive on a non-GAAP basis. ON Semi expects to achieve annual cost savings run rate of $160 million by the end of 2017, $200 million by the end of 2018, and $225 million by the end of 2019.

ON Semi has also announced a new organizational structure, which reflects the evolution of its portfolio to highly differentiated power management, imaging, and analog solutions from standard products. The new organization is comprised of three reporting units - Power Solutions Group, headed by **Bill Hall**, Analog Solutions Group, headed by **Bob Klosterboer**, and Image Sensor Group, headed by **Taner Ozcelik**. The operations of System Solutions Group have been absorbed in the three reporting units.

Quanergy Systems, a provider of solid state LiDAR sensors and smart sensing solutions, has acquired **OTUS People Tracker software from Raytheon BBN Technologies**. The software complements Quanergy's existing software portfolio and, when used with Quanergy's LiDAR sensors, creates an integrated hardware and software solution for advanced people detection and tracking applications within the security and autonomous driving markets. OTUS uses sophisticated human perception algorithms to identify and track people for safety and security in crowded environments at ranges exceeding 100 meters when used with Quanergy LiDAR sensors. The software is the foundation for Q-Guard, Quanergy's 3D perimeter fencing and intrusion detection system.

Renesas has signed a definitive agreement to acquire **Intersil** for $22.50 per share in cash, representing an aggregate equity value of approx. $3.2 billion. By combining Renesas' MCU and SoC products and technologies and Intersil's power management and precision analog capability, Renesas will be well positioned to address some of the most exciting opportunities in areas such as automotive, industrial, cloud computing, healthcare, and IoT. Renesas anticipates near- and long-term revenue expansion opportunities combined with modest anticipated cost efficiencies associated with greater scale will

M&A
(Continued from page 7)

eventually generate synergies of $170 million. The transaction is expected to immediately increase both gross and operating margins and be accretive to non-GAAP earnings per share and free cash flows after closing.

Tessera and **DTS** (NASDAQ: DTSI), an audio solutions provider for mobile, home and automotive markets, have entered into a definitive agreement under which Tessera will acquire DTS for $42.50 per share, representing a 28% premium to DTS's 30-day volume weighted average price as of September 19, 2016. The all-cash transaction is valued at approx. $850 million. The combined company is forecasted to achieve pro forma 2016 revenue of approx. $450 million, nearly half of which will come from product licensing. The combined company will be renamed at closing. The transaction will be immediately accretive to earnings per share and free cash flow. The combined company is expected to realize $15 million in annualized cost synergies within the first 12-18 months following closing. ∎

Business

Akoustis, manufacturer of BulkONE bulk acoustic wave (BAW) high-band RF filters for mobile wireless, has executed an exclusive patent license agreement with the Center for Technology Licensing (CTL) at Cornell University. The agreement expands its portfolio of IP in the area of single crystal piezoelectric materials to improve performance of RF filters in mobile devices and smartphones.

Allwinner has debuted its new business division, Allwinner Services, which will offer a range of solutions within the Set Top Box market, specializing in application processors. Traditionally, Allwinner has supported large manufacturers in China. Their new business division

will bridge the gap between them and international tier 2/3 companies by engaging with design houses to offer complete solutions.

At its 2016 Analyst Day, **Applied Materials** detailed its strategy to drive growth. Applied highlighted how the industry's transition from lithography-based scaling to materials-enabled scaling has increased its addressable opportunity from 53% of wafer fab equipment (WFE) spending in 2012 to an estimated 63% this year. Applied expects to achieve a 4-point gain in its share of WFE spending and nearly double its display business, from 2012 through 2016.

Large, multi-year inflections are driving sustained growth in semiconductor and display: the evolution of 3D NAND; transition to 10/7nm nodes; growing need for 3D materials-enabled patterning; increasing investments in China; and accelerated adoption of OLED displays. These technology inflections are enabled by materials innovation, which plays directly to Applied's strengths and expands its available market. The company has outlined plans to drive 50% growth in its display business to $1.8 billion by FY2019.

GigPeak sees a record quarter for orders for its 40Gbps QSFP+ and 100Gbps QSFP28 ICs for active optical cables (AOCs) and optical transceiver modules for data center customers. The company also introduced driver and TIA ICs for 200Gbps short-reach (SR) and long-reach (LR) PAM4 Ethernet applications to augment its data center chipset solutions.

Ovum and LightCounting project the 40Gbps SR and LR will remain the dominant speed, with volume growing from 10 million units in 2015 to 17Mu in 2018, before slowly transitioning to the 100Gbps NRZ generation of ICs. GigPeak is the sole merchant provider of 40Gbps ICs for the datacom optical modules, according to the company. For 100Gbps NRZ

ICs, market analysts such as Light-Counting project less than 1 million shipments of chipsets for the data centers in 2015, growing to about 8 million chipsets in 2018.

Silego has shipped two billion units since introduction of its Configurable Mixed-signal ICs (CMICs). In just two years since Silego announced shipment of its billionth unit, Silego has more than doubled its total volume shipped. Since the introduction of the CMIC, Silego has developed five generations of CMIC silicon and design tools. Over 1300 designs incorporating CMICs by Silego customers have gone into production in almost every end market. ∎

Market Research

Worldwide sales of semiconductors reached $27.1 billion for the month of July 2016, an increase of 2.6% compared to the previous month's total of $26.4 billion, reports the **SIA**. July marked the largest month-to-month increase since September 2013, though sales were down 2.8% compared to the July 2015 total of $27.9 billion. Month-to-month sales increased in all regional markets for the first time since October 2015. Most major product categories saw increased sales in July compared to the previous month, with DRAM leading the way with 7.1% growth.

North America-based manufacturers of semiconductor equipment posted $1.75 billion in orders worldwide in August 2016 and a book-to-bill ratio of 1.03, according to **SEMI**. The three-month average of worldwide bookings in August 2016 was $1.75 billion, 2.3% lower than the final July 2016 level of $1.80 billion, and 5% higher than the August 2015 order level of $1.67 billion. The three-month average of worldwide billings in August 2016 was $1.71 billion, approx. the same as the final July 2016 level of $1.71 billion, and 8.4% higher than the August 2015 billings level of $1.58 billion.

The **Worldwide semiconductor market** is forecasted to be down 3.2% to $325 billion in 2016 and up 2% to $331 billion in 2017, according to the **WSTS'** re-calculated Spring 2016 Forecast using the actual figures of Q2'16. The year 2018 is forecasted to be up another 2.2% to $338 billion.

The **global market for gallium nitride (GaN) semiconductor devices** is largely consolidated, with the top four companies commanding a share of over 65% of the overall market in 2015, states **Transparency Market Research**. The dominant company, **Efficient Power Conversion** (EPC), accounted for 19.2% share. The other top three companies, which collectively enjoyed a considerably large share in the overall global market, are **NXP**, **GaN Systems**, and **Cree**.

The global GaN semiconductor devices market will expand at a 17% CAGR over the period between 2016 and 2024, growing from $871 million in 2015 to $3.4 billion by 2024. Of the key end-use industries utilizing GaN, the aerospace and defense sector dominates, accounting for over 42% of the global market in 2015. North America and Europe are the dominant regions for GaN and are expected to retain dominance over the next few years. ■

Emerging Trends

The **4WDM MSA** (4-wavelength Wavelength Division Multiplexing Multi-Source Agreement) Group announced its formation as an industry consortium dedicated to defining optical specifications and promoting adoption of interoperable 100G (4x25G) optical transceivers for 10km based on the CWDM4 wavelength grid, and for 20km and 40km based on the LAN-WDM wavelength grid, over duplex single-mode fiber (SMF).

These extended reaches are important for modern datacenter interconnects and mobile backhaul applications. The CWDM4 MSA defined the first duplex low cost 100G specification for 2km reaches based on a CWDM grid and using RS (528,514) FEC. The 4WDM MSA extends the value proposition of the CWDM4 MSA and RS-FEC to define an even more cost-effective set of specifications for reaches from 10 to 40 km. Founding members include Broadcom, Brocade, Ciena, ColorChip, Dell, Finisar, Foxconn Interconnect, Huawei, Intel, Juniper, Kaiam, Lumentum, MACOM, Oclaro, Skorpios, Source Photonics, and Sumitomo. www.4wdm-msa.org ■

Products

Acorn Technologies, a semiconductor and wireless technology innovator focused on the IoT, has developed and demonstrated new LTE positioning technology for the location of things. The LTE location-based technology meets the new 2021 Enhanced 911 (E911) mandate performance requirements and performs exceptionally well in very low bandwidth conditions. Acorn Tech hellaPHY LTE positioning technology provides pinpoint accuracy for LTE Advanced low cost devices for next generation location of things in the Machine-Type Communications (MTC) and IoT markets. The company has demonstrated better than 50-meter accuracy in live network testing of their User Equipment (UE)-based positioning algorithms for low bandwidth CAT-M devices. Further gains are expected when optimizations begin to rollout.

The technology has been developed from the core hellaPHY Channel Estimation algorithm that employs machine learning techniques. The positioning algorithms are ideally suited for IoT applications due to their extremely low complexity, and require less then 10kB of memory and only a fraction of a low-end DSP during the maximum processing interval. It has proven to exceed the performance of super resolution algorithms at a fraction of the complexity. hellaPHY RSTD is a drop-in replacement for existing Reference Signal Time Difference (RSTD) algorithms in UE chipsets and can be customized for any DSP or interface requirements. The hellaPHY RSTD IP core is scalable and can support CAT-M through CAT-15.

Applied Materials has introduced the display industry's first high-resolution inline e-beam review (EBR) system, increasing the speed at which manufacturers of OLED and UHD LCD screens can achieve optimum yields and bring new display concepts to market. Applied is the semiconductor industry leader in EBR with more than 70% market share in 2015. Applied's

WSTS Forecast Summary, Spring 2016 - Q2 update								
	Amounts in US$B				Year on Year Growth in %			
	2015	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**
Americas	68.7	62.1	62.8	64.1	-0.8	-9.7	1.2	2.1
Europe	34.3	32.5	32.8	33.5	-8.5	-5.1	1.0	1.9
Japan	31.1	31.3	32.1	32.6	-10.7	0.7	2.4	1.6
Asia Pacific	201.1	198.6	203.3	208.1	3.5	-1.2	2.3	2.4
Total World	335.2	324.6	331.0	338.3	-0.2	-3.2	2.0	2.2
Discrete Semis	18.6	19.0	19.6	20.1	-7.7	2.1	2.9	2.7
Optoelectronics	33.3	30.9	31.6	32.6	11.3	-7.0	2.1	3.5
Sensors	8. 8	10.5	11.2	11.5	3.7	18.8	6.9	3.1
ICs	274.5	264.2	268.7	274.0	-1.0	-3.8	1.7	2.0
Analog	45.2	45.9	47.5	48.8	1.9	1.6	3.3	2.9
Micro	61.3	61.5	62.5	63.6	-1.2	0.4	1.6	1.7
Logic	90.8	85.5	84.9	85.9	-1.0	-5.7	-0.7	1.1
Memory	77.2	71.2	73.8	75.7	-2.6	-7.8	3.7	2.6
Total Products	335.2	324.6	331.0	338.3	-0.2	-3.2	2.0	2.2

Products

(Continued from page 9)

EBR system has received orders from 6 of the top 10 largest display manufacturers and demand is increasing.

Current inline automated optical defect inspection tools for displays are not as effective as SEM analysis in distinguishing killer from non-killer defects, or in determining systematic root causes of defects. Prior to the introduction of Applied's EBR system, conducting SEM analysis on displays required breaking the glass substrate into pieces and examining each piece separately under a microscope. Applied solves these limitations by providing inline SEM review at the industry's highest resolution and throughput without requiring the panel to be broken.

Crocus Technology, a developer of Tunneling Magnetoresistive sensors (TMR) based on patented Magnetic Logic Unit (MLU) technology, has introduced the CT51x digital switch, the first in a series of fully integrated digital sensors. This family of devices accommodates a wide range of applications with larger air gaps, smaller magnetic fields, and significantly lower power consumption then traditional Hall Effect and mechanical reed switches. The CT51x TMR family of sensors is fully integrated with the CMOS process to create a completely monolithic solution. The device can perform switching, positioning and rotation measurement, while consuming less than 350nA on average. Production now. Crocus also provides TMR sensor licensing, custom TMR sensor design and integration, and TMR bare sensor or integrated sensor wafers/die.

The company has also introduced the CT219 magnetic field sensor, which makes older technologies obsolete due to its contactless nature, high sensitivity, and high dynamic range when used in a close-loop configuration. The CT219 would make it safer to deal with high current systems, and significantly reduce the size and weight when replacing Current Transformers. It is also capable of measuring, with high accuracy, linear-distance movements induced by a magnetic field in applications such as gear measurements, servo-controlled motion systems, printers, automotive and robotics.

Flex Logix has completed design of a family of reconfigurable IP cores for TSMC 40ULP. Now in fabrication and expected to be fully validated in silicon during Q4, the EFLX IP Core family for TSMC 40ULP will enable customers to design MCUs and SoCs with reconfigurable RTL that can be quickly, easily and cost-effectively updated or changed at any time after fabrication, even in-system.

GLOBALFOUNDRIES has unveiled a new 12nm FD-SOI semiconductor technology built on a 12nm fully-depleted silicon-on-insulator (FD-SOI) platform, enabling the performance of 10nm FinFET with better power consumption and lower cost than 16nm FinFET. The platform offers a full node of scaling benefit, delivering a 15% performance boost over today's FinFET technologies and as much as 50% lower power consumption.

GLOBALFOUNDRIES also plans to deliver a new 7nm FinFET technology that is expected to deliver more than twice the logic density and a 30% performance boost compared to today's 16/14nm foundry FinFET offerings. The platform is based on an industry-standard FinFET transistor architecture and optical lithography, with EUV compatibility at key levels.

This approach will accelerate the production ramp through significant re-use of tools and processes from the company's 14nm FinFET technology, which is currently in volume production at its Fab 8 campus in Saratoga County, NY. GLOBALFOUNDRIES plans to make an additional multi-billion dollar investment in Fab 8 to enable development and production for 7nm FinFET. Test chips with IP from lead customers have already started running and the technology is expected to be ready for customer product design starts in 2H'17, with ramp to risk production in early 2018.

InVisage has launched its Spark Micro-LiDAR (SML20) module. The Spark4K 13-megapixel, 1.1-micron NIR sensor enables the SML20 module to sense structured light patterns with high acuity at a range of 20 meters, even in direct sunlight. At just 8.5 x 8.5 x 4.5 mm, the SML20 is ideal for drones and other mobile autonomous devices compared to conventional LiDAR without the limitations of ultrasonic and stereo-camera depth sensing systems.

Conventional structured light cameras have struggled to perform accurately in bright sunlight because more than half of sunlight is in the infrared spectrum. The SML20 delivers QuantumFilm's increased sensitivity to 940nm NIR light (5X that of silicon) at a 1.1-micron pixel size. The device also has a global electronic shutter, which eliminates the distortion of fast-moving objects caused by conventional rolling shutter. The company plans to introduce extended range options at 100 meters and beyond in the coming quarters.

Kalray has showcased its Massively Parallel Processor Array (MPPA) processors for autonomous vehicles. With a determinist architecture and extremely low latency, Kalray's MPPA is particularly well-equipped for use in autonomous vehicles. Kalray has begun working with some of the automotive industry's key manufacturers to put its MPPA technology at the heart of the electronics systems of their new fleets of self-driving vehicles.

LeddarTech, a provider of solid-state LiDAR technology, has introduced LeddarVu, a new platform for the next generation of its Leddar detection

and ranging modules. The LeddarVu platform combines the benefits of a very compact, modular architecture with superior performance, robustness and cost efficiency towards high resolution LiDAR applications, such as autonomous driving.

The Vu8, the first module based on the new LeddarVu platform, is a compact solid-state LiDAR that provides highly accurate multi-target detection over eight independent segments. Detecting targets at up to 215m range and weighting only 75 grams, the Vu8 delivers nearly twice the range for half the volume compared with the Leddar M16 from which it inspires. Upcoming iterations of LeddarCore ICs are expected to deliver ranges reaching 250m, fields of view up to 140°, and up to 480,000 points per second.

Linear Tech has introduced the LT4295 IEEE 802.3bt powered device (PD) interface controller for applications requiring up to 71W of delivered power, claiming to be first to be market for the new IEEE 802.3bt Power over Ethernet (PoE) standard, which enables manufacturers to go beyond the 25.5W allocated by the 2009 IEEE 802.3at standard. The new standard, also known as PoE++ or 4PPoE, increases the power budget to enable new applications and features, while supporting 10GBASE-T and maintaining backward compatibility with older IEEE equipment.

NuVolta has developed the industry's first 20W receiver IC based on its high efficiency Controlled Resonance wireless power architecture. The NU2500 power management IC can cover wireless power applications from 0.5W to 20W. In combination with the company's NU1000 transmitter IC, NuVolta provides complete fast wireless charging solutions for smart watches, smart phones, tablets and notebook computers at very high efficiency. For example, a typical 6.78MHz system with the NU2500 can reach over 85% efficiency at 12V, 15W output with simple and thin

receiver coil, significantly better than any existing wireless power solutions, according to the company. NuVolta's magnetic resonance solutions are also compatible with metal cases and metal back covers.

NVIDIA has unveiled a palm-sized, energy-efficient artificial intelligence (AI) computer that automakers can use to power automated and autonomous vehicles for driving and mapping. The new single-processor configuration of the NVIDIA DRIVE PX 2 AI computing platform for AutoCruise functions, which include highway automated driving and HD mapping, consumes 10 watts and enables vehicles to use deep neural networks to process data from multiple cameras and sensors. It will be deployed by China's **Baidu** as the in-vehicle car computer for its self-driving cloud-to-car system.

More than 80 automakers, tier 1 suppliers, startups and research institutions developing autonomous vehicle solutions are using DRIVE PX. DRIVE PX 2's architecture scales from a single mobile processor configuration, to a combination of two mobile processors and two discrete GPUs, to multiple DRIVE PX 2s. NVIDIA DRIVE PX 2 is powered by the company's newest SoC, featuring a GPU based on the NVIDIA Pascal architecture. A single NVIDIA Parker SoC can process inputs from multiple cameras, plus lidar, radar and ultrasonic sensors.

NVIDIA has unveiled the latest additions to its Pascal architecture-based deep learning platform, with new NVIDIA Tesla P4 and P40 GPU accelerators and new software. Modern AI services such as voice-activated assistance, email spam filters, and movie and product recommendation engines are rapidly growing in complexity, requiring up to 10x more compute compared to neural networks from a year ago. The Tesla P4 and P40 are specifically designed for inferencing, which uses trained deep neural networks to recognize speech, images or

text in response to queries from users and devices.

Based on the Pascal architecture, these GPUs feature specialized inference instructions based on 8-bit (INT8) operations, delivering 45x faster response than CPUs and a 4x improvement over GPU solutions launched less than a year ago. A single server with a single Tesla P4 replaces 13 CPU-only servers for video inferencing workloads. With 47 tera-operations per second (TOPS) of inference performance, a server with eight Tesla P40 accelerators can replace the performance of more than 140 CPU servers.

Complementing the Tesla P4 and P40 are two software innovations to accelerate AI inferencing: TensorRT is a library created for optimizing deep learning models for production deployment that delivers instant responsiveness for the most complex networks. DeepStream SDK taps into the power of a Pascal server to simultaneously decode and analyze up to 93 HD video streams in real time compared with seven streams with dual CPUs. This addresses one of the grand challenges of AI: understanding video content at-scale for applications such as self-driving cars, interactive robots, filtering and ad placement.

Quantenna announced a new product family for Dual-Band Selectable (DBS) client solutions. The QSR2000C family builds upon Quantenna's Wi-Fi technology and offers superior speed, range and reliability while offering the fullest set of carrier-grade capabilities. Key features include Multi-User MIMO (MU-MIMO), transmit beamforming, precise 5GHz radar detection, and up to four spatial streams support. QSR2000C supports operation in either 2.4GHz or 5GHz Wi-Fi spectrum.

When QSR2000C client solutions are paired with Quantenna's line of AP solutions, additional features include iQStream for carrier-grade QoS for simultaneous deployment of multiple

Products

(Continued from page 11)

services such as live linear TV, voice, data and other services; Zero PER for increased reliability during live, linear video transmissions over Wi-Fi; and uequal MCS for increased speed and range. Sampling now; production in Q1'17.

Sequans has demonstrated the first LTE Category M1/NB1 chip. Category M1, also known as LTE-M and Cat M, delivers about 1 Mbps max in a 1.4 MHz channel. Category NB1, also known as narrowband IoT, or NB-IoT, delivers about 40 kbps in a 200 kHz channel. According to ABI Research, cumulative cellular M2M module shipments from 2016 through 2021 will reach 1.1 billion units; LTE modules will experience the highest growth, exceeding 50% of all cellular M2M shipments in 2021. Monarch is the world's first purpose-built and most highly optimized Cat M1/NB1 chip, and is expected to be ready for network deployments in Q4.

Silicon Labs has introduced a CMOS-based isolated FET driver family that enables developers to use their choice of application-specific, high-volume FETs to replace outmoded electromechanical relays (EMRs) and optocoupler-based solid-state relays (SSRs). The Si875x family features the industry's first isolated FET drivers designed to transfer power across an integrated CMOS isolation barrier, eliminating the need for isolated secondary switch-side power supplies and reducing system cost and complexity.

When paired with a discrete FET, the Si875x drivers provide a best-in-class EMR/SSR replacement solution for motor and valve controllers, HVAC relays, battery monitoring, AC mains line and communications switches, HEV/EV automotive charging systems, and other industrial and automotive applications.

Silicon Mobility has introduced OLEA T222, a new member of the OLEA family, the first automotive microcontrollers with embedded, robust and secured programmable logic. OLEA T222 flexibility, hard-real time parallel processing and safe architecture makes it a perfect fit to control all flavors of hybridization, micro, mild or full, including Integrated Belt Starter Generator (i-BSG), Crankshaft Motor driven Generator (CMG), Gearbox Motor driven Generator (GMG), in wheel Motor or in axle Motor, DC/DC converter, as well as full Electric powertrains. It is also an ideal controller for Battery Management System (BMS), Exhaust or Selective Catalytic Reduction systems (SCR), or even conventional Internal Combustion Engine. Applications such Damping Control for Chassis will also get the full benefits of OLEA T222.

Spin Transfer Technologies, developer of Orthogonal Spin Transfer Magneto-Resistive Random Access Memory technology (OST-MRAM), has fabricated perpendicular MRAM magnetic tunnel junctions (MTJs) as small as 20nm, among the smallest MTJs reported, at its development fab in Silicon Valley. The MTJ is the primary component of an MRAM memory cell and is the core technology of an MRAM device. STT has had working ST-MRAM memory chips internally for some time, and based on requests from certain major semiconductor and systems companies, the company is now preparing to deliver fully functional samples to select customers. Initial samples are targeted for non-volatile memory applications. The company is currently preparing evaluation boards to enable customers to fully evaluate the parameters of the memory. To date, STT has received $108M in aggregate funding.

Telechips (KOSDAQ: 054450), has introduced the HD-DMB TCC5700 chipset. Telechips minimizes thermal characteristics of the chipset by reducing the CPU load with an embedded hardwired HEVC (H.265) decoder.

TI has introduced a dual-band wireless MCU supporting Sub-1 GHz and Bluetooth low energy connectivity on a single chip. As part of TI's pin-to-pin and software compatible SimpleLink ultra-low power platform, the SimpleLink dual-band CC1350 wireless MCU enables developers to move from a three-chip solution to a single chip. The CC1350 offers a range of up to 20km on a coin cell battery for building and factory automation, alarm and security, smart grid, asset tracking and wireless sensor network applications. Ultra-low power consumption offers a sleep current of 0.7uA, which allows for more than 10 years of battery life.

VisIC has launched a new 650V GaN Power Switch, offered in a smaller package with bottom side cooling, an on resistance (RDS_{ON}) rating of 0.080Ω, and a reduced external components requirement using a simplified driving scheme. This device is a member of the ALL-Switch family designed for bridge converters in motor drives, power supplies, chargers, UPS, Inverters and other circuits requiring high efficiency and currents up to 12A. The company has also introduced a new family of high-voltage GaN devices for switching power electronics designs. With 1200V ratings, the GaN module have RDS_{ON} ratings down to 0.04Ω. Switching losses are 3-5X lower compared to SIC MOSFETs counterparts. Target applications are power converters for motor drives, three phase power supplies and other applications requiring current switching up to 50A. ∎

Licensing & Partnerships

Fujitsu Semi and **Mie Fujitsu Semi** have reached an agreement with **Nantero** to license Nantero's NRAM, non-volatile RAM using carbon nanotubes, and to conduct joint development towards releasing a product

based on 55nm process technology. The three companies are aiming to develop a product using NRAM that achieves several 1000X faster rewrites and many 1000X more rewrite cycles than embedded flash memory, making it potentially capable of replacing DRAM. Fujitsu Semi plans to develop an NRAM-embedded custom LSI by the end of 2018, with the goal of expanding the product line-up into stand-alone NRAM after that. Mie Fujitsu Semi, a pure-play foundry, plans to offer NRAM-based technology to its foundry customers.

GLOBALFOUNDRIES has introduced a scalable, embedded MRAM technology on its 22FDX platform, providing system designers with access to 1,000x faster write speeds and 1,000x more endurance than today's non-volatile memory offerings. 22FDX eMRAM also features the ability to retain data through 260°C solder reflow and industrial temp operation, while maintaining an industry-leading eMRAM bitcell size. This eMRAM technology is designed for both code storage (flash) and working memory (SRAM) to enable ultra-efficient memory sub-systems that can be power cycled without any energy or performance penalty.

The technology is a result of the company's multi-year partnership with MRAM pioneer, **Everspin**. The partnership has already delivered the world's highest density ST-MRAM in August 2016 – Everspin's 256Mb DDR3 perpendicular magnetic tunnel junction (pMTJ) product, which is now sampling and is being readied for mass production at GLOBALFOUNDRIES. The 22FDX eMRAM is currently in development and is expected to be available for customer prototyping in 2017, with volume production in 2018. GLOBALFOUNDRIES' eMRAM technology is scalable beyond 22nm and is expected to be available on both FinFET and future FDX platforms.

Himax co-announced a partnership with **NUVIZ** to develop a head-up display (HUD) product. With headquarter in San Diego, USA and research team in Finland, NUVIZ is a leading HUD provider for motorcycle helmets. NUVIZ will incorporate Himax's LCOS microdisplays into its flagship product, the first connected HUD for any motorcycle helmet. Himax's LCOS manufacturing facility is currently shipping NUVIZ's customized displays for assembly in preparation of the company's pending product launch in 2H'16. NUVIZ is one of the 30+ customer brand leaders with whom Himax is currently working and includes leading multinationals in a wide variety of industries such as software, gaming, search, mobile, social media, military, automotive, wearable, and toy.

Lime Micro has formed a manufacturing partnership for the LimeSDR product line with **Advanced Semiconductor Engineering** (ASE). The LimeSDR, successfully funded on the Crowd Supply crowdfunding platform, is a low cost application-enabled software defined radio (SDR) platform that can be programmed to support virtually any type of wireless standard, including Wi-Fi, ZigBee, and Bluetooth through to cellular standards such as UMTS, LTE and GSM and emerging IoT communication protocols such as LoRa.

MagnaChip has begun volume production of a Power Management IC (PMIC) designed by **Himax**, a Taiwanese fabless company, using MagnaChip's specialty 0.18u BCD (Bipolar CMOS-DMOS) technology process. MagnaChip collaborated on the PMIC product development with Himax, as both companies plan to expand their presence in the PMIC market. With production already underway with Himax, MagnaChip is now engaged on a second product development project with Himax.

UMC and dedicated MEMS foundry **Asia Pacific Microsystems** (APM), announced a collaboration to provide enhanced MEMS manufacturing services for mutual customers. UMC will leverage its 8" and 12" production capabilities with APM's 6" fab and extensive MEMS know-how and prototyping experience to provide chip designers with a flexible and scalable end-to-end MEMS manufacturing solution. Founded in 2001, APM is a leading pure-play MEMS foundry service providers.

TI has entered into an agreement with **Silicon Catalyst**, a Silicon Valley-based incubator, that will expand TI's access to new technology innovations and potentially lead to engagements with semiconductor startups focused on creating chips and system solutions in analog and embedded processing. In the past 15 months, Silicon Catalyst has screened nearly 100 startups from the U.S., Europe and Asia. The 10 startups admitted to the incubator are developing innovations in LED, energy, silicon photonics, memory technology, wireless communications and biomedical devices. ■

Design Wins

Attopsemi announced that **Eminent Electronic Technology**, a fabless sensor IC company, has embedded **Attopsemi's** I-Fuse OTP IP in UMC's 0.35um mixed-signal process for proximity sensor products, and has shipped more than 10 million chips for name-brand smartphones. Attopsemi's I-fuse OTP provides small size, high reliability, low program voltage, low power, wide read range, and wide temp range to enable Eminent's high reliability proximity sensors, especially in extremely light-sensitive environments. An affiliate of ELAN founded in 2010, Eminent is shipping high volumes of ambient light sensors (ALS), proximity sensors (PS), color sensors (RGB Sensors), UV Sensors, heart rate monitor sensors, gesture sensors and 3D image detectors.

Dialog Semi's DA14580 SmartBond SoC is at the heart of **Tile's** newest consumer product, Tile Slim. Available now, Tile Slim is the world's thinnest

Design Wins
(Continued from page 13)

Bluetooth tracker, designed specifically for wallets and measuring only 2.4mm thick. According to ABI Research, Bluetooth low energy shipments will surpass 500 million units by 2021 in the tag and beacon market.

IDT announced that **Samsonite** has selected IDT as exclusive IC provider for the first generation of bags and luggage featuring wireless charging. Samsonite selected IDT's P9038 Qi-compliant wireless power transmitter to enable wireless charging in two new business collections, EnerQI and Lady Tech. Samsonite plans to introduce the products in Europe in Q1'17, followed by global availability. The IDT chips will be integrated into power banks built into the Samsonite products. IDT's magnetic induction devices have been deployed in more than 100 million products.

Inova Semi announced that **SocioNext** is the first licensee for Inova's APIX3 technology. APIX3 is the latest generation of Inova's APIX SerDes technology for in-vehicle video and data communications. It supports transmission rates of up to 12 Gbps, quadrupling the speed of the present APIX2 generation, making it an ideal fit for next-generation HD and ultra HD infotainment, and ADAS (Advanced Driver Assistance Systems).

APIX is a serial high-speed Gigabit multichannel link for interconnecting displays, cameras and control units over a single cable. With more than 50 million units sold together with license partners Socionext (formerly Fujitsu), Analog Devices, Toshiba and Cypress, Inova has created a de-facto standard in the market. APIX is used by ten of the leading automotive manufacturers and more than 30 OEMs and tier 1 suppliers.

MaxLinear announced that **Microelectronics Technology** (MTI) has produced over 1 million digital satellite outdoor units (D-ODU) using MaxLinear's MxL868 channel stacking and band translation SoC. The ODUs have shipped to a single major satellite operator, who is a leading adopter of digital channel stacking technology. The MxL868 is based on MaxLinear's Full-Spectrum Capture (FSC) technology, and can simultaneously digitize up to 4GHz of spectrum from eight RF inputs. Each 500MHz-wide RF input can be translated in its entirety to another 500MHz-wide frequency band between 250MHz and 3000MHz and be fed to one of three outputs. Individual transponders from each RF input can also be selected, filtered and combined onto a single coaxial cable for distribution to multi-channel satellite gateways and individual low cost client set-top boxes.

MediaTek announced that the first MediaTek-enabled smartphone for **Sprint** has launched. This marks MediaTek's first premium chipset offered in a device on a major U.S. carrier network. Sprint introduced the **LG** X power, which features the MediaTek helio P10 chipset for its high-performance, power efficiency and compact size to allow for a slim, stylish device design. MediaTek spent significant time and effort to optimize its LTE carrier aggregation feature for Sprint's LTE+ network.

Quantenna announced that the Quantenna Dual-Band Dual-Concurrent (DBDC) QV860 is powering **AirTies'** newest and most advanced Wi-Fi Mesh Access Point, the Air 4830. The QV860 combines Quantenna's ultra-high performance 4x4 11ac, with an 802.11n 2x2 offering connectivity to 2.4GHz legacy clients.

QuickLogic announced that **Motorola** has chosen the ArcticLink III BX programmable display bridge for use in the new "Moto Insta-Share Projector." The ArcticLink III BX is used to convert the MIPI output of the applications processor to support the RGB input requirement for the TI DLP-based pico projector engine. The Moto Insta-Share Projector is part of Motorola's family of Moto Mods, which are modular accessories that magnetically snap on to either the Moto Z or Moto Z Force families of smartphones to add new capabilities.

Titan IC Systems announced that **LookingGlass Cyber Solutions** has signed a multi-year strategic partnership to further advance their network–based threat mitigation with the Titan IC Helios regular expression (RegEx) processor. LookingGlass threat mitigation solutions will take full advantage of the Helios RegEx processor to assist in threat detection by implementing tens of thousands of complex regular expressions in network data at speeds up to 40 Gbps. Titan IC has implemented it on a Xilinx Kintex Ultrascale FPGA, so it can be customized for each customer's needs. ∎

Company Financials

Company	Symbol	Next Qtr Outlook	Current Qtr				Last Qtr			Yr-ago Qtr			Sales Growth	Qtr	Ending
			Sales	Net	Margin	GM	Sales	Net	GM	Sales	Net	GM			
Ambarella	AMBA	$95-99M	65	8.6	13%	67%	57	1.8	64%	84	23.1	65%	-23%	2Q17	31-Jul
Broadcom (Avago)	AVGO	$4090M	3792	-298.0	-8%	47%	3541	-1186.0	30%	1735	240.0	51%	119%	3Q16	31-Jul
LTX-Credence	XCRA	$80-84M	91	7.1	8%	46%	82	3.2	44%	102	7.5	45%	-11%	4Q16	31-Jul
Marvell	MRVL	Dwn 0-4%	624	51.3	8%	54%	541	-22.7	52%	711	-771.9	35%	-12%	2Q17	30-Jul
Sigma Designs	SIGM	n/a	61	-1.7	-3%	48%	54	-8.1	45%	58	0.3	49%	5%	2Q17	30-Jul
ViXS	VSX	n/a	8	-2.7	-34%	32%	6	-3.2	32%	6	-3.0	35%	32%	2Q17	31-Jul

Philadelphia SOX Index

TSMC – Foundry Barometer
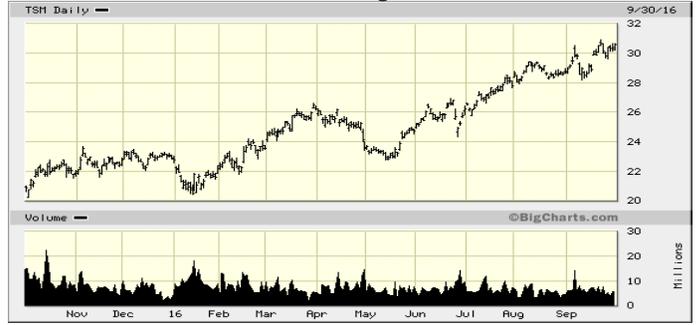
## Micron – DRAM Barometer
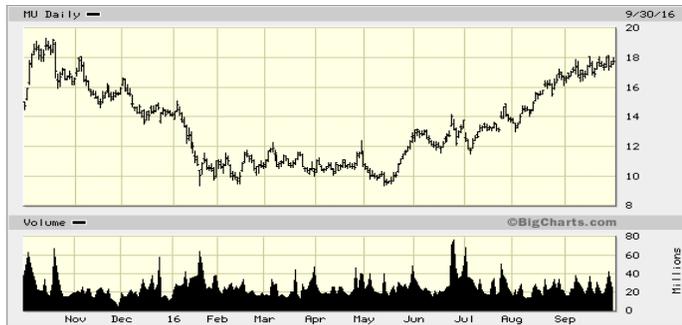
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Intel

AMD
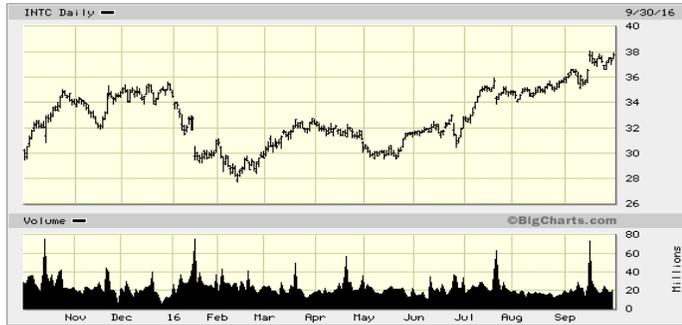
Brodcom (Avago)
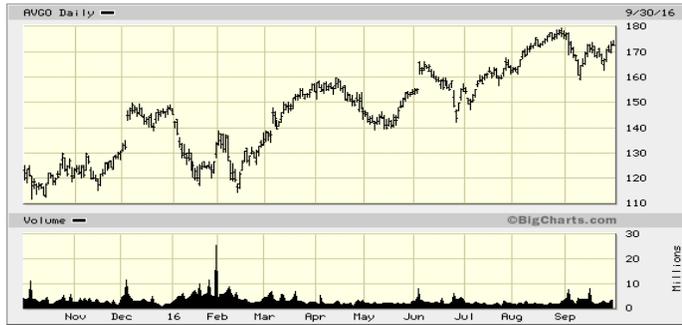
Marvell
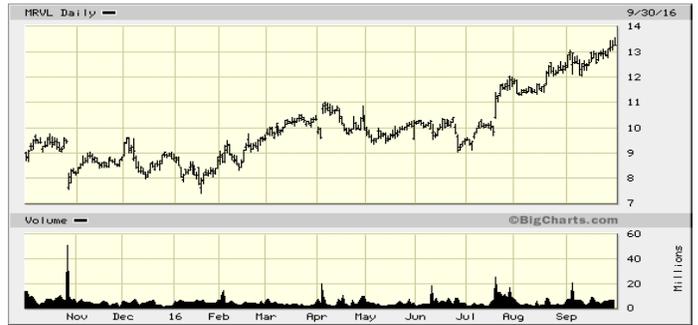
Startups In This Issue

✔ **Avogy** – *GaN on GaN Discrete Semiconductor Devices, Modules & Systems*

✔ **Kolo Medical** – *Capacitive Micro-Machined Ultrasound Transducers*

✔ **Silicon MicroGravity** – *MEMS-based Gravity Sensors for Oil & Gas Boreholes*

✔ **Teramount** – *Photonic-Plug for Connecting Optics to Silicon*

✔ **USound** – *Piezoelectric-based MEMS Micro-Speakers*

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