EE Times

Silicon 100

100 Startups
Worth Watching

EETimes

Silicon

100

Table of Contents

Foreword

The global semiconductor market is famous — perhaps notorious — for its cycles of explosive growth and ferocious downturns. Analysts annually place their bets on one sure thing: Except in the oddest years and under the most exceptional of circumstances, unit shipments will increase year over year. Beyond that, few forecasters can lay claim to regularly and accurately predicting the market's untamed pricing swings or determining the right balance of supply and demand to end the notorious inventory imbalances that have decimated fortunes in segments such as DRAM.

For all its vagaries, however, the semiconductor sector commands the attention of governments, entrepreneurs, investors, engineers, and management gurus alike. That's because the chip industry has expanded from its zero-dollar base mere decades ago to assume a transformative role in most sectors of the economy.

The sheer number of semiconductor startups that emerge to address every evolving market need or coalesce around each promising technology is a testament to the importance, influence, and allure of this industry. In a sense, based on the ubiquitous presence of electronics, chipmakers may be the most invasive species with which other enterprises must partner, compete, or at least contend for profit, growth, and survival.

Silicon 100 is a place to identify the building blocks for future wonders.

The numbers hint at what lies ahead. The World Semiconductor Trade Statistics (WSTS) first reported global chip sales in 1986 and estimated that year's market at $26 billion. Ten years later, WSTS reported that worldwide semiconductor sales had ballooned to $144 billion. The market crossed $200 billion for the first time in 2000, surging to $204 billion, a 37% increase over 1999's $149 billion.

This June, WSTS projected the market would expand at a much slower rate in 2020, up just 3% to $426 billion. But it predicted that the industry would continue an upward trajectory that would push the global market to a record $452 billion in 2021.

Intel Corp., the world's biggest chipmaker by revenue, reported $72 billion in sales for 2019 and is projected to top $75 billion this year. Other big players include No. 2 global vendor Samsung ($52 billion,

versus $74 billion the prior year), Qualcomm (fiscal 2019 sales of $24 billion), and Broadcom ($22.6 billion in sales in fiscal 2019).

The big players have an outsized role in the industry, but their statistics tell only part of the story. This is a market of startups. Hundreds of startups have made enormous contributions to the industry since its inception. They have energized specific sectors and sparked innovations that have advanced systems companies' product developments in the various enterprise and consumer market segments.

For 16 years, contributing writer Peter Clarke's Silicon 60 — now expanded, in its 20th iteration, into the Silicon 100 — has celebrated another hallmark of the chip industry: the daring innovators, fervent visionaries, serial investors, and barrier-busting men and women who have collectively given the world inventions that were unimaginable barely 100 years ago. In this industry, the limits of innovation are unknown by engineers who thrive on the belief that whatever can be invented will eventually show up in a patent filing, preferably theirs.

This is what the Silicon 100 is all about — a place to identify the building blocks for future wonders. The 2021 list will change somewhat from this year's lineup, as will all the iterations to come. But the criteria used by Clarke to determine the companies that make his list will lead to the identification and discovery of more wonders of the semiconductor world.

Speaking of wonders, AspenCore's reach extends around the globe, including China. Currently the world's biggest market for semiconductors, China is chasing a bigger role as a supplier of chips to the global electronics industry. For now, that title belongs to the United States, which in 2018 produced 45% of semiconductors manufactured globally, down from more than 50% in the 1980s. To gain market share, Chinese companies have mainly taken the fabless route. AspenCore Asia tracks China's fabless semiconductor companies annually. This year, for the first time, we are publishing AspenCore Asia's findings on those businesses as part of our Silicon 100 package of features.

Our list of 23 Chinese Fabless Startups rounds out this Silicon 100 e-book, indicating that while the semiconductor industry began its journey in the United States, the top startups in the market today are spread worldwide.

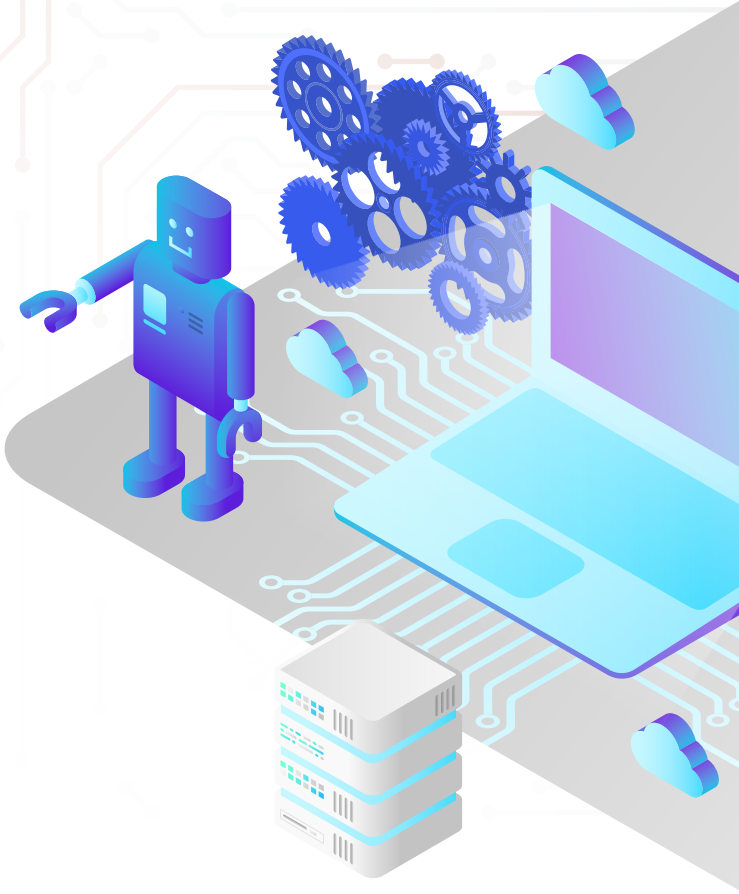
You'll be hearing more about many of these companies soon.

Bolaji Ojo, *global publisher and editor-in-chief at AspenCore Media*

Silicon 100: The Class of 2020

SILICON 100

Peak Machine Learning — A Peek Over the Horizon



By Peter Clarke

EE Times' 20th revision of its list of emerging start-ups is marked by a major change: from our practice of listing 60 of the brightest — which we have done since 2004 — to listing 100 electronics and semiconductor companies that catch our attention.

The change was made because of a rapid increase in startup company formation that happened in the second half of the last decade and the fact that so many of those concerns are achieving emerging growth company status. And bear in mind that EE Times takes a narrow view of the term "technology," requiring that companies have at least one foot in the hardware camp, unless they are perhaps in the EDA or IP licensing space.

Nonetheless, hardware startups are again investible, and that reflects a return to investment that had diminished to relatively small amounts a decade ago. That was a time when venture capital moved predominantly into software and internet-mediated services.

The love that the venture capitalists show for the internet and for services remains, and almost all the best-known "unicorns" — privately held startup companies with valuations in excess of $1 billion — are in the software, services, or, occasionally, end-user equipment areas. However, such definitions can be loose, and some startups work both sides of the street.

Take the example of Royole Corp., a unicorn that was in the Silicon 60 v19 and has been retained in the Silicon 100. The company provides intellectual-property (IP) licenses, development services, and mass production for flexible electronics such as full-color AMOLED flexible displays and flexible sensors. But it also makes flexible products that show off its capabilities, such as a foldable smartphone. It is effectively competing with potential customers, but it is also betting big in hopes of winning big.

Royole has a 4.5 million-square-foot mass-production campus in Shenzhen, China, with a total investment of $1.7 billion.

So why did venture capitalists' confidence in hardware return? It can be thought of in terms of the ebb and flow of a technical tide against a changing economic and applications background.

For many years, the biggest value-add proposition in hardware was the efficient fabless design of ICs using standard manufacturing platforms from foundries. Digital computation and business models remained stable. Venture capitalists became habituated to trying to spot the next big thing or the company that had executed best on some known protocol and had the ear of a systems company.

In effect, the existence of Moore's Law attracted funds to the design of the latest ASIC or SoC that could exploit the next manufacturing process node. Moore's Law sucked investment away from other electronics activity that did not seem to have the same big-buck potential. In the first decade of the 21st century, moving down through the process nodes seemed the easy route to wealth creation.

But as the migration of chip architectures to subsequent nodes became more expensive and the volumes needed to justify the expense increased, the opportunities declined. The reaction of the venture capitalists was to swim up the supply chain. Following the example of their peers who had backed Google, Amazon, and Facebook, the rest of them were pumping money into the likes of Uber, Lyft, Spotify, and GoPro.

Many venture capitalist firms stopped investing in hardware altogether. Much of the hardware investment that remained came from strategic investors, such as Intel, Samsung, Qualcomm, and Bosch, or from government-backed regional development boosters who hoped to encourage job creation.

But then, as the end of Moore's Law came into sight, R&D activity moved out into other areas.

Engineering creativity extended into a slew of related activities, including alternative computational architectures and business models such as open-source hardware, RF communications, sensors, 3D assembly and packaging and chiplet-style manufacturing, and human-to-machine and machine-to-machine interfaces. Some of these activities required far less funding than the $100 million or so needed to get a leading-edge digital chip out the door, and so they started to gain some traction.

It also became clear that software and networking architectures that had proved powerful in the cloud running on servers could be supported by fresh architectures and ICs to reduce power consumption and potentially transfer similar functions to the edge.

Of those software architectures, the most important was artificial intelligence, particularly artificial neural networks. The possibility of direct hardware support for AI, which would allow the win of lower power consumption and computation more closely

modeled on biological systems, was clearly the next logical step for multicore systems and the power-efficient way forward.

With the advent of machine learning, the internet of things and 5G communications, and ramping electronics in automobiles, the venture capital funds came flooding back, and the number of startups being formed increased dramatically.

It seems that human beings are rarely more creative or hardworking than when they are chasing an engineering dream and a fortune at the same time.

Machine learning

EE Times has hosted much discussion over the past few years about the rise of machine learning as a form of hardware-supported computing, and the discipline has been a theme of the year for the last two Silicon 60 listings.

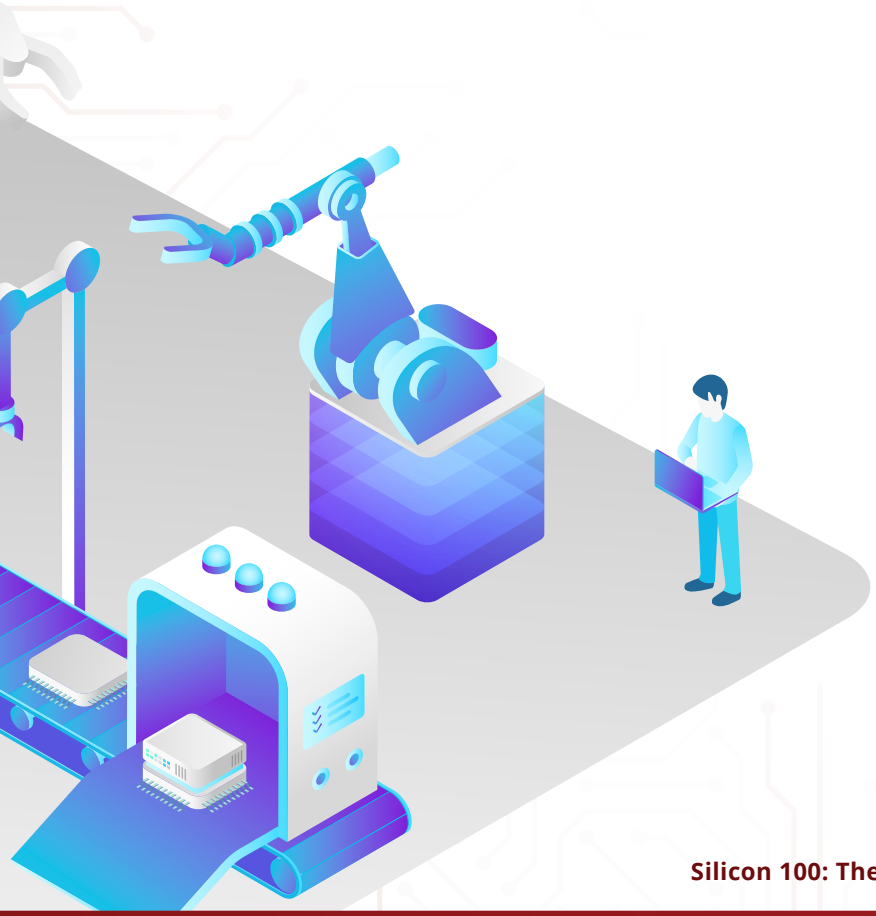
It is a theme again this year, with 14 of the 51 additional companies brought onto the Silicon 100 involved in AI. To be sure, AI, machine learning, and neural networks are the latest buzzwords, but there is no consensus yet about the best architecture or development framework or who will become the Intel of this next era.

The additions bring the total number of companies on the list claiming development of an AI or machine-learning solution either as a fabless chip company or as an IP licensor to 31, compared with 15 companies on the previous list and six on the list before that.

It is notable that Intel is repeatedly buying startups in this area, from Movidius and Nervana in 2016 to Habana Labs Ltd. (Caesarea, Israel) in 2019. Intel announced that it would buy Habana for about $2 billion, which makes Habana a unicorn swallowed by a giant.

Nonetheless, the Silicon 100 is broader than machine learning. The technologies covered in this year's Silicon 100 include silicon and compound semiconductor manufacturing, materials research, analog and digital ICs and SoCs, memory, FPGA fabric, gallium nitride for power and lighting, energy harvesting, sub-threshold voltage operation of ICs, signal-processing techniques, 5G communications for automobiles and IoT, LiDAR, wireless power transfer, environmental sensors, MEMS design and manufacturing, neural networks, and other architectures for machine learning, vision, and cognitive processing.

This year, we allowed ourselves to be less severe than in previous years, retaining 49 of the previous year's 60 companies and admitting 51 startups. This brings the total number of companies admitted to the



list to 506 since v1.0 came out in April 2004.

It should be considered that AI and machine learning are not single entities but diverse fields of computation ranging in complexity and data requirements. This, in part, explains why so many companies can attract funding.

It is not yet known whether it will be better to be more general — even hybridized — with conventional data processing or more specifically focused on tasks such as natural-language processing, machine vision, and so on. The requirements are different depending on where training and inferencing are performed and whether a neural processor is expected to scale in the data center or operate at the edge.

Several technical approaches are demonstrated in the Silicon 100 list. Some companies, such as Habana and Graphcore, are looking to do heavy lifting in the data center, replacing GPUs.

Some are betting on the TensorFlow development platform as the software engineer's target and are seeking to accelerate that seamlessly, while others believe that minimal energy consumption is key and are looking at compute-in-memory architectures as a way to minimize data movements. Still others are turning to analog electronics to accelerate matrix-multiplication operations that are key to many neural networks. Another set of companies is exploiting the inherent parallelism of light to let optical processing perform mathematical operations.

Historically, the more exotic the fundamental technology, the greater the effort required to interface that technology to the pre-existing mainstream electronics. Likewise, the closer the fit to pre-existing vested interests, the more likely the adoption. But if the benefits of the technology are orders of magnitude greater than the status quo, then sometimes adoption is worth the disruption.

For now, a more general hybrid engine that can take your conventional compiled programs and accelerate machine-learning algorithms while fitting seamlessly into the engineering community's preferred development environment is likely to be a winner.

LiDAR and radar

Machine learning is joined by LiDAR, radar, and 5G communications as strong themes in the Silicon 100. The prospect of automated transportation as a service provided by autonomous vehicles may not be the most appealing, but to get there, vehicles must be upgraded into highly aware, mobile, connected computers. And in any case, such smart cars will undoubtedly save lives and would be worthwhile for that reason alone.

LiDAR — ranging using infrared light — is generally thought to be an essential element for autonomous vehicles and can provide much more information than radar. However, LiDAR is complex, the volume of data generated is burdensome, and LiDAR data has been misinterpreted with potentially catastrophic results. As such, it has remained in development mode for many years, and the accepted view is that LiDAR and radar — and other sensors — will be deployed together and some sort of sensor fusion will be necessary to produce reliable and useful systems.

Early LiDAR was often of the mechanical, spinning variety, which provided an all-around view of the vehicle but was too bulky for inclusion on anything but prototype and demonstrator vehicles. It operates on time-of-flight principles to provide a detailed depth map of vehicle surroundings in contrast to the one or few channels of distance information provided by radar.

LiDAR has migrated to scanning MEMS mirror devices in a second wave, but taking the technology properly solid-state and moving it up in reliability will probably require a third wave based on beam-steering by optical phase-array or liquid crystal metamaterials.

Innoviz Technologies Ltd. (Kefar Sava, Israel), a 2016 startup, is a Silicon 100 company that represents that possibility. However, SiLC Technologies Inc. (Monrovia, California) claims to have gone further than others in integrating photonics functions, including lasers and detectors, into a single chip. It also touts the benefits of using frequency-modulated continuous wave (FMCW) at a wavelength of 1,550 nm rather than pulsed laser light at a 905-nm wavelength. SiLC contends that to avoid eye-safety concerns, power and, therefore, range are restricted at 905 nm and that pulsed but unencoded light will cause multi-user crosstalk.

"It is broadly accepted that a transition to FMCW technology at 1,550-nm wavelength is needed to address eye-safety regulatory concerns and enable volume deployment with minimal multi-user interference," states SiLC. That remains to be seen, but the field is definitely one to watch.

Meanwhile, radar techniques are pushing up in frequency in automotive applications and pushing out into other applications. We highlight the rise of China's Calterah Semiconductor Technology (Shanghai) Co. Ltd. as a provider of 77-GHz CMOS millimeter-wave radar sensor ICs targeting ADAS, security screening and imaging, and the smart home.

Vayyar Imaging Ltd. (Tel Aviv, Israel) is a slightly older fabless semiconductor company that develops intelligent radar sensors for 3D imaging. Initially developed for the purpose of detecting cancer with SoC radar technology, Vayyar sensors cover a range of microwave frequencies from 3 GHz to 81 GHz and have been employed in sectors including automotive, construction, agriculture, smart homes, robotics, and medical care.

Geography

We have discussed in previous years how the return of venture capital to hardware investment has been accompanied by the rise of California and China as the most popular headquarters locations for start-ups. California has almost unimaginable amounts of venture capital locally available, while China is also attractive to VCs and has government funds, subsidy, and encouragement.

Israel also deserves mention as a small country with a high density of startups and a history of producing some of the most successful exits.

This year's expansion to 100 companies has done little to change the overall picture, although it is notable that India has slipped back. While many electronics engineers are employed in India, relatively few notable startups are headquartered there. Europe continues to generate ideas and companies but has a relatively weak venture capital environment. This is partly compensated for by government-backed regional funding, although such funds tend to reinforce a technology push (rather than a market pull) approach.

PsiQuantum Corp. (Palo Alto, California) provides a good example. Professor Jeremy O'Brien, then of Bristol University in England, had spent most of his academic career up until 2016 pursuing ideas about quantum computing. In that year, he formed PsiQuantum Ltd. in the U.K. and PsiQuantum Corp. in the United States. But it was upon moving to Palo Alto, California, that PsiQuantum could gain the ear of some serious venture capital. The company disclosed that it had raised $230 million in November

2019 from investors, including Playground Global, a venture capital fund co-founded by former Google executive Andy Rubin.

Silicon Valley continues to thrive, and California alone provides 40 companies for the Silicon 100. With nine startups from other U.S. states and five headquartered in Canada, that makes 49% of Silicon 100 startup activity headquartered in the U.S. and 54% in North America.

China is the next busiest location, with 13 startups that we highlight, and Israel is incubating seven of our startups. The rest of Asia has just four startups, providing a total of 17 (or 24, if you include Israel in Asia). That leaves 22 startups out of the 100 spread across Europe, with hot spots in France and the U.K.

Quantum computing

With the large showing of AI and machine-learning companies in the Silicon 100, it seems likely that we have hit or are close to "peak machine learning." And it seems likely that the next wave of startup activity to command our attention will be in the area of quantum computing.

The list of companies on our radar already includes about 40 startups that were formed to address the field with a hardware engineering approach. These were all formed in 2015 or later, and as is usually the case, there are very many more with a focus on software or services around the base technology.

While quantum computing is thought of as having application to a limited set of problems, the arrival of more general and affordable quantum processors will change the landscape. This will initially be in such fields as cryptography, database searching, simulation of physical and chemical processes, medical discovery, and so on. But then engineering creativity will be used to apply quantum algorithms to the important — and most profitable — tasks facing humanity. This will perhaps create quantum-computable ways to increase the efficiency of tasks already performed by classical computing.

Although the field of quantum computing started in the electronics area, its development has been limited by the need to operate circuits at close to absolute zero. The use of optical quantum computing is widely seen as one way of avoiding the low-temperature requirements of electronic quantum computing, and a number of the youngest startups are eager to exploit these possibilities.

It is also notable that quantum computing may be applicable to highly parallel AI algorithms. So the ultimate winner in the race toward the AI processor, and the riches that it will command, may yet arrive on the Silicon 100 list as a quantum computing startup.

Peter Clarke *is a freelance electronics journalist and the curator of the Silicon 100.*

Available in September 2020

AspenCore Media Guide to Sensors in Automotive

Making Cars See and Think Ahead

Foreword

...Identifying the key players in the industry and clarifying the market potential and limitations of the next generation of sensor technology allow the reader to catch a glimpse of the future of automotive safety to understand the most important challenges that we will need to overcome.

— ***Michiel van Ratingen***, *Secretary General at Euro NCAP*

Market Analysis by Yole Développement

Technology Analysis by leading automotive thinkers:

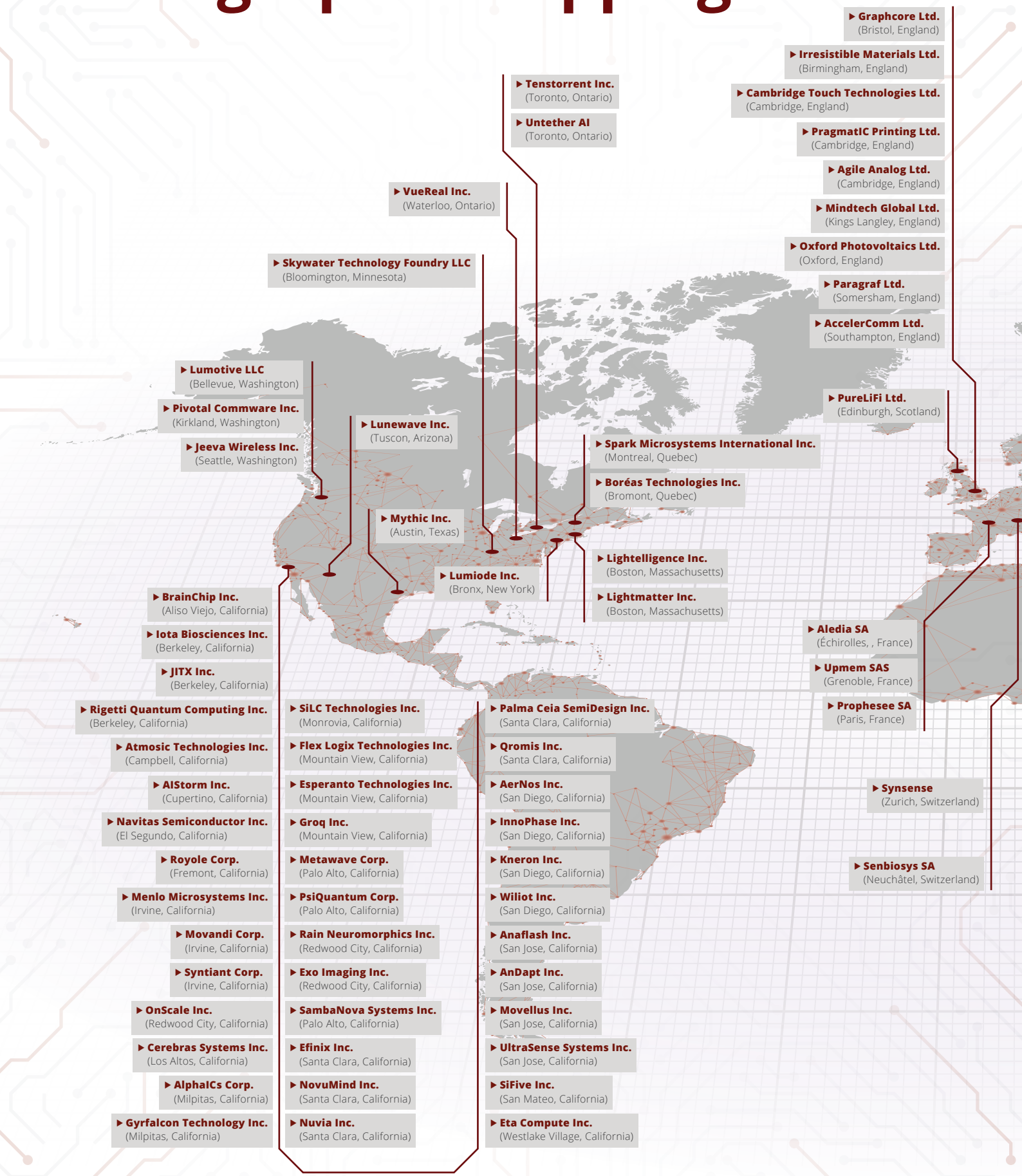
- Colin Barnden
- Mike Demler
- Mark Fitzgerald
- Egil Juliussen
- Philip Koopman
- Phil Magney
- Robert Stead
- Q&A with Mobileye CEO Amnon Shashua
- Q&A with TDK InvenSense CTO Peter Hartwell

ADAS/AV News & Analysis by the editors of AspenCore Media

Industry Resources

Edited by Junko Yoshida, EE Times
Publisher: AspenCore Media
Available in PDF and in print (limited edition)

Geographic Mapping




Beijing Winner Microelectronics Co. Ltd. (Beijing, China)
Bitmain Technologies Holding Co. Ltd. (Beijing, China)
Cambricon Technologies Corp. Ltd. (Beijing, China)
Horizon Robotics Technology Co. Ltd. (Beijing, China)
Ferroelectric Memory Company GmbH (Dresden, Germany)
E-peas Semiconductors (Mont-Saint-Guibert, Belgium)
Calterah Semiconductor Technology Co. Ltd. (Shanghai, China)
Cista Systems Corp. (Shanghai, China)
SemiBlocks B.V. ('s-Hertogenbosch, Netherlands)
Smartsens Technology Co. Ltd. (Shanghai, China)
Shanghai Zhaoxin Semiconductor Co. Ltd. (Shanghai, China)
Dispelix Oy (Espoo, Finland)
Minima Processor Oy (Oulu, Finland)
Hanking Electronics (Liaoning) Co. Ltd. (Shenyang, China)
ChangXin Memory Technologies Inc. (CXMT) (Hefei, China)
Flosfia Ltd. (Kyoto, Japan)
Almotive Ltd. (Budapest, Hungary)
Yangtze Memory Technologies Co. Ltd. (Wuhan, China)
Kyulux Inc. (Fukuoka, Japan)
XTX Technology Ltd. (Shenzhen, China)
USound GmbH (Graz, Austria)
RoboSense aka Suteng Innovation Technology Co. Ltd. (Shenzhen, China)
Zhuhai Eeasy Technology Co. Ltd. (Zhuhai, China)
ProteanTecs Ltd. (Haifa, Israel)
NeuroBlade Ltd. (Hod HaSharon, Israel)
Weebit Nano Ltd. (Hod HaSharon, Israel)
INT Tech Co. Ltd. (Hsinchu, Taiwan)
Unispectral Ltd. (Ramat Gan, Israel)
Morse Micro Pty. Ltd. (Sydney, Australia)
Innoviz Technologies Ltd. (Rosh Haayin, Israel)
Hailo Technologies Ltd. (Tel Aviv, Israel)
Vayyar Imaging Ltd. (Tel Aviv, Israel)

EE Times Lists 100 Emerging Companies to Watch

By Peter Clarke

It's been more than a year since EE Times produced the 19th iteration of the Silicon 60. In the ensuing months, there was an explosion of startups emerging with novel technologies, implementations, architectures, and materials. So for v20, we have expanded the Silicon 60 to make it the Silicon 100.

The semiconductor and electronics sectors have not been so vibrant for many decades — a time when these industries were much smaller in terms of annual global revenues than they are now. However, today's feverish and global R&D activity is cast in an economic context that is inhibited and a geopolitical mood that is confrontational. Set that against a global climate that is changing — and not for the better — and we must conclude that the human race has a lot on its plate.

But technologies that can create well-being and wealth while helping to turn back the greenhouse gas tide are likely to be part, if not all, of the solution. So we are eager to recognize these startups.

The flow of venture capital toward hardware-based startups, which ticked back up in the middle of the last decade, has not abated, and the consensus now is that artificial intelligence, machine learning, 5G communications, and transportation solutions are set to drive the industry onward and upward for the next several years.

EE Times has retained 49 companies from its most recent list of companies that we believe are worth keeping an eye on and selected 51 startup companies to join the list, expanding the total to 100. We have been publishing and updating our list of emerging startups since April 2004, with the revisions reflecting corporate, commercial, technology, and market conditions. The latest batch of newcomers includes companies active across the breadth of the widening technology front.

Areas of interest include analog circuits, AI, neural networks, vision in the form of processors and intellectual property, processing-in-memory, memory, optical processing, machine vision and speech recognition, security, sensors, haptics, displays, LiDAR, RF, internet of things, energy harvesting and power management, photovoltaics, materials, and printed electronics.

Selection is based on the consideration of a mix of criteria, including technology, intended market, financial position and investment profile, maturity, and executive leadership. These are emerging companies to follow for a variety of reasons. The names of the newest recruits appear in red in the pages to follow.

Readers are welcome to nominate their own emerging companies for inclusion in a future iteration of the Silicon 100 list and should include a short citation providing details about the company and explaining why the company is suitable for inclusion on the list.

AccelerComm Ltd.

Southampton, England

AccelerComm Ltd. is a semiconductor IP core company that provides channel coding solutions for communication standards. Founded in 2016, AccelerComm is coming to market with polar encoder and decoder solutions for 3GPP's 5G standards.

www.accelercomm.com

AerNos Inc.

San Diego

AerNos Inc., founded in 2016, uses doped materials and nanotechnology to detect multiple airborne gases and volatile organic compounds simultaneously at parts-per-billion levels. Its sensors include carbon nanotubes, nanowires, and polymers.

www.aernos.com

Agile Analog Ltd.

Cambridge, England

Agile Analog Ltd., founded in August 2017, is seeking to change the way analog circuits are designed with the intention of becoming a leading analog IP company. Agile includes Arm alumni at the top of the company and on its board of directors and claims that it can design analog circuits faster, to a higher quality, and on any silicon process.

www.agileanalog.com

AImotive Ltd.

Budapest, Hungary

AImotive Ltd. is an AI company working on Level 5 (full autonomy) driving. It was founded in 2015 as AdasWorks but changed its name to AImotive in November 2016. AImotive has raised $75 million in funding, including from investors Robert Bosch Venture Capital, Nvidia, Inventure Oy, Draper Associates, Day One Capital Fund Management, and Tamares. The company is a licensor of ADAS-related IP and counts Altera, Arm, Bosch, Ceva, Intel, Nvidia, NXP, Qualcomm, Volvo, and Wind River among its partners.

www.aimotive.com

AIStorm Inc.

Cupertino, California

AIStorm Inc. was founded in 2011 and has a chip design capable of 2.5 TOPS and 10 TOPS/W. It uses switched charge processing, which allows the chip to control the movement of electrons between storage elements. It can also use CMOS image sensors as part of the input layer. AIStorm refers to its technology as AI-in-sensor.

www.aistorm.ai

Aledia SA

Échirolles, France

Aledia SA has developed a method of forming light-emitting diodes (LEDs) within vertical pillars of gallium nitride (GaN) grown on silicon wafers. The company spun out of CEA-Leti in 2011 and claims that the technique produces 3× more light per planar area than conventional approaches while using less GaN material.

www.aledia.com

AlphaICs Corp.

Milpitas, California

AlphaICs Corp. was founded in 2016 to address a broad variety of AI and machine-learning tasks with a processor architecture designed to support "agents." The company also has an office in Bengaluru, India.

www.alphaics.ai

Anaflash Inc.

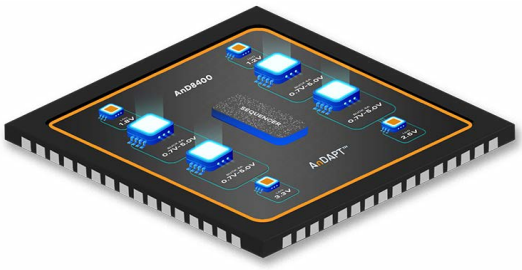
San Jose, California

Anaflash Inc., founded in 2017, is an AI accelerator chip startup that uses logic-compatible single polysilicon embedded flash memory for compute-in-memory machine-learning acceleration. A multi-level-cell program scheme has been employed to program the cell state without using sophisticated voltage regulator circuits.

www.anaflash.ai

AnDapt Inc.

San Jose



AnDapt Inc., a fabless company founded in 2014, has launched a range of configurable ICs that combine power MOSFETs, analog circuitry, and digital circuitry and that can be used to create a variety of power circuits. The company includes veteran semiconductor executives Kapil Shankar and John Birkner and is backed by Intel Capital and Cisco.

www.andapt.com

Atmosic Technologies Inc.

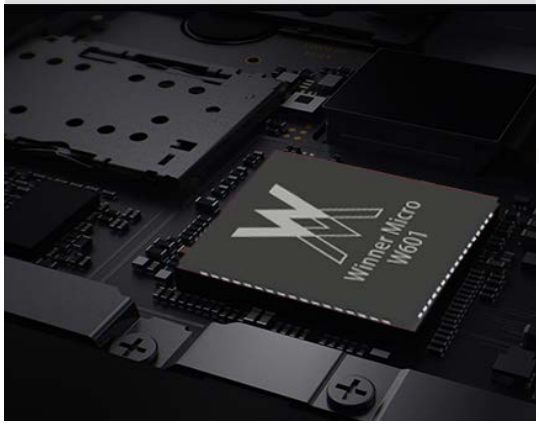
Campbell, California

Atmosic Technologies Inc., founded in 2016, has launched Bluetooth 5.0 transceiver chips with low-power features including RF energy harvesting. The company is led by former Atheros and Qualcomm engineers David Su (CEO) and Masoud Zargari (vice president of engineering). Atmosic has received $21 million in Series A/A1 financing led by Sutter Hill Ventures, Clear Ventures, and Walden International. The company's products, starting with a Bluetooth transceiver, enable the IoT device ecosystem — designers and manufacturers, as well as end users and those responsible for deployments — to lower cost and effort for IoT in multiple market segments.

www.atmosic.com

Beijing Winner Microelectronics Co. Ltd.

Beijing



Beijing Winner Microelectronics Co. Ltd., or Winner Micro, is a fabless company founded in 2013 that focuses on wireless communications chips in the IoT field. The products are mainly used in smart home, health-care, wireless video and audio, and industrial applications.

www.winnermicro.com/en

BitMain Technologies Holding Co. Ltd.

Beijing

BitMain Technologies Holding Co. Ltd. is best known as a producer of cryptocurrency-mining ASICs on leading-edge processes, but the company is expanding to become a more general blockchain and semiconductor company. Founded in 2014, the company is involved in machine learning, AI, deep learning, ASIC chip design, and AI ASIC chips.

www.bitmain.com

Boréas Technologies Inc.

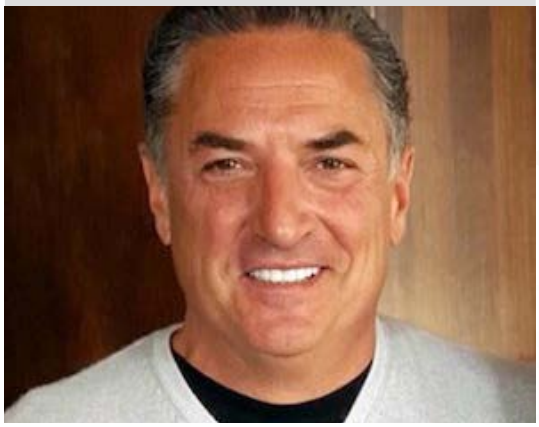
Bromont, Quebec

Boréas Technologies Inc. was founded in mid-2016 and closed a seed financing equity round in March 2017. The company has developed its first product, the BOS1901, a piezoelectric driver IC for high-definition haptic feedback in wearables and other battery-powered consumer devices.

www.boreas.ca

BrainChip Inc.

Aliso Viejo, California



BrainChip Inc. is developing spiking neural networking cores for licensing to semiconductor partners. Founded in December 2013, it is now owned by BrainChip Holdings Ltd., which is listed on the Australian Securities Exchange. The company appointed Louis DiNardo CEO in September 2016.

www.brainchipinc.com

Calterah Semiconductor Technology Co. Ltd.

Shanghai

CALTERAH

Calterah Semiconductor Technology Co. Ltd. was founded in 2014 and has rolled out a series of 77-GHz and 60-GHz CMOS radar transceivers and sensors, including antennas-in-package. The Yosemite (77/79 GHz) and Yellowstone (60 GHz) were produced in 2017, followed by the Alps 77-/79-GHz CMOS radar SoC in 2019. The Rhino 60-GHz CMOS radar SoC is due to follow.

www.calterah.com

Cambricon Technologies Corp. Ltd.

Beijing

Cambricon 寒武纪科技

Cambricon Technologies Corp. Ltd. develops AI chips. The company offers the MLU100 processor for deep learning and the MLU100 intelligent processing card. Additionally, the company offers solutions, including IP licensing and chip services. The company's products can be applied in smartphones, security and surveillance cameras, servers, robots, drones, wearable devices, and autonomous driving. The company was founded in 2016.

www.cambricon.com

Cambridge Touch Technologies Ltd.

Cambridge, England

Cambridge Touch Technologies Ltd., founded in 2012, is a provider of 3D multipoint touch technologies to the consumer electronics, automotive, industrial, and military markets. CTT supports its OEM and supply chain customers with IP, know-how, analog and digital technologies, and system architectures.

www.camtouch3d.com

Cerebras Systems Inc.

Los Altos, California

Cerebras Systems Inc. is working on specialized chips for deep-learning applications and claims to be backed by premier venture capitalists and industry-leading technologists. The company was founded in 2016 and is headed by Andrew Feldman, who sold micro-server chip company SeaMicro to Advanced Micro Devices (AMD) in 2012 for $334 million. Benchmark is reported to have led a funding round totaling more than $20 million.

www.cerebras.net

ChangXin Memory Technologies Inc.

Hefei, China

ChangXin Memory Technologies Inc. (CXMT) was founded in Hefei, China, with Chinese state support in May 2016. CXMT has opened a 300-mm wafer fab to manufacture DRAM chips.

www.cxmt.com

Cista Systems Corp.

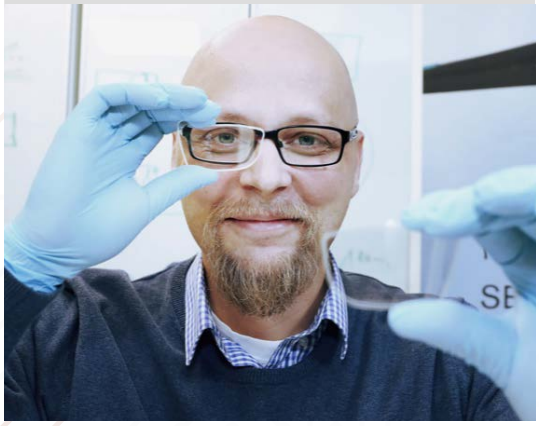
Shanghai

Cista Systems Corp., founded in 2013, has developed a number of CMOS image sensors, making use of Chinese foundry SMIC's 0.13-micron backside-illuminated manufacturing process technology platform.

www.cistadesign.com

Dispelix Oy

Espoo, Finland



Dispelix Oy, founded in 2015, has developed special gratings and optical waveguides that can route an image from a display engine located in the frame of smart spectacles to the inside surface of the glass. Company researchers have dealt with several issues typically associated with the optical grating approach, namely rainbow effects and pattern artifacts due to transmissive diffraction.

www.dispelix.com

Efinix Inc.

Santa Clara, California

Efinix Inc. is an FPGA startup founded in 2012 by a couple of veteran FPGA engineers. The company has developed what it calls "quantum" programmable technology — a circuit-level architecture that it claims gives it a 4× improvement in power-performance-area (PPA) over traditional programmable architectures. Efinix has received backing from Xilinx and Samsung.

www.efinixinc.com

E-peas Semiconductors

Mont-Saint-Guibert, Belgium

E-peas Semiconductors has announced its first chip, an energy management IC for use with photovoltaic and thermoelectric energy harvesting. The company was founded in 2014 with a vision to address IoT applications on two fronts: by increasing harvested energy and by reducing the energy consumption of circuit blocks. It also offers an Arm-based microcontroller.

www.e-peas.com

Esperanto Technologies Inc.

Mountain View, California

Esperanto Technologies Inc. was founded in 2014 by CEO Dave Ditzel, a chip industry veteran well known as a chip designer previously with Intel and Sun Microsystems and as founder of code-morphing startup Transmeta. Esperanto has developed the ET-Maxion cores, which are designed to deliver high single-thread RISC-V performance. The company is working on an AI chip that is projected to contain more than 4,000 64-bit processor cores on 7-nm manufacturing technology.

www.esperanto.ai

Eta Compute Inc.

Westlake Village, California

Eta Compute Inc., a fabless chip company founded in 2015, claims to have developed the world's lowest-power microcontroller IP, with a Cortex-M3 processor core that operates down to 0.25 V. The company has turned its technology into the Delay Insensitive Asynchronous Logic (DIAL) technology as a first step toward enabling intelligence for embedded systems and devices. Eta Compute has a series of low-power ICs based on this technology, including an Arm-based microcontroller and an ASIC that includes pre-trained machine-learning speech-recognition and keyword-spotting applications.

www.etacompute.com

Exo Imaging Inc.

Redwood City, California

Exo Imaging Inc. was founded in 2015 by serial entrepreneur Janusz Bryzek with a plan to develop a handheld ultrasound imager. The company is developing a piezoelectric micromachined ultrasound transducer (pMUT) that it plans to marry with advances in ultrasound imaging algorithms and deep-learning processors as well as cloud and fog computing.

www.exo-imaging.com

Ferroelectric Memory Company GmbH

Dresden, Germany

Ferroelectric Memory Company GmbH, founded in 2016 as a spin-off of NaMLab at Technical University of Dresden, is developing embedded non-volatile memory based on the ferroelectric effect in hafnium dioxide. Hafnium dioxide is the classical high-κ metal-gate (HKMG) material used in transistors, and there is no roadblock for FMC's technology to be applied to 22-nm FD-SOI, 1x-nm FinFET, and beyond, the company claims. FMC raised €4.6 million in July 2018.

www.ferroelectric-memory.com

Flex Logix Technologies Inc.

Mountain View

Flex Logix Technologies Inc., founded in March 2014 and supported by Lux Capital soon afterward, was started to bring a field-programmable gate array (FPGA) architecture to market as a licensable fabric for inclusion in system chips. The architecture, EFLX, is available for the most popular process nodes and is being ported to additional process nodes based on customer demand. Flex Logix is a member of the TSMC IP Alliance.

www.flex-logix.com

Flosfia Ltd.

Kyoto, Japan

Flosfia Ltd. is a spin-out from Kyoto University that is working with Denso on a power semiconductor device expected to reduce the energy loss, cost, size, and weight of inverters used in electrified vehicles. Professor Shizuo Fujita at Kyoto University has pioneered the application of corundum-structured gallium oxide (α-Ga_2O_3) for use in semiconductors to provide a wide bandgap of 5.3 eV and high electric breakdown field strength to withstand higher-voltage applications. Flosfia was founded in 2011 to commercialize the technology through film formation by mist chemical vapor deposition (mist CVD). The company claims that gallium oxide can replace today's current silicon and silicon carbide power semiconductors.

www.flosfia.com

Graphcore Ltd.

Bristol, England

Graphcore Ltd. was founded in 2015 as a spin-out from XMOS Ltd. to develop a processor for machine learning based on graph theory. In 2017, it raised a second round of funding of $30 million, bringing the total invested in the company to $60 million. It calls its architectural implementation an intelligence processing unit (IPU). The first IPU was codenamed Colossus partly because of the size of the die. IPUs are designed into a specific Dell server and have been used as an optional way to run Microsoft's Azure cloud computing service.

www.graphcore.ai

Groq Inc.

Mountain View

Groq Inc. was founded by Douglas Wightman and Jonathan Ross, former Google executives who worked on the TensorFlow processing unit, and venture capitalist Chamath Palihapitiya. They have formed a fabless semiconductor startup for cognitive computing that raised $10.3 million at its incorporation in September 2016. Groq launched its tensor streaming processor in November 2019.

www.groq.com

Gyrfalcon Technology Inc.

Milpitas

Gyrfalcon Technology Inc. was founded in 2017 by veteran Silicon Valley entrepreneurs to move cloud AI to local devices with greater performance and efficiency. Gyrfalcon has designed and implemented the Lightspeeur 2801S AI processor, which provides 2.8 TOPS while consuming 300 mW (9.3 TOPS/W). Lightspeeur is the first instantiation of Gyrfalcon's APiM architecture, which uses memory as the AI processing unit.

www.gyrfalcontech.ai

Hailo Technologies Ltd.

Tel Aviv, Israel

Hailo Technologies Ltd. was founded in 2017 by engineers with backgrounds in the Israel Defense Forces and commercial engineering. The company claims to have a revolutionary processor architecture to accelerate neural network processing that will provide a PPA point suitable for processing high-resolution sensory data at the edge and in real time. Hailo launched its Hailo-8 processor in May 2019. The processor is being designed to run embedded AI applications on edge devices that are installed in autonomous vehicles, drones, and smart home appliances such as personal assistants, smart cameras, and smart TVs.

www.hailotech.com

Hanking Electronics (Liaoning) Co. Ltd.

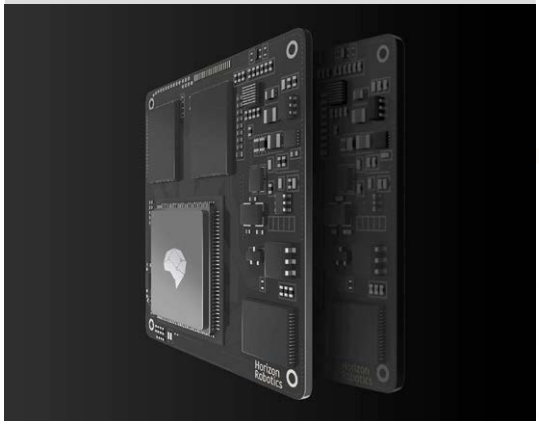
Shenyang, China

Hanking Electronics (Liaoning) Co. Ltd., founded in April 2011, is a privately funded microelectromechanical systems (MEMS) company and a subsidiary of the Hanking Industrial Group. Hanking Electronics focuses on developing, fabricating, and marketing MEMS products and related electronic components. It provides customers with design and development, fabrication processing, volume manufacturing, MEMS foundry services, MEMS sensors, MEMS actuators, ASICs, MEMS technology, and application consulting.

www.hankingmems.com

Horizon Robotics Technology Co. Ltd.

Beijing



Horizon Robotics Technology Co. Ltd., founded in 2015, targets autonomous driving, smart life, and smart surveillance, with a view to equipping terminal devices with perception, interaction, comprehension, and decision-making. The company has attracted investment from Morningside Venture Capital, Hill House Capital, Sequoia Capital, and GSR Ventures and has released the Sunrise and Journey 2 AI processors.

en.horizon.ai

InnoPhase Inc.

San Diego

InnoPhase Inc., founded in 2013, claims it has developed an approach to processing RF signals that reduces the energy consumed compared with previous approaches. The fabless semiconductor company's products are built around a specialized hardware architecture known as a nonlinear radio processing unit (nRPU). Various RF protocols are implemented in software that executes on the nRPU. The result is a hardware platform capable of running multiple radio standards at low levels of power. The company has launched its Talaria Two multiprotocol wireless chipset for battery-based IoT equipment.

www.innophaseinc.com

Innoviz Technologies Ltd.

Rosh Haayin, Israel

Innoviz Technologies Ltd., a 2016 startup developing LiDAR sensors for autonomous vehicles, raised $9 million in a Series A financing round and then extended a Series B financing round to $73 million in October 2017. Backers include Samsung Catalyst and SoftBank Ventures Korea. The company was founded by former members of the Israeli Intelligence Corps who went on to work for multiple startups and multinational corporations.

www.innoviz.tech

INT Tech Co. Ltd.

Hsinchu, Taiwan

INT Tech Co. Ltd., founded in June 2016 with a vision to enable high-bandwidth 5G and the delivery of ultra-high-resolution content, has developed a proprietary glass-based deposition process to deliver red/green/blue active-matrix organic LED (AMOLED) displays at pixel densities above 2,200 ppi. The company is seeking partners to create joint ventures for particular product developments, such as its formation of UltraDisplay back in 2017 with AMOLED driver IC manufacturer UltraChip. Since then, UltraDisplay has become an AMOLED driver IC design house for AMOLED manufacturers.

www.int-tech.com.tw/en/

Iota Biosciences Inc.

Berkeley, California

Iota Biosciences Inc. was established in 2017 to commercialize the "neural dust" technology invented at the University of California, Berkeley and thereby change the monitoring and treatment of disease. The technology is based on swarms of implantable communicating electronic ICs to provide a platform for the future of bioelectronic medicine.

www.iota.bio

Irresistible Materials Ltd.

Birmingham, England

Irresistible Materials Ltd. is a spin-out from the University of Birmingham working in alliance with Nano-C Inc. to develop materials for application in semiconductor lithography. Since its 2010 launch, IM has developed a patent portfolio covering resists for extreme-ultraviolet and electron-beam lithography and hard-mask materials.

www.irresistiblematerials.com

Jeeva Wireless Inc.

Seattle

Jeeva Wireless Inc., founded in 2015, is introducing passive Wi-Fi technology based on backscatter theory to improve the range/power consumption tradeoff for most power-constrained IoT and wireless sensing devices.

www.jeevawireless.com

JITX Inc.

Berkeley

JITX Inc. uses AI to automate the design of circuit boards as a service, producing designs faster and at a lower cost than when designed by engineers, the company claims. JITX was founded by CEO Duncan Haldane in 2016.

www.jitx.com

Kneron Inc.

San Diego

Kneron Inc., a developer of neural processing units for edge devices, was founded in 2015 and completed a Series A financing round worth more than $10 million in November 2017. Alibaba Entrepreneurs Fund and CDIB Capital Group are the lead investors, and Himax Technologies, Qualcomm, Thundersoft, Sequoia Capital, and CYZONE are co-investors.

www.kneron.com

Kyulux Inc.

Fukuoka, Japan

Kyulux Inc., founded in 2015, is developing OLED technology for use in displays and lighting based on research conducted at Kyushu University. Professor Chihaya Adachi, the inventor of thermally activated delayed fluorescence (TADF) technology, is a co-founder. Kyulux investors include Samsung, LG Display, and Japan Display.

www.kyulux.com

Lightelligence Inc.

Boston

Lightelligence Inc. was spun out of the Massachusetts Institute of Technology (MIT) in 2017 to commercialize optical processing as an approach to AI. Lightelligence has received seed funding of about $10 million from Baidu Ventures and a group of U.S. semiconductor executives.

www.lightelligence.ai

Lightmatter Inc.

Boston

Lightmatter Inc. is an MIT spin-off founded to commercialize optical processing through waveguides on silicon applied to neural networking architectures. The company, formed in 2017, announced it had received $11 million in Series A funding early in 2018.

www.lightmatter.co

Lumiode Inc.

Bronx, New York

Lumiode Inc. is a semiconductor company that develops and manufactures microLED-based displays for head-worn, high-brightness, and augmented-reality systems. The claim is that the Lumiode microdisplay is 10× brighter and 10× more efficient than other technologies. The company has been investigating both visible light and non-visible light applications such as depth scanning and 3D printing. The company received a two-stage SBIR grant to develop prototype LED arrays and advanced silicon circuitry to control the arrays and methods to achieve full-color displays. It was founded in 2012 and is backed by IP Group, Applied Ventures, and M Ventures.

www.lumiode.com

Lumotive LLC

Bellevue, Washington

Lumotive LLC was founded in 2017 to develop solid-state LiDAR for the automotive industry based on metamaterials deployed with semiconductor chips. The liquid crystal metasurface allows an incident laser beam to be reflected in a programmable direction, depending on the electronic configuration of the metamaterial elements on the surface of the chip. The company is backed by Bill Gates.

www.lumotive.com

Lunewave Inc.

Tucson, Arizona

Lunewave Inc. is a 2017 startup developing antenna and radar sensor technology for use in self-driving vehicles and other applications. Lunewave uses 3D printing to create a Luneburg lens antenna as a spherical sensor with a 360° field of view. Lunewave has ties to the University of Arizona and claims that its technology has applications in aerospace and wireless telecommunications.

www.lunewave.com

Menlo Microsystems Inc.

Irvine, California

Menlo Microsystems Inc. was founded in 2016 to bring to market work on MEMS switches originally started at General Electric's Global Research Center. GE's research led to an understanding of failure modes and the development of patented metal alloys and processing techniques that enable reliable operation with high performance. Menlo Micro's Digital-Micro-Switch (DMS) platform is applicable to 5G mobile networks, industrial IoT markets, battery management, home automation, electronic vehicles, and medical instrumentation. Menlo Micro is backed by GE Ventures, with investments from Corning, Microsemi Corp., and Paladin Capital Group.

www.menlomicro.com

Metawave Corp.

Palo Alto, California

Metawave Corp., founded in 2017, is working on wireless communications and radar sensing using metamaterials and AI, with a focus on building a better beam-steered radar for autonomous driving. Metawave claims that its radars will be capable of 4D point-cloud imaging, non-line-of-sight object detection, and vehicle-to-vehicle communication. In parallel, Metawave is developing smart antenna platforms for fixed wireless and 5G cellular networks.

www.metawave.co

Mindtech Global Ltd.

Kings Langley, England

Mindtech Global Ltd. is an AI processor startup formed in August 2017 by executives formerly with Imagination Technologies. Target markets are visual processing in automotive, unsupervised machines, retail, and security. The original founder of Mindtech was Sir Hossein Yassaie, previously CEO of Imagination. The company's first product is a synthetic data generator for training AI systems. The company is working on an AI engine intended to blend traditional and AI algorithms. It will then produce integrated AI processors. The processor roadmap covers IoT sensor fusion and visual processing.

www.mindtech.global

Minima Processor Oy

Oulu, Finland

Minima Processor Oy was founded in April 2016 to develop sub-threshold-voltage processors based on technology developed by VTT Technical Research Centre and the Universities of Aalto and Turku. Minima was a founding partner in the RISC-V Foundation. Minima's techniques can be used to optimize processor voltage and frequency operating points dynamically, although the company also advocates the use of sub-threshold-voltage operation. Minima's clocking is adaptive-synchronous rather than asynchronous, and the company provides a middleware stack with its hardware that provides compatibility with dynamic voltage and frequency scaling (DVFS) regimes.

www.minimaprocessor.com

Morse Micro Pty. Ltd.

Sydney

Morse Micro Pty. Ltd. is a fabless semiconductor startup developing Wi-Fi HaLow chips for the IoT market. The company was founded in 2016 by Andrew Terry and Michael De Nil, who had both worked on Wi-Fi for Broadcom.

www.morsemicro.com

Movandi Corp.

Irvine

Movandi Corp. was formed in 2016 by a brother-and-sister team that was previously with Broadcom. It is the developer of a millimeter-wave module for 5G networks. Movandi's BeamX module is an RF front end that comprises the antenna array through to the baseband interface. It targets 28- and 39-GHz 5G systems, including base stations and receivers, as well as use in indoor gigabit, fixed wireless access, and satellite networks. Movandi sampled eight- and 16-antenna modules for 28 GHz at the end of 2017 and announced the 39-GHz version early in 2018.

www.movandi.com

Movellus Inc.

San Jose

Movellus Inc., formed in April 2014, has launched itself on the market with a focus on the use of digital design and verification tools to implement analog circuit functionality. In April 2019, Movellus announced $6 million in a funding round that brought total investment in the company to $10 million.

www.movellus.com

Mythic Inc.

Austin, Texas

Mythic Inc., founded in 2012 as Isocline Engineer Corp., is adopting a processing-in-memory approach to neural network implementation based on a hybrid mix of digital and analog computation. The company raised $9.3 million in a Series A funding round in 2017 and accepted Steve Jurvetson of Draper Fisher Jurvetson and Shahin Farshchi of Lux Capital to the board of directors.

www.mythic-ai.com

Navitas Semiconductor Inc.

El Segundo, California

Navitas Semiconductor Inc. was founded in 2013 by a team of power semiconductor veterans with experience in materials, devices, applications, systems, and marketing. Its process design kit enables monolithic integration of lateral GaN FETs with logic and analog circuits. Navitas GaN power ICs enable power for mobile, consumer, enterprise, and new energy markets. More than 25 Navitas patents are granted or pending.

www.navitassemi.com

NeuroBlade Ltd.

Hod HaSharon, Israel

NeuroBlade Ltd. was founded in 2017 by Elad Sity, CEO, and Eliad Hillel, CTO, to address the AI processor opportunity. It raised $4.5 million in seed capital while in stealth mode from StageOne Ventures and Grove Ventures. A $23 million Series A round in 2019 brought the total raised by NeuroBlade to more than $27 million.

www.neuroblade.ai

NovuMind Inc.

Santa Clara

NovuMind Inc. was established in 2015 by Ren Wu, formerly a distinguished scientist at Baidu, with 50 people, including engineers in the U.S. and in Beijing. NovuMind is testing what Wu describes as a minimalist approach to deep learning. In 2018, the company benchmarked its NovuTensor processor, which comes as a 28-nm chip or on a PCIe short card that can plug into a server.

www.novumind.com

Nuvia Inc.

Santa Clara

Nuvia Inc. was founded in early 2019 by the former chief CPU architect at Apple and two former staff members from Google on the promise of reimagining silicon design for high-performance computing environments. The company is focused on blending compute performance, power efficiency, and scalability. In November 2019, Nuvia announced that it had raised $53 million in Series A funding.

www.nuviainc.com

OnScale Inc.

Redwood City

OnScale Inc. has raised seed funding of $3 million to launch its solver-as-a-service company for complex engineering calculations that require high-performance computing. OnScale combines computer-aided engineering with high-performance computing to offer online solutions for tasks such as finite element analysis (FAE) and computational fluid dynamics (CFD) for applications in 5G, IoT, biomedical, and autonomous driving. The company was founded in 2017 as a spin-off from construction engineering consultancy Thornton-Tomasetti, where some of the CFD and FEA technology originally resided.

www.onscale.com

Oxford Photovoltaics Ltd.

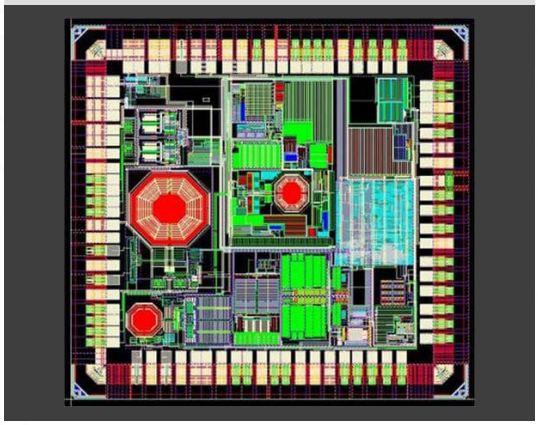
Oxford, England

Oxford Photovoltaics Ltd., formed in 2010, is a spin-out from Oxford University that has developed stable perovskite solar cells in recent years. At the end of 2018, the company announced that it had achieved a record-breaking 28% conversion efficiency in a 1-cm^2 tandem solar cell. A complete line for the manufacture of perovskite-on-silicon solar cells is due to start production by the end of 2020.

www.oxfordpv.com

Palma Ceia SemiDesign Inc.

Santa Clara



Palma Ceia SemiDesign Inc. is a provider of modem chips, transceivers, systems, and IP for emerging IoT and machine-to-machine (M2M) Wi-Fi and cellular RF markets. Founded in 2012, PCS offers modem chips for LTE NB-IoT and Wi-Fi HaLow.

www.pcsemi.com

Paragraf Ltd.

Somersham, England

Paragraf Ltd. is a 2015 spin-out from the gallium nitride group of Professor Sir Colin Humphreys at the University of Cambridge. Paragraf is developing 2D materials, starting with graphene, and applying these to a range of electronic, energy, and medical devices. The company has received backing from Cambridge University, Amadeus Capital Partners, and IQ Capital Partners, among others.

www.paragraf.com

Pivotal Commware Inc.

Kirkland, Washington

Pivotal Commware Inc. formed as a spin-off from Intellectual Ventures Management LLC in 2016 to commercialize the use of metamaterial structures for holographic beamforming in communications applications. It raised $17 million in Series A.

www.pivotalcommware.com

PragmatIC Printing Ltd.

Cambridge, England

PragmatIC Printing Ltd. was founded in 2010, when it acquired the printed-electronics business of Nano ePrint Ltd., including that company's patented technology for planar nano-electronic devices that can be fabricated in a single layer of semiconductor via single-step imprint patterning. PragmatIC has extended this imprinting process to allow a range of device and circuit architectures to be printed in transparent, flexible semiconductors at micron and submicron scale.

www.pragmatic.tech

Prophesee SA

Paris

Prophesee SA, a startup company founded in 2014 as Chronocam, develops machine-vision sensors and systems based on asynchronous pixel sensor technology and sparse data models. The architecture creates an image sensor that is close to a biological model, and a method of reporting image changes reduces off-chip bandwidth requirements and system power consumption. Prophesee has received investment from Robert Bosch Venture Capital and CEA Investissement.

www.prophesee.ai

proteanTecs Ltd.

Haifa, Israel

proteanTecs Ltd., founded in 2017, has developed a cloud-based platform that combines data created in chip-embedded software agents with machine learning to predict faults before they become failures. Insights can be gained during chip design, chip production, and system production, as well as after deployment. The level of Universal Chip Telemetry (UCT) is determined by the coverage and variety of agents integrated. It is applicable to chip developers, system builders, and service providers.

www.proteantecs.com

PsiQuantum Corp.

Palo Alto

PsiQuantum Corp., founded in 2016, aims to create a photonic quantum computing platform. The company was co-founded by Jeremy O'Brien, previously a professor of physics and electrical engineering at the U.K.'s University of Bristol and the director for the Centre for Quantum Photonics there, and Terry Rudolph, a professor at Imperial College London. The company raised $230 million in a round of equity financing in 2019. Investors include Playground Global, founded in 2014 by Andy Rubin, a former senior executive with Google.

www.psiquantum.com

PureLiFi Ltd.

Edinburgh, Scotland

PureLiFi Ltd., a 2012 startup, has gone to market with a product that allows LED lighting to be used as an alternative to a Wi-Fi router. The company raised $18 million in a Series B financing round in 2019.

www.purelifi.com

Qromis Inc.

Santa Clara

Qromis Inc., formed in March 2015 as Quora Technology by a couple of former BridgeLux employees, is focused on developing wide-bandgap semiconductor materials and devices in pursuit of energy efficiency. Quora Substrate Technology (QST) enables the use of 6-inch, 200-mm, and 300-mm silicon wafers with GaN surface layers in thicknesses varying from a few microns to bulk and in support of both discrete components and integrated circuits. The process is said to be compatible with existing silicon wafer fabs. The markets that Qromis is aiming to serve include power electronics, LEDs, displays, and RF electronics.

www.qromis.com

Rain Neuromorphics Inc.

Redwood City

Rain Neuromorphics Inc., founded in 2017, is reported to have a "memristive nanowire neural network" (MN3) chip architecture that is able to train larger, more powerful neural networks than any commercial chip currently on the market. The processor is suitable for use both in the data center and at the edge of the network. The company reportedly is to use TSMC for manufacturing. Rain Neuromorphics claims that it can build and train neural architectures with more than 1 billion neurons, bringing the industry closer to true brain-scale intelligence.

www.rain.ai

Rigetti Quantum Computing Inc.

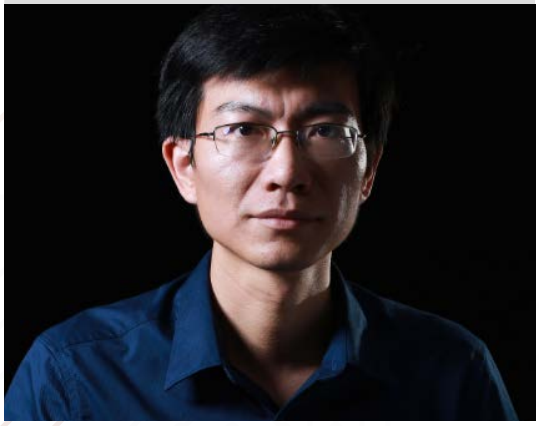
Berkeley

Rigetti Quantum Computing Inc., founded by Chad Rigetti in 2013, is developing quantum computer hardware and cloud software. The company's business model is to build a cloud quantum computer and provide access to it through an application programming interface (API) called Forest. Forest, which is in public beta testing, emphasizes a quantum-classical hybrid computing model, integrating directly with existing cloud infrastructure and treating the quantum computer as an accelerator. Rigetti has raised $64 million across Series A and Series B funding rounds.

www.rigetti.com

RoboSense

Shenzhen, China



RoboSense, also known as Suteng Innovation Technology Co. Ltd., is a LiDAR developer founded in 2014. RoboSense has two product lines, including MEMS-based solid-state LiDAR and mechanical LiDAR systems. Customers include automotive OEMs and Tier One suppliers. To date, RoboSense LiDAR has been used in self-driving logistics vehicles, buses, and passenger cars.

www.robosense.ai

Royole Corp.

Fremont, California

Royole Corp. was founded in Silicon Valley, Shenzhen, and Hong Kong in 2012 by three Stanford University and Tsinghua University engineering graduates. The company produces flexible AMOLED displays at a resolution beyond 3,000 ppi as well as flexible sensors. In Q4 2015, Royole began building a flexible display production line in Shenzhen with a projected final capacity of more than 50 million flexible display units per year. Royole's Series D funding included $240 million of equity financing and $560 million of debt financing.

www.royole.com

SambaNova Systems Inc.

Palo Alto

SambaNova Systems Inc. was founded in November 2017 and raised $56 million in Series A funding to develop a computing platform for distributed machine learning. The technology is based on work conducted in hardware and software labs at Stanford University. In April 2019, SambaNova announced a $150 million equity financing round led by Intel and GV (formerly Google Ventures) to take the company into "unicorn" territory. SambaNova said that it would use the money to recruit engineers and accelerate the buildout of its vertically integrated computing platform.

www.sambanovasystems.ai

SemiBlocks B.V.

's-Hertogenbosch, Netherlands

SemiBlocks B.V. is developing a CMOS solution to allow self-compensation for frequency errors due to temperature variations in crystal oscillators and eliminate the effects of hysteresis. The SemiBlocks solution works with a low-cost crystal. No further external components are required, enabling integration in other functions. The company was founded in 2017, and first products are expected to be for small base stations in the 4G/5G radio communications market.

www.semiblocks.com

Senbiosys SA

Neuchâtel, Switzerland

Senbiosys SA is a 2017 spin-off from École Polytechnique Fédérale de Lausanne (EPFL). The company has developed a chip that can measure heart rate and oxygen levels using both photoplethysmography (PPG) and time-of-flight (ToF) signals. The chip also measures ambient light.

www.senbiosys.com

Shanghai Zhaoxin Semiconductor Co. Ltd.

Shanghai

Shanghai Zhaoxin Semiconductor Co. Ltd. is a state-owned fabless chip company established in 2013 and headquartered in Shanghai's Zhangjiang Hi-Tech Park, with R&D centers and domestic branch offices in Beijing, Wuhan, Shenzhen, and Xi'an. Zhaoxin is a developer of x86 processors with included GPU and is getting a handle on 7-nm manufacturing process technology. The company plans to introduce a 7-nm KaiXian KX-7000 in 2021. The processor will be based on a new CPU architecture with up to 32 cores and will support 64 threads.

en.zhaoxin.com

SiFive Inc.

San Mateo, California

SiFive Inc. was founded in 2015 by creators of the free and open RISC-V processor architecture as a reaction to the end of conventional transistor scaling and escalating chip design costs. SiFive provides IP cores, processors, and boards.

www.sifive.com

SiLC Technologies Inc.

Monrovia, California

SiLC Technologies Inc., a silicon photonics startup founded in 2018, has launched an integrated frequency-modulated continuous-wave (FMCW) LiDAR-on-chip designed to operate at 1,550-nm wavelength.

www.silc.com

SkyWater Technology Foundry LLC

Bloomington, Minnesota

SkyWater Technology Foundry LLC was formed in 2017 by private equity firm Oxbow Industries LLC through the purchase of a 200-mm wafer fab in Bloomington from Cypress Semiconductor. The foundry is a trusted supplier for U.S. defense microelectronics and provides process development support. It has made chips ranging from quantum circuits to microfluidic chips for DNA sequencing.

www.skywatertechnology.com

Smartsens Technology Co. Ltd.

Shanghai

Smartsens Technology Co. Ltd., founded in 2011, is a supplier of CMOS imaging sensors. It has R&D teams in Silicon Valley and Shanghai and an ISO-certified supply chain infrastructure to supply CMOS image sensors for security and surveillance, consumer, automotive, and other mass-market applications. The company signed a license agreement with IBM in 2018.

www.smartsenstech.com

Spark Microsystems International Inc.

Montreal

Spark Microsystems International Inc. was founded in 2016 to work on a low-power radio for IoT with an order of magnitude better energy efficiency and latency than BLE or Zigbee and supporting faster data rates. Applications may be found in high-end audio distribution and hearing aids.

www.sparkmicro.com

Synsense

Zurich

Synsense, formerly aiCTX AG, has created an asynchronous, event-driven neuromorphic processor for always-on, real-time dynamic vision applications. The DynapCNN chip measures 12 mm^2 and is fabricated in a 22-nm manufacturing process technology that houses more than 1 million spiking neurons. It is suitable for implementing convolutional neural networks for use in vision processing. The company is a China-backed startup spun out of the Institute of Neuroinformatics at the University of Zurich in March 2017.

www.aictx.ai

Syntiant Corp.

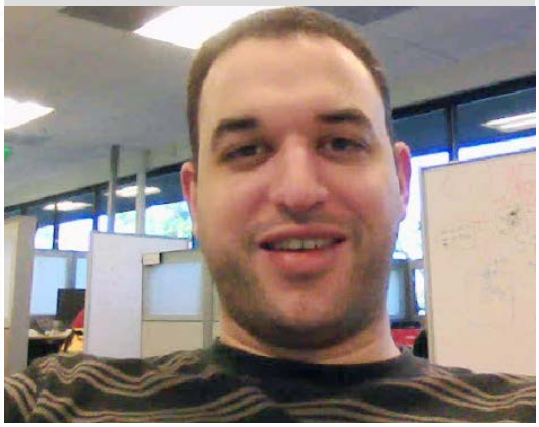
Irvine

Syntiant Corp., a startup formed in 2017, is developing analog neural networking processors that remove data movement penalties by performing neural network computations in flash memory. The company has received an undisclosed amount of backing from Intel Capital and other venture capital firms. It has an agreement to marry its neural decision processors with the microphone technology of Infineon Technologies AG (Munich, Germany).

www.syntiant.com

Tenstorrent Inc.

Toronto



Tenstorrent Inc., founded in 2016, is creating high-performance processor ASICs engineered for deep learning. Tenstorrent's processor is designed to excel at both learning and inference while being software-programmable. The processor's architecture scales from battery-powered IoT devices to large cloud servers. The Tenstorrent team comprises alumni from hardware companies such as Nvidia and AMD. The company is backed by Real Ventures and Eclipse Venture Capital.

www.tenstorrent.com

UltraSense Systems Inc.

San Jose

UltraSense Systems Inc. was founded in 2017 by Mo Maghsoudnia, former vice president of technology and manufacturing at InvenSense. The company has come up with an ultrasound actuator/sensor that can be attached to the inside surface of an enclosure to create a touch user interface on the outside. Smartphones and automotive dashboards are applications in which the company believes it can do well, although the technology is of more general applicability in industrial applications, medical equipment, and white goods.

www.ultrasensesys.com

Unispectral Ltd.

Ramat Gan, Israel

Unispectral Ltd., founded in 2016, is developing a hyperspectral image sensor that not only can be used for spectrometric analysis of materials such as foodstuffs but can also capture images in low light. The sensor is suitable for wearables, digital health, medical imaging, IoT, industrial, and agricultural applications. The company is reported to be in negotiations with smartphone manufacturers for the inclusion of its sensor on next-generation phones.

www.unispectral.com

Untether AI

Toronto

Untether AI was founded in February 2017 and claims to have developed a neural network inference engine based on bus-free near-memory computing and enabled by software capable of pre-placing data. The architecture is said to be scalable from mobile devices to data centers.

www.untether.ai

Upmem SAS

Grenoble, France

Upmem SAS, founded in 2015, develops processor-in-memory chips for use on DRAM modules to improve performance of data-intensive applications in the data center. The technology consists of integrating processing units into the DRAM modules so that the main processor can offload functions to coprocessors sitting close to the data. For some applications, the approach can improve performance by a factor of 10 while yielding lower system-level power consumption.

www.upmem.com

USound GmbH

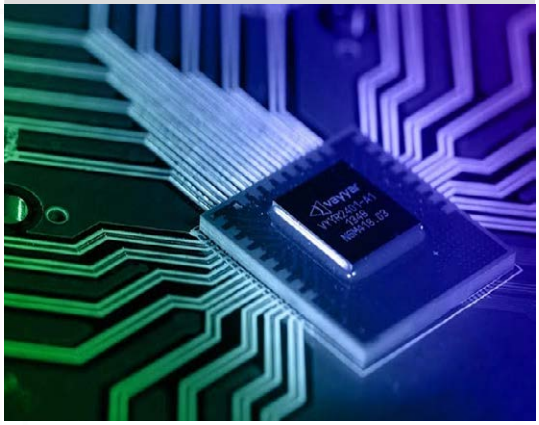
Graz, Austria

USound GmbH is a fabless MEMS company that was founded in 2014 with the mission of producing audio systems based on MEMS piezo-actuators. USound claims that its MEMS speakers exceed the performance of voice coil speakers for in-ear applications. Its products include audio amplifiers, audio codecs, and passive components and may be suitable for smartphones and wireless in-ear systems.

www.usound.com

Vayyar Imaging Ltd.

Tel Aviv



Vayyar Imaging Ltd., founded in 2010, provides a radar-on-chip sensor for applications ranging from breast cancer screening to detecting water leakage to safety monitoring. Vayyar's chip covers imaging and radar bands from 3 GHz to 81 GHz with 72 transmitters and 72 receivers. Enhanced by an integrated DSP with internal memory, Vayyar's sensor executes complex imaging algorithms without the need for an external CPU.

www.vayyar.com

VueReal Inc.

Waterloo, Ontario

VueReal Inc., founded in 2016, makes microLED displays and is developing microLED arrays with resolution densities of up to 30,000 ppi. VueReal will offer two types of microLED displays: one with submicron pixels for AR and VR micro-display applications and another for larger displays with pixels structured and pitched only a couple of microns apart.

www.vuereal.com

Weebit Nano Ltd.

Hod HaSharon

Weebit Nano Ltd., founded in 2014, has an R&D agreement with Rice University (Houston) and has licensed seven patents on the silicon oxide resistive random access memory (ReRAM) technology being researched there by Professor James Tour. The company has moved rapidly down through nodes and is now targeting both CMOS bulk and fully depleted silicon-on-insulator (FD-SOI) manufacturing processes. Weebit's technology is being adopted by at least two Chinese semiconductor manufacturers. The company has also demonstrated a 40-nm 1-Mb memory array.

www.weebit-nano.com

Wiliot Inc.

San Diego

Wiliot Inc., founded in 2017, is a fabless semiconductor company developing passive SoC platforms for the IoT market. The company is aiming at battery-less operation and seamless connectivity as the baseline enabler of IoT growth.

www.wiliot.com

XTX Technology Ltd.

Shenzhen

XTX Technology Ltd., formerly known as Paragon Technology, sells flash memory chips. The company was founded in 2014 and by 2016 had achieved annual sales exceeding $20 million. XTX also provides a system-in-package assembly service.

www.xtxtech.com

Yangtze Memory Technologies Co. Ltd.

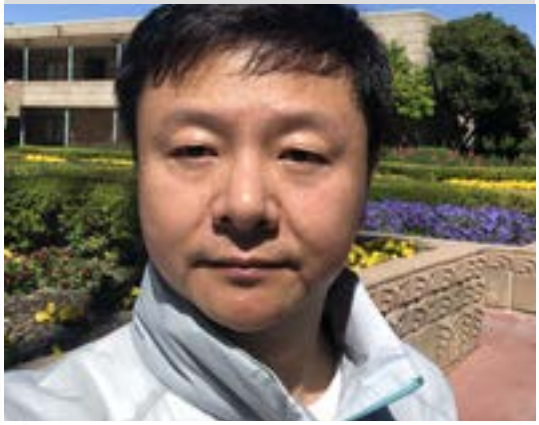
Wuhan, China

Yangtze Memory Technologies Co. Ltd., partly funded by Tsinghua Unigroup, was formed by the takeover of Wuhan Xinxin Semiconductor Manufacturing Corp. (XMC) in July 2016 with a plan to spend $24 billion to establish a memory chip company to rival market leaders Samsung, SK Hynix, Toshiba, and Micron. Yangtze describes itself as the main entity to implement China's national memory base project. YMTC acquired a 100% stake in XMC, a volume producer of NOR flash and image sensors that had broken ground on a wafer fab for the production of 3D NAND flash memory. Simon Yang, previously CEO of XMC, was appointed CEO of YMTC in October 2016. The company had introduced its Xtacking 3D NAND process.

www.ymtc.com

Zhuhai Eeasy Technology Co. Ltd.

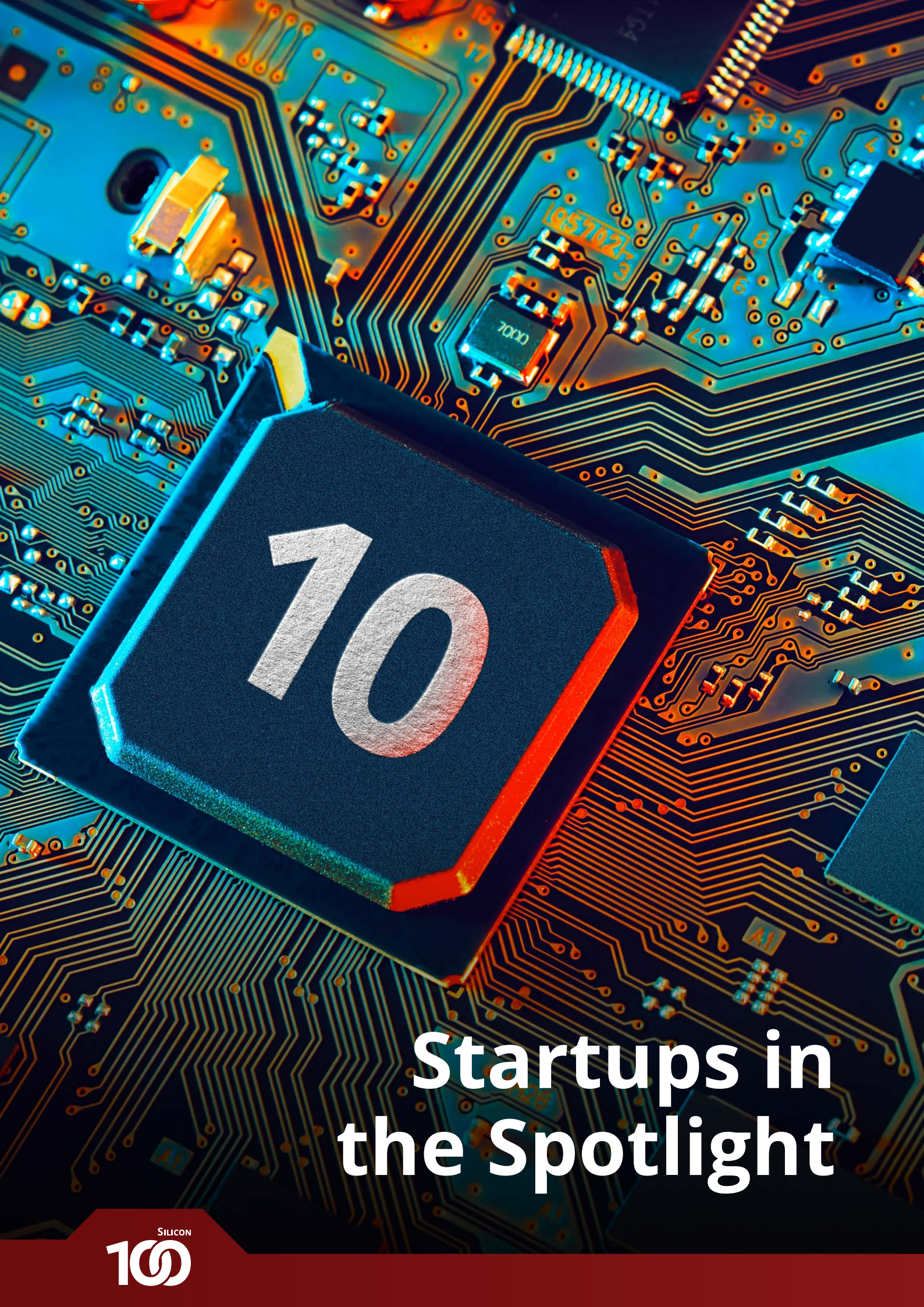
Zhuhai, China



Zhuhai Eeasy Technology Co. Ltd., founded in 2016, focuses on proprietary IP research and development for AI acceleration, high-definition display and audio-visual coding and decoding, and high-speed mixed-signal circuits. Eeasy Tech launched its first test chip in 2017 and has completed a tape-out of its edge AI chip.

www.eeasytech.com

Video interview of Peter Clarke, technology journalist and curator of Silicon 100



Startups in the Spotlight

Silicon 100

Ten Silicon 100 Companies Recommended for Deeper Analysis

By Peter Clarke
Freelance electronics journalist and curator of the Silicon 100

Analog, AI, MEMS, memory, short-range RF, 5G, LiDAR, quantum computing, and displays from around the world, including California, Canada, the U.K., and France.

1. An analog Arm?

Agile Analog Ltd. *(Cambridge, England)*, founded in August 2017, is seeking to change the way analog circuits are designed, with the intention of becoming a leading analog IP company. The company is an inheritor of the legacy of one of the best startups of recent decades: Arm, now part of SoftBank Group. Agile Analog includes Arm alumni at the top of the company and on its board of directors. It claims that it is able to design analog circuits faster than previously possible, to a higher quality, and for implementation in almost any silicon process.

2. Child of FANG

Nuvia Inc. *(Santa Clara, California)* is a potential poster child of the artificial intelligence era. It could also represent a backwash from vertically integrated companies to disaggregated companies because the founders were drawn from prominent positions in hardware teams at Apple and Google. The founding team is so experienced and so well-connected, they surely have a head start in the race to AI success — well, maybe.

Gerard Williams, lead designer of Apple's custom iOS chips from A7 to A12X, left the company in February 2019 to set up Nuvia, and Apple was not happy. Apple filed a lawsuit, alleging that Williams had broken his employment contract while setting up his next company. Nuvia is focused on blending compute performance, power efficiency, and scalability in the data center and is a potential competitor to Graphcore Ltd. (Bristol, England) and SambaNova Systems Inc. (Palo Alto, California). Nuvia announced that it had raised $53 million in its Series A funding round in November 2019.

3. Do it again

UltraSense Systems Inc. *(San Jose, California)* is a MEMS-based company and is one of those likely to succeed because the team is on the carousel for a second time. When TDK Corp. bought InvenSense, a pioneer of integrated inertial measurement sensors, for about $1.3 billion in 2017, one executive did not transfer with the company. That was Mo Maghsoudnia, previously vice president of technology and manufacturing.

Maghsoudnia had an idea for a sensing and human interface technology based on ultrasound, so he formed UltraSound Systems and developed an actuator/sensor that can be attached to the inside surface of an enclosure to create a touch user interface. The MEMS-based technology operates at megahertz frequencies. It sends and receives

pressure-wave signals through about 5 mm of aluminum, glass, or other rigid materials. It can detect strength of tap and avoids the need for cutouts or openings in the enclosure — good for smartphone manufacturers and others. Maghsoudnia has attracted some former InvenSense executives to join him, and they are ready to "do it again."

Interestingly, InvenSense was founded by Steve Nasiri, who grew the company and took it through its initial public offering (IPO) on the New York Stock Exchange. Nasiri subsequently left InvenSense and became a venture capitalist, angel investor, and philanthropist. One of his investments is 2012 startup NextInput Inc. (Mountain View, California), which is pioneering a form of force-sensing technology. A sensing and human-machine interface duel in the making?

4. Quantum unicorn: photons versus electrons

PsiQuantum Corp. *(Palo Alto, California)* hasn't done much yet — except raise $230 million to fund plans to create a photonic quantum-computing platform. But that is reason enough to delve deeper.

The company was founded in the U.K. in 2016 by Jeremy O'Brien, previously a professor of physics and electrical engineering at the University of Bristol and the director for the Centre for Quantum Photonics there, and Terry Rudolph, a professor at Imperial College London.

O'Brien has been pursuing quantum computing from his student days in Australia in the 1990s and throughout a relatively brief but illustrious academic career. PsiQuantum is pressing forward in the belief that photonics-based quantum computing is vastly superior to electronic versions and thus is the way forward.

5. Open for NVM business

Weebit Nano Ltd. *(Hod HaSharon, Israel)* seems to be making progress in the non-volatile memory field, where many have been in development for many years without conspicuous success.

Weebit was founded in 2014, has an R&D agreement with Rice University (Houston), and has licensed seven patents on silicon oxide resistive random access memory (ReRAM) technology. It is just one of numerous startups that have tried to create a solid-state non-volatile memory to outperform and out-scale NAND flash, which struggles to get below 28-nm process nodes.

Weebit Nano, working with French research institute CEA-Leti as a development partner, seems to be making real and rapid progress toward commercialization of its technology. And we know this partly because Weebit is a public company. In 2016, when venture capital firms were reluctant to invest in hardware startups, Weebit engineered a reverse takeover of Australian firm Radar Iron Ltd. to raise funds. Radar Iron was traded on the Australian Stock Exchange, and one of the terms of the deal was that Radar Iron would change its name to Weebit Nano once the takeover was completed.

One consequence is that, as a public company, Weebit Nano is compelled to disclose material developments in R&D and business partnerships. There has been plenty of good news, and there is the prospect that silicon oxide ReRAM could provide a significant alternative to embedded and discrete magnetic RAM.

6. Representing the Grenoble cluster

Aledia SA *(Grenoble, France)* is the longest-serving member of the Silicon 60/Silicon 100, having been on the list since v15. The company was founded in

2011 to capitalize on six years of research at the CEA-Leti research institute in the creation of 3D GaN-on-silicon nanowire LEDs. The company is now using that base to create emissive displays with greater battery life, better outdoor readability, improved image quality, and higher resolution. After seven years at the Minatec campus in central Grenoble, the company has invested €20 million to build a 4,000-square-meter facility in Échirolles, in the Grenoble metropolitan area. The site will support R&D and include advanced manufacturing equipment to launch LED display production.

7. LiDAR dreams

SiLC Technologies Inc. *(Monrovia, California)* has a small chip that could be changing LiDAR but also has applications away from autonomous driving. The company was founded in 2018 and has launched an integrated frequency-modulated continuous-wave (FMCW) LiDAR on a chip designed to operate at a 1,550-nm wavelength.

Many 3D vision solutions use 905-nm-wavelength IR light and time-of-flight detection, and while this has been good for vehicle trials, it is SiLC's contention that eye-safety concerns have restricted their range and that multi-user crosstalk will most likely hamper their widespread usage. If a transition to FMCW at a 1,550-nm wavelength is a must, then SiLC is well positioned to benefit.

8. Not your parents' spark-gap transmitter

Spark Microsystems International Inc. *(Montreal)* has innovative RF technology that could displace incumbents such as Wi-Fi and Bluetooth for some IoT applications. The company was founded in 2016 to develop a specialized low-power, short-range, ultra-wideband (UWB) wireless transceiver aimed at the internet of things. For short-range applications, up to about 100 meters, Spark claims that its UWB transceiver can achieve energy efficiencies of 1 nJ/bit — a factor of 30 below Bluetooth Low Energy — along with megabit-per-second data rates. The system also has low latency, opening up duplex applications, and has great inherent immunity to electromagnetic interference.

9. Upon reflection

Jeeva Wireless Inc. *(Seattle)* is being highlighted for its highly innovative technology. However, bear in mind that customer pull usually beats technology push. Back in 2014, researchers at the University of Washington used RF signals as a power source for relatively long-range communications using a system called ambient backscattering; in the process, they opened up the prospect of battery-less IoT. In 2017, the researchers demonstrated transmission of data across distances of up to 2.8 km. They also started to put effort into a company that had formed in 2015 to commercialize the technology by linking it to Wi-Fi. What about the impact of Wi-Fi 6?

10. Go analog or go home

Syntiant Corp. *(Irvine, California)*, a startup formed in 2017, is developing analog neural networking processors that perform the neural computations in flash memory to remove data movement penalties. This development hits a lot of hot buttons of modern processor thinking, but can the company be the best at executing and going to market?

The startup has received an undisclosed amount of backing from Intel Capital and other venture capital firms. It has an agreement to marry its neural decision processors (NDPs) with the microphone technology of Infineon Technologies AG (Munich, Germany).

Changing the Analog IP Dynamic

Agile Analog
Cambridge, England
Creation: 2017
www.agileanalog.com

Agile Analog automates analog IP development to streamline chipset design.

By Jennifer Baljko

It's been a long time coming, but engineers may breathe easier knowing there's a way around the bottleneck called analog chip design.

Taking a page from well-established models for acquiring and using digital intellectual property (IP) cores, Agile Analog aims to change the slow and manual analog design processes that have remained largely unchanged for the last 60 years. The Cambridge, England, startup — which fashions itself more as a software company than a hardware one — automates the design and delivery of analog IP for microchips and uses its rules-based AI as a standout way to replicate the behavior of real analog engineers.

"Companies like Arm, Imagination, and Synopsys have transformed the digital space to make purchasing IP a really easy process," said Agile Analog CEO Tim Ramsdale. "The fact that you can lay out blocks automatically means you can pick any silicon process and you're good. On the analog side, it doesn't work that way. What we were finding as we spoke to customers was that they all have common challenges. They couldn't find the [analog] IP they wanted. They would find IP with features they didn't need or IP that had been engineered for other customers, and it was never on the right silicon process."

Agile Analog CEO Tim Ramsdale, non-executive director Sir Hossein Yassaie, and chairman Pete Hutton use their longtime industry experience to change the way analog IP is delivered.
(Image: Agile Analog)

Agile Analog was founded in 2017 out of this "frustration with the quality and availability of analog IP in the market," Rams-

dale added. "I realized what we needed to do was to automate the development of analog IP."

That vision led to creating programmatic, systematic, and repeatable processes and developing more verifiable and reliable analog IP products — such as computer-generated, configurable analog-to-digital (ADC) and digital-to-analog (DAC) data converters — that reduce the time engineers spend on this part of the chip design.

Agile Analog's executive team and board members are longtime industry veterans hailing from Arc, Arm, Broadcom, Cadence, Imagination, and Wolfson, and their collective experience is steeped in analog, digital, EDA, mixed-signal SoC, RF, and application processor product development. The company currently has 28 employees and has raised $8 million to date in what Ramsdale called a Pre-A funding round, attracting Delin Ventures, firstminute Capital, and MMC Ventures as its primary investors. While Ramsdale declined to disclose annual revenue numbers, he said that 2020 is expected to be a strong year for the startup based on its order bookings.

One customer that has signed on is Palma Ceia SemiDesign, a provider of communication chips and IP for Wi-Fi HaLow and cellular NB-IoT applications. In a deal announced in May 2020, Palm Ceia will use Agile Analog's data converter and power management IP for its next-generation Wi-Fi and cellular IoT products.

For now, Agile Analog sees the internet of things and consumer electronics as its sweet spots. But increasing demand for electronic components in the the automotive, enterprise, health-care, industrial automation, and smart-home digital-assistant markets presents other near-term opportunities.

"There's more analog design to be done in the world than there are analog designers. That's the niche we're trying to fill in the market: [to] provide the analog IP you need in your SoC," said Ramsdale, acknowledging that while many companies will still assign their highest-performance designs to their in-house engineering team, other analog gaps will exist. "There's no real benefit to doing everything in-house. What we're trying to do is to relieve the pressure on all of that other stuff that people need to make their products work." ■

Jennifer Baljko *is a contributing writer for EE Times.*

Nuvia: Reimagining Silicon Design for the Data Center

By Jeff Dorsch

Nuvia Inc.
Santa Clara, California
Creation: 2019
www.nuviainc.com

Nuvia is all about a new approach to silicon design.

The growing, well-funded startup is based in Santa Clara, California, a prime locale in Silicon Valley, not far from Intel's headquarters. The company was founded in 2019. Before the end of last year, Nuvia received $53 million in Series A funding from Capricorn Investment Group, Dell Technologies Capital, the Mayfield Fund, and WRVI Capital, with participation by Nepenthe LLC.

The company used the money to expand its workforce, opening an office in Austin, Texas, and another in Toronto. While Crunchbase estimates Nuvia's employee count at 51 to 100, the actual headcount is about 150 and increasing, according to the company. There are dozens of job listings on the company's website.

The startup's three founders have working backgrounds at Apple and Google, along with Advanced Micro Devices, Arm, Broadcom, and other companies. The trio consists of Gerard Williams III, CEO; Manu Gulati, senior vice president of silicon engineering; and John Bruno, senior vice president of system engineering.

Jon Carvill *(Image: Nuvia Inc.)*

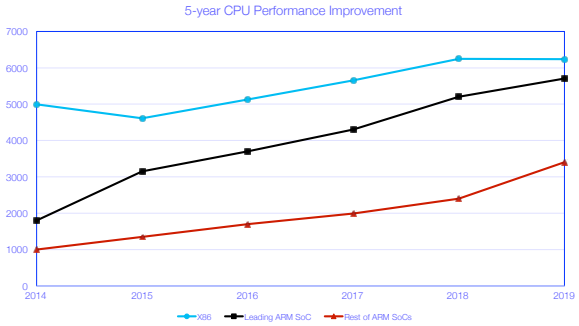
Jon Carvill joined Nuvia late last year as vice president of marketing. He previously worked at Intel, where he was vice president of technology leadership marketing.

Nuvia is developing a custom instruction-set architecture for hyperscale data centers. While Nuvia has yet to introduce its product, the company has given some general guidance on what it is up to.

"Our focus is really on reimagining the way silicon is built for the data center," Carvill said. "We're building a server-class SoC from the ground up with the architecture to serve the needs of that market and to deliver an experience that is going to be, when it's a chip, best-in-class for performance, energy efficiency, and total cost of ownership.

"That's kind of where we are right now in our existence — doing well and weathering things pretty well during the pandemic. It certainly helps when you're working remotely. We don't have working silicon back from the fab yet. We haven't settled on a foundry yet."

Paradigm Shift in CPU Performance Leadership



The CPU performance for Leading Arm SoC for 2019 is projected as a moving average of its past years' performance. *(Image: Nuvia Inc.)*

In addition to the existing offices, Nuvia is hiring people to work remotely from the United Kingdom and different parts of the U.S., according to Carvill.

Like most startups, Nuvia faces a number of challenges, even with significant financial support.

"Our No. 1 priority is hiring," Carvill said. "We have set a very high bar for the caliber of talent we want at Nuvia. You have to go out there pretty aggressively to pursue those people, because most of [them] are not submitting job applications. They're coming in from people we've known, or we've worked with in the past, that we have to really target, [with] the proposition that Nuvia would be a great fit for them. Hiring is definitely top of mind for us. Beyond that, these other challenges go to the point of putting the infrastructure in place so as to make the company capable of offering options to the best of our abilities. We are a startup, but we also want to have resources; we want to have things like benefit packages and otherwise that still put us in a very strong place."

Carvill, who is in charge of recruiting in addition to marketing and other responsibilities, described the difficulties of growing the company during a pandemic. "During the Covid-19 period, there are also challenges just with onboarding, because we're onboarding people while we can't actually meet them first," he said. The ability to get people to integrate with their team, to do some initial team building, presents two challenges in a virtual world.

"The only other challenge on that was, as you move all your systems to virtual, you want to make sure you're not doing too much to disrupt your development environment, because you don't have the ability to have a ton of people in the office to really make changes as needed, so you want to make sure that development environment is stable. That's more of a Covid situation, and we've done that, so those are probably the challenges; for the company overall, it's hiring and expansion, getting new offices open, and really putting ourselves in the position that we can bring on all the talent we need to meet our technology milestones and roadmap. That's priority one for us."

Carvill continued: "With silicon design, it may be 10 or 12 people that do a particular function globally; you're looking for a very precise function. And that's not always easy to find! You really have to do pretty aggressive search and analysis to find those people, to reach out and engage them, and to get them to want to look at a change, because generally, those people are also fairly well-adapted by their current employers. I'm proud of the work we've done there, but there's still a lot more for us to do." ■

Jeff Dorsch *is a veteran editor who has covered Silicon Valley for a variety of industry publications.*

Ultrasound Sensor Turns Any Surface Into a Touch Button

UltraSense Systems Inc.
San Jose, California
Creation: 2017
www.ultrasensesys.com

By Anne-Françoise Pelé

What if any surface — home door, car dashboard, oven glass — could be turned into a user interface? Mechanical buttons would disappear and electronic devices would be waterproof. That's the ambition of UltraSense Systems (San Jose, California), a newly formed company whose ultrasound sensor technology aims to create new touch experiences in the internet of things era.

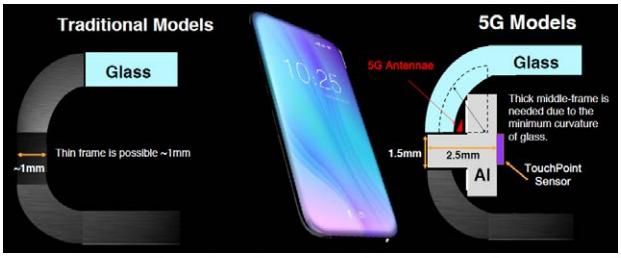
UltraSense introduced what it claims is the smallest ultrasound sensor-on-chip for touch and gestures through any material and any material thickness. Dubbed TouchPoint and TouchPoint Z, its initial products are sampling now and are expected to be incorporated into several consumer and industrial devices in 2020.

Removing mechanical buttons

UltraSense brings together former InvenSense executives: Mo Maghsoudnia, a co-founder and the CEO of the new company, and Dan Goehl, chief business officer, worked together for about six years at InvenSense and saw that company rise to IPO. At the time, Maghsoudnia was vice president of technology and worldwide manufacturing, while Goehl was vice president of worldwide sales.

When TDK Corp. completed the acquisition of InvenSense for $1.3 billion in May 2017, Goehl stayed for another 15 months. Maghsoudnia, however, left to pursue ultrasound in medical. "He found that it would take a while to take off and came up with the idea of using ultrasound as a touch user interface," Goehl told EE Times. "That really was the genesis of UltraSense."

Created in April 2018, UltraSense is now emerging from stealth mode. And because the smartphone market is a high-growth market, it has made mobile handsets its primary focus. "Adoption is relatively quick, and we are hitting the market at the right time with the launch of 5G technology, in particular millimeter-wave 5G," said Goehl.



(Image: UltraSense Systems Inc.)

As part of the process, the entrepreneurs went through their list of contacts, leveraged their network, and started pitching their concept. "All phone makers were receptive, but they said the first thing they want to do is replace the mechanical buttons," said Goehl. It's a request that makes even

more sense with the advent of 5G, he added: "For millimeter-wave 5G technology, the industrial design of the phone is going to have to change because there are going to be 24 antennas in the phone just for 5G." And those antennas will have to be able to work under glass and metal.

Sensing through all materials

A shift has recently occurred in the way that users interact with their smartphones, smart home appliances, and other devices that have penetrated their daily lives. Digital has been replacing mechanical, and the move to virtual buttons and surface gestures is accelerating.

Immune to sensing through moisture, dirt, oils, and lotions, UltraSense's sensor is claimed to enable touch sensing through any material and any material thickness, including metal, glass, wood, ceramic, and plastic.

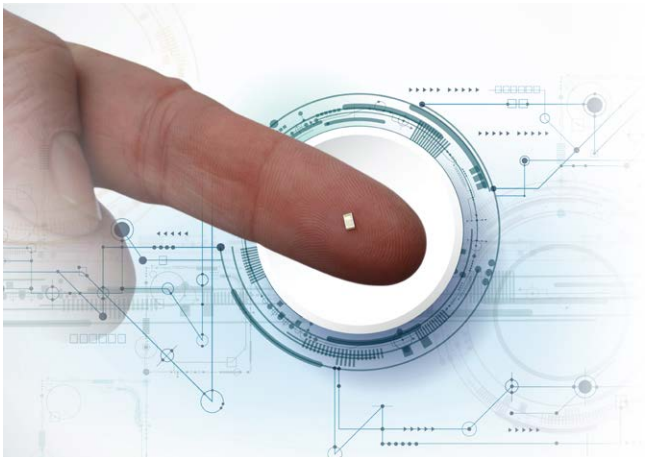
Asked about any physical barriers, Goehl said the limit would be air and power. "We have designed our first products to be power-efficient. We focus on the mobile environment, and we can go through 5 mm of aluminum, 5 mm of glass, or 2 mm of stainless steel, the densest metal. Theoretically, with what we have and some other products coming up next year, power is not an issue. We can go through 20 mm of solid aluminum without any issue."

Moving to the ultrasound technology itself, Goehl said: "We are transmitting an ultrasound beam through the material, and we are looking for a change in acoustic impedance at the surface. As it reflects back into the sensor, we can see and interpret it as a medium or a heavy touch."

With a light touch, he explained, "there is still air within the ridges of your fingerprints, but as you press harder, the ridges of your fingerprint deform against the surface material, and the air goes away. The harder we press, the more contrast we see."

What if users carry their smartphone in their pocket? Could they trigger the sensor by accident? There is little risk, Goehl said, because "we are able to understand the input material and reject that." In the case of a fabric, "we designed our ultrasound signal to dissipate in air, so when the phone is in your pocket, and it is rubbing against the cloth material, we can reject that pattern."

Sampling now



(Image: UltraSense Systems Inc.)

No bigger than the tip of a pen (1.4 × 2.4 × 0.49 mm in an optical LGA package), UltraSense's TouchPoint is described as the smallest ultrasound sensor-on-chip. Consuming less than 20 µA of power in always-on mode, it can operate independently of a product's host processor, with all the algorithm processing embedded in the sensor. It can be used as a standalone power button for wake-on-touch sensing, by powering on the entire product with a simple touch, and as a multi-functional user interface using a series of taps, holds, and swipes.

Basically, the sensor-on-chip is composed of an ASIC and a microelectromechanical system (MEMS) transducer. The ASIC, Goehl specified, includes the

microcontroller, low-dropout regulator, memory, and analog front end. The MEMS transducer is a piezoelectric micromachined transducer (PMUT). "The recipe to do it is ours, but we can use both GlobalFoundries and TSMC to fabricate the transducer and the whole sensor-on-chip," Goehl said.

Dan Goehl, UltraSense

(Image: UltraSense Systems Inc.)

Sampling now, the TouchPoint sensor-on-chip is ready for mass production. "We have several design wins going on today where phone makers have designed phones around our products to prove out the concept," said Goehl. "We see some of those going into production in the second half of 2020."

Executing on plans

Looking two to three years ahead, Goehl said he sees strong traction in selling not just a sensor but a multi-functional user interface to go along with it. Starting in the mobile and consumer space, UltraSense sees prospects in the automotive sphere with "a lot of proofs of concept going on with several automotive suppliers for various types of applications."

In automotive, other avenues could be pursued and synergies found between UltraSense's technology and other touch interfaces, including haptic-enabled touch interface systems, he said. For instance, "we can work with other materials and provide larger touch areas."

UltraSense is not entering virgin territory. A handful of companies such as strain-gauge sensor supplier Sentons and force-touch sensor supplier New Degree Technology have been around for several years, "but our technology is very different," said Goehl. Whereas strain-gauge, force-touch, and surface-acoustic-wave solutions have industrial and mechanical design restrictions (e.g., material thickness, integration complexity, and production calibration time), UltraSense claims that its TouchPoint solutions provide for minimal integration effort and mere seconds of production calibration. "The nice thing is the market is ripe today," said Goehl. "Maybe a couple of years ago, it wasn't the right time."

Today, UltraSense employs just over 20 people, but Goehl said it is in hiring mode. "We will be ramping up production next year and in 2021, and we have some great vision for our product roadmap. We need engineers to be able to execute on our plans." ■

Anne-Françoise Pelé
is editor-in-chief
of eetimes.eu.

PsiQuantum Hiring All-Hands-on-Deck Team to Build the First Useful Quantum Computer

By Jeff Dorsch

PsiQuantum, which is developing a quantum computer, grabbed headlines in April when it announced $215 million in Series C funding, bringing its total private funding to $508.5 million over four rounds.

PsiQuantum Corp.
Palo Alto, California
Creation: 2016
www.psiquantum.com

The startup was founded in 2016 by Jeremy O'Brien and Peter Shadbolt. O'Brien, PsiQuantum's CEO, is a professor at the U.K.'s University of Bristol. Shadbolt, the company's chief strategy officer, holds a postdoctoral position at the Centre for Controlled Quantum Dynamics at Imperial College London.

Among PsiQuantum's investors are Atomico, Baillie Gifford, BlackRock, Founders Fund, Horsley Bridge Partners, M12, Pitango Venture Capital, Quantum1 Group, and Redpoint Ventures.

Many companies, big and small, are developing quantum computing technology. Google, Honeywell, Intel, and IBM are among the tech behemoths pursuing the field. On the smaller side are Rigetti Quantum Computing, D-Wave Systems, IonQ, QC Ware, Cambridge Quantum Computing, Atom Computing, IQM, and Riverlane.

Jeremy O'Brien, PsiQuantum CEO *(Image: PsiQuantum Corp.)*

On its website, PsiQuantum says that it is making "the first useful quantum computer," but there's not much more information. The company is hiring; it's looking for systems architects, programmers, application engineers, quantum physicists, photonics experts, and engineers in semiconductors, systems, and software. It is working on quantum bits (qubits) made with silicon photonics that could be produced in a regular wafer fabrication facility. The goal is a general-purpose quantum computer.

O'Brien published a paper of using photons to make qubits. He set a goal of producing 1 million qubits to achieve the scale needed for his startup's quantum computer.

Robert Niffenegger, a research scientist at MIT's Lincoln Labo-

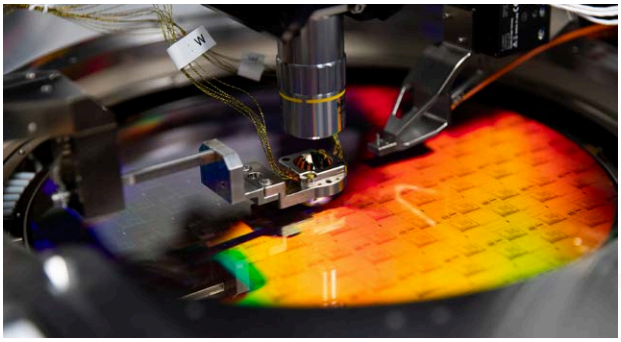
A stack of silicon wafers in a test stand at PsiQuantum's facility *(Image: PsiQuantum Corp.)*

ratory, said of PsiQuantum's concept, "By setting a goal of a million qubits, they emphasize that scale and integration are the only path forward and flaunt the fact that existing nano-photonics based on CMOS fabrication technologies is able to fabricate thousands of optical components on a single chip. However, even if they had very high-performance photonics on a single photonic chip the size of a wafer, that would at best get you maybe thousands of qubits."

What kinds of challenges has PsiQuantum faced, and how did it overcome those issues?

"We have long said that there are a million ways to make a qubit but only one way to make a million qubits," said Shadbolt. "Conventional wisdom has historically been that a quantum computer cannot be built using photonics, because photons do not interact. Prior to the existence of the company, none of the architectures proposed to overcome this lack of interaction were truly practical. Historically, some people have been motivated to think that error correction might not be required and they could perhaps build a quantum computer with only a few hundred noisy qubits."

PsiQuantum has "remained singularly focused on developing a useful quantum computer, which means focusing on building a million-qubit, fault-tolerant system," he added. "During this time, the scientific consensus has moved in our favor. No applications have yet been discovered that give a useful speedup without error correction, and many groups are starting to believe that error correction (and, therefore, a million qubits) is, in fact, required for useful applications. Many quantum computing projects have struggled to escape from lab environments due to a need for exotic materials, nonstandard manufacturing processes, or extreme operating environments. Thanks to the unique manufacturability of the photonic approach, we have been able to graduate to a 300-millimeter process in a Tier One semiconductor fab."



A closeup image of PsiQuantum chips on a silicon wafer *(Image: PsiQuantum Corp.)*

The startup sees "huge potential for quantum computing to be a world-changing technology that will address humanity's most pressing challenges," he added. "We will address meaningful problems that no supercomputer can. This includes drug discovery; uncovering new catalysts to scrub CO_2 from the atmosphere; designing new materials for the energy, aerospace, construction, and other high-tech industries; and enabling advances in genomics, communications, finance, agriculture, and more.

"As a result, we believe there will be an enormous market for a large-scale, error-corrected, useful quantum computer and the computational advances it will unlock." ■

Optimistic Weebit Nano Closer to ReRAM Commercialization

Focus remains on embedded market as discrete ReRAM efforts ramp up.

By Gary Hilson

Weebit Nano Ltd.
Hod HaSharon, Israel
Creation: 2014
www.weebit-nano.com

Weebit Nano is one of just a handful of emerging memory companies making some headway in the non-volatile memory field, where others are stuck in development.

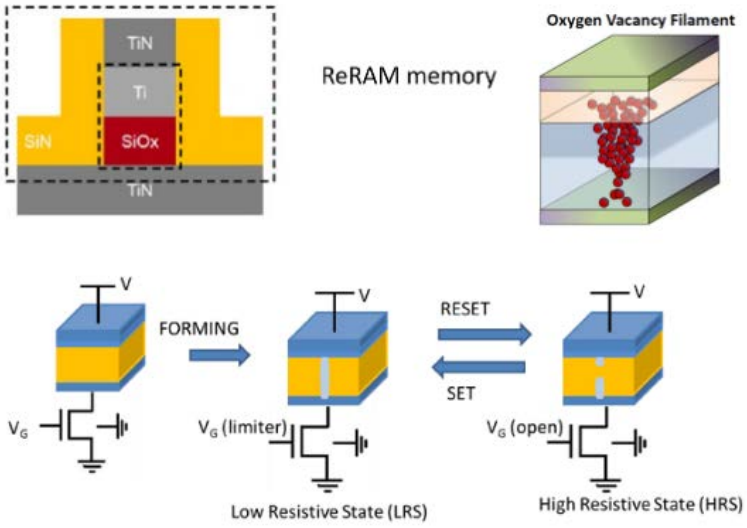
The Israeli company is getting closer to commercializing resistive random-access memory (ReRAM). One factor in its favor is that ReRAM can be manufactured using existing manufacturing methods. The company is also traded on the Australian Stock Exchange, and keeping investors happy is arguably a good motivator for any company to hit its mile stones.

CEO Coby Hanoch, who took the reins after the company had already begun trading, said that there's a benefit to being a public company with a board of directors — "luminaries" who guide the company forward. The most critical differentiator for Weebit Nano, however, is that its ReRAM is silicon oxide (SiOx)-based and doesn't require novel materials. That appeals to potential customers and partners, he said, and "really enables us to move much faster than our competitors."

Until the Covid-19 pandemic struck, Weebit Nano was on track to deliver its SiOx-based ReRAM memory modules for a South Korean company before the end of 2020. Hanoch said that temporary fab closures due to the coronavirus might delay some company activities for a few months, though "in general, we're continuing to make very good progress." In a recent business milestone, Weebit Nano signed a letter of intent with SiEn Integrated Circuits to deploy SiOx ReRAM technology in the Chinese company's semiconductor products.

On the technology front, last year, Weebit Nano confirmed test results in collaboration with French research institute Leti, showing that it's possible to produce its ReRAM technology as an embedded memory using two, or possibly only one, additional mask. That's an improvement over the seven to 10 additional masks normally needed by flash memory, making ReRAM a viable replacement for NOR. The company also attained external verification from memory chip manufacturer XTX Technology in China four months ahead of schedule.

That verification is a key driver for what was probably the company's biggest news in 2019. Weebit



Weebit's ReRAM cell consists of two metal layers with a silicon oxide layer between them, comprised of materials that can be used in existing production lines. *(Image: Weebit Nano Ltd.)*

Nano's strategy had been to establish itself in the embedded market first to generate revenue before ramping up efforts on discrete ReRAM, said Hanoch. But it closed out the year by announcing that it would accelerate its program to develop discrete ReRAM memory technology in response to interest from customers, including XTX.

A critical enabler of the discrete memory program is the company's ongoing collaboration with Leti, which will play a key role in developing the necessary selector. For embedded devices, a transistor is sufficient, he said, because although it's large, the size of the memory array is less important. But a discrete ReRAM device requires a selector to isolate the memory cells so that only the specific cells that should be modified are changed and all the other cells are disconnected and not affected. A selector is not something that can be created quickly, Hanoch said, but because Leti has already had one in development for the past five years to fulfill a variety of purposes, that collaboration will save Weebit Nano time and lower its risk.

Longer term, the company still sees opportunity for its ReRAM technology to support neuromorphic computing. Currently, research institutes are permitted to use Weebit Nano's ReRAM for their research, said Hanoch.

In the meantime, the embedded market remains the company's main focus. "The shortest path to revenue for us is the embedded market," Hanoch said. "We're really putting the emphasis there so that we can get revenues, because especially as a public company, everyone's waiting to see that."

Aside from the pandemic, getting an initial memory module out the door to realize revenue is a key challenge, followed by integrating a selector with its ReRAM module. "We need to show them working together," he said. "As soon as we do that, we'll be in a much stronger position in terms of our confidence in this technology." ■

Gary Hilson *is a general contributing editor with a focus on memory and flash technologies for EE Times.*

Related articles

Weebit Nano Ramps Up Discrete ReRAM Development
Is ReRAM Ready to Leave the R&D Phase?
Are Emerging Memories Finally Emerging?
Researchers Explore Emerging Memories for AI

FMCW LiDAR Chips Take Machine Vision to 4D and Beyond

By Jeff Dorsch

SiLC Technologies Inc.
Monrovia, California
Creation: 2018
www.silc.com

SiLC Technologies is developing light detection and ranging (LiDAR) chips for autonomous vehicles, biometrics and security, and industrial systems and robotics. The Monrovia, California-based silicon photonics startup touts its product as the 4D+ Vision Chip.

"We're taking machine vision beyond 3D," said Ralf J. Muenster, the company's vice president of business development and marketing. The veteran Texas Instruments executive joined SiLC last year and works out of the startup's new office in Silicon Valley.

Ralf J. Muenster
(Image: SiLC Technologies Inc.)

"We are different from other LiDAR companies," he added. "We are more of a semiconductor company."

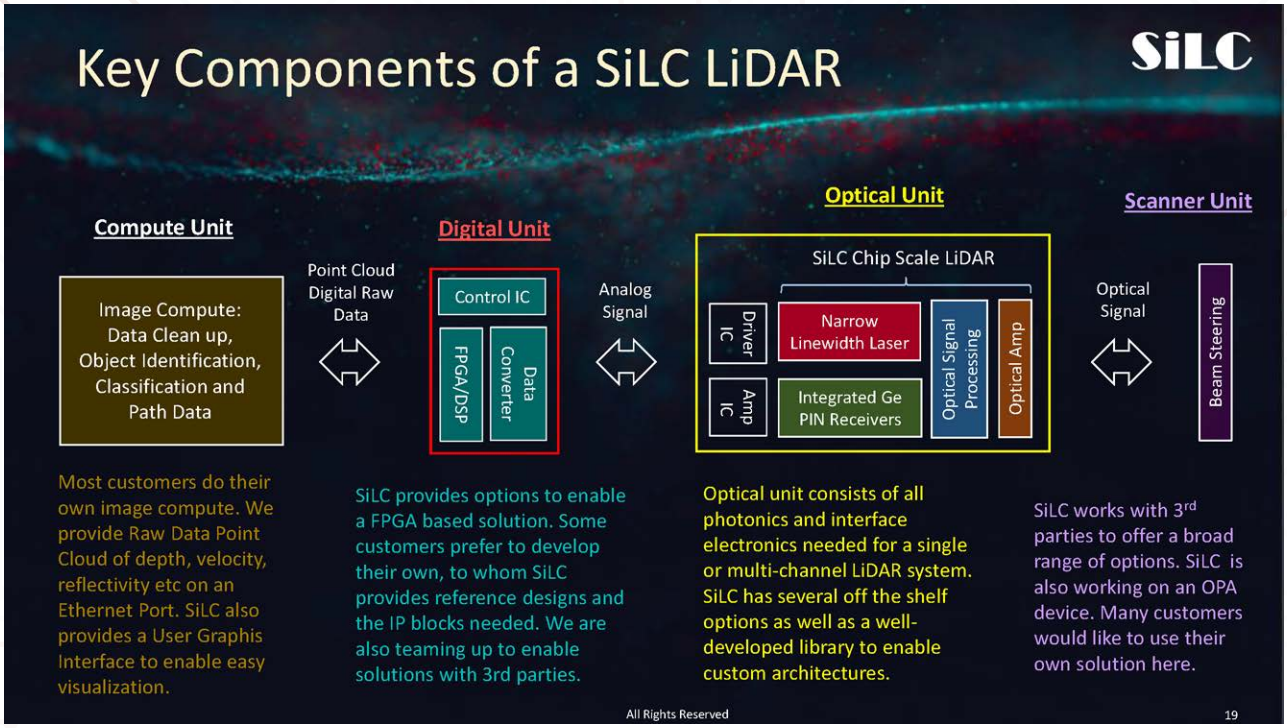
While SiLC was founded two years ago, "the technology goes back to the 1990s," Muenster said. Its founders were involved in Bookham Technology and in LightCross Inc. LightCross was acquired by Kotura, which was bought in 2013 by Mellanox Technologies; Nvidia recently purchased Mellanox for $7 billion. SiLC this year raised $12 million in seed funding from Dell Technologies Capital, which led the round, with participation by Decent Capital, ITIC Ventures, and angel investors.

The founders — Mehdi Asghari, president and CEO; Jonathan Luff, vice president of research and development; and Wayne White, vice president of fab operations — all have extensive business and technology experience. Asked about challenges that the startup faced, one was getting to the point where the founders no longer had commitments to other companies where they worked, according to Muenster.

While most LiDAR chip suppliers offer time-of-flight sensors to help vehicles and other applications "see" their surroundings, SiLC chose frequency-modulated continuous-wave (FMCW) technology, which it says provides more detailed and granular images of its operating environment.

Mehdi Asghari
(Image: SiLC Technologies Inc.)

SiLC's FMCW LiDAR chips are fabricated in Japan with an undisclosed partner. The process is owned by SiLC and exclusive to SiLC. The chips represent third-generation technology for the start-



(Image: SiLC Technologies Inc.)

up's founders. The IC has silicon germanium photodetectors and edge-emitting lasers. The FMCW technology enables longer-range scanning, Muenster said, adding that other LiDAR vendors use spinning lasers, microelectromechanical system (MEMS) mirrors, and optical phase arrays.

Muenster explained how the FMCW tech works: "What we do is chirp a low-power, continuous-wave beam laser. You chirp the frequency of the outgoing signal, and the returning signal is then offset by a frequency versus the outgoing light, just because you have a time delay. And that frequency offset is directly proportionate to range.

"Now, if you have a radio-velocity component of that object, you get a Doppler shift — you get another frequency shift here. So you get an aggregate range and velocity frequency shift. As a result, you chirp up or chirp down [and] get two integrations of unknowns right away: distance and velocity."

Realizing FMCW requires "a chirp-able laser," said Muenster. "It's not truly a tunable laser. A tunable laser would be over a wide range of wavelength. [With] chirp-able, you're tuning 0.8 nanometers, for example. So you're chirping the laser, and it's important that it's very linear."

The laser also needs to have a long coherence length, which is "inversely proportionate to the linewidth of the laser," he said. That's because "we're sending out coherent photons, and when they come back on the receiver, they still need to be coherent to the outgoing light, because what we're going to do is take a portion of the outgoing light and mix it together with the returning photons. Since they're both coherent to each other, they start mixing constructively.

"Basically, you get a mixing treatment. There's a shot-noise limit. You get a very unique analog feature here, because only coherent photons will mix, so any DC background light would mix; it's nearly

impossible to make two lasers that are not the same cavity-coherent. So any other LiDAR would be literally blocked out."

With discrete FMCW, the cost is very high, according to Muenster. SiLC brings down the cost with integration.

The startup went to CES 2020 in January with Varroc Lighting Systems, having integrated SiLC single-chip LiDAR with Varroc automotive headlights for demonstrations at the show. That exhibition was the first large trade show of the year and might have been the last; other events on the industry calendar have gone all-virtual in response to the coronavirus pandemic.

In addition to automotive electronics, the 4D+ Vision Chip can be used in augmented/virtual reality, gaming, cobots, and security/surveillance cameras, according to Muenster. The technology also applies to access control for facilities, wind farms, face detection, warehouse robots, palletization, and metrology.

"Machine vision is critical to robotics," he said. "The future of vision is 4D." ■

Spark Microsystems Brings Next-Gen, 'No Compromise' Wireless to Designers

By Jeff Dorsch

SPARK Microsystems International Inc.
Montreal
Creation: 2016
www.sparkmicro.com

"Wireless without compromise" is the motto of Montreal-based Spark Microsystems International, a purveyor of ultra-wideband (UWB) radio chips for short-range data transmissions.

The startup was established in 2016. A year later, the Canadian government invested almost $1.4 million in the company, a developer of ultra-low-power wireless transceivers, touted for their environmentally friendly technology. The Canadian government later added $800,000 through its Sustainable Development Technology Canada foundation.

CEO Fares Mubarak joined the fabless semiconductor company as an adviser in 2017 and was named CEO in 2018. He succeeded co-founder Frederic Nabki as CEO; Nabki remains with the startup as chief technology officer. The other co-founder is Dominic Deslandes, chief science officer.

Fares Mubarak
(Image: SPARK Microsystems International Inc.)

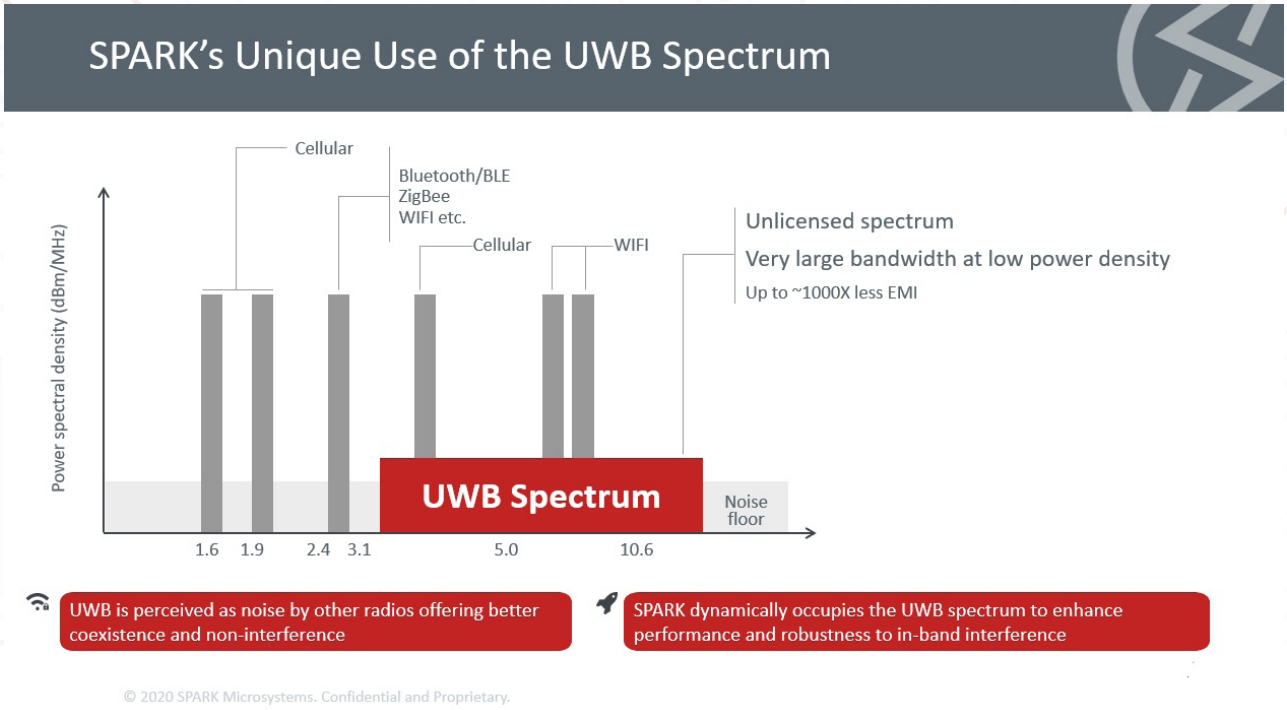
Mubarak has held senior leadership positions at ANSYS, TeleResults (a health-care IT company), and Actel. He has also worked at Advanced Micro Devices and Samsung Semiconductor.

Spark Microsystems was in the Silicon 60 Class of 2018. Soon after that honor, the company won the Nokia Open Innovation Challenge, which came with a $100,000 grant.

The company's initial products are the SR1010 and SR1020 UWB wireless transceivers. The first members of the Spark SR1000 line, the chips are said to be capable of data transmission rates up to 10 Mb/s.

"Spark is in the short-range wireless transmission business," Mubarak said. "We have a chip that gives you up to a hundred meters' line of sight for short-range communication. It's ultra-low-power, ultra-low-latency, and much higher-performance than what currently is available.

"How do I quantify that? If I compare that with Bluetooth, and in particular with Bluetooth Low Energy, we are up to 40× lower power than Bluetooth Low Energy, up to 60× lower latency, and we are 10× higher bandwidth. We can transmit and receive a thousand bits in about 50 microseconds.



(Image: SPARK Microsystems International Inc.)

Our over-the-air data rate is 20 megabits per second. So we're looking in the camp here of Bluetooth, Zigbee, and Z-Wave. We're already faster than Bluetooth and much, much faster than LoRa, Zigbee, and everything else. We're not talking about Wi-Fi here. Our claim to fame is power, latency, and data rate."

He added: "We are not in narrowband radio; we are ultra-wideband radio. So instead of being built based on a carrier frequency, like most radios out there, you have a carrier, you have a rather precise clock, and then you transmit over the carrier. We transmit in impulses, so there is no setup; the radio is on for a short period. Now, being in the ultra-wideband spectrum, which is a regulated, unlicensed spectrum, between 3.1 GHz and 7.6 GHz, we can dynamically use the entire spectrum. Ultra-wideband, by nature of this regulatory status, has orders of magnitude lower electromagnetic interference than other narrowband radios, probably 100× lower than Bluetooth and 1,000× lower than Wi-Fi. Ultra-wideband is very precise, because we can do time-of-flight positioning instead of signal strength like Bluetooth and other narrowband radios do it. And because we dynamically balance the spectrum, we can really navigate around other signals, so we are very good for coexistence with other signals. We can dynamically shift frequencies from packet to packet."

When it was getting its seed funding, Spark employed 10 people. Its headcount is now up to 32 full-time employees, plus interns, according to Mubarak.

"We have fully functional silicon," he added. The company works with the shuttles of Taiwan Semiconductor Manufacturing to fabricate its chips.

While the startup has had modest funding, it has kept costs low, having started in incubator organizations, Mubarak said. "Hiring has been relatively good for us. We've been hiring mostly in the Montreal area, which has a superb amount of talent that we could get. Our two co-founders, Fred and Dominic, are professors at the local university. A lot

of the students and graduate students have done enough research, have been involved in the technology, and we've been able to get them involved and hired the best of the best when they came into the industry. We've been growing in a fairly smooth way without too many headaches in hiring."

The coronavirus pandemic has brought changes to the business, of course.

"We can safely assume that our customers are going to slow down and that investors and VCs are going to be reluctant to spend more money on new portfolio companies," Mubarak said. "We looked at our cash flow, and we really sharpened our pencils and focused ourselves to selling what we have today, to doing the development in order to sell what we have today, and making sure our cash flow lasts us well past the initial stage so we can be in a good cash position to recover from this pandemic." ■

Ubiquitous Battery-Free Wireless Connectivity Serves the Internet of Everything

By Jeff Dorsch

Jeeva Wireless Inc.
Seattle, Washington
Creation: 2014
www.jeevawireless.com

Seattle-based Jeeva Wireless has a "Bright" CEO and two University of Washington (UW) professors among its co-founders.

The semiconductor startup specializes in wireless connectivity. It offers a low-power platform utilizing 860-MHz to 960-MHz long-range protocols, such as IEEE 802.15.4g. The platform comprises the Jeeva Companion, Jeeva Endpoint, and Jeeva Gateway. The company is readying a passive backscatter modem ASIC that will be part of Jeeva Endpoint; the chip will be fabricated by X-Fab.

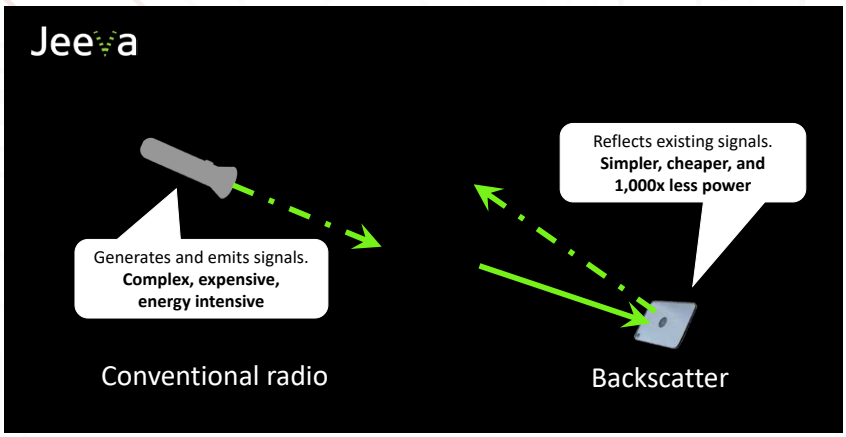
Jeeva Wireless was founded in 2015 and raised just over $1.2 million in seed funding in early 2017, followed by another seed round totaling $3 million one year later. The company also received two Small Business Innovation Research grants, totaling $1.8 million, from the National Science Foundation.

Scott Bright *(Image: Jeeva Wireless)*

CEO Scott Bright, who joined the company last year, is leading the commercialization of the company's connectivity technology. The five co-founders all have connections to UW, where the technology was originally developed. Joshua Smith, chairman of the board, and Shyam Gollakota, president, both hold doctorates from the Massachusetts Institute of Technology (MIT) and are UW professors. Vamsi Talla, chief technology officer, and Aaron Parks, vice president of product, got their doctoral degrees from UW. The fifth co-founder is Bryce Kellogg, director of engineering, who has bachelor's and master's degrees in engineering from UW.

The backscatter technology is "the primary focus" of Jeeva, Bright said. Its energy-harvesting technology is crucial to what the company calls "ubiquitous battery-free wireless connectivity" serving the "internet of everything."

Bright said, "We're a small shop; we're a dozen engineers. We'll probably be opening a new round sometime next year." He added, "It's an exciting time for the company. We've been a long time in



(Image: Jeeva Wireless)

the making, and we're just now on the cusp of being ready to commercialize the technologies. My background is product development. I've been a design engineer, EE, and done a lot of products in medical, consumer, [and the] industrial space. I'm excited about the potential for this technology. But we need to figure out what product it enables."

Bright said that the company has developed intellectual property as it nears the day when the rubber will meet the road for its technology. "One of the things that I often run into is the need to differentiate between what Jeeva is doing with backscatter, which can be easily confused with energy harvesting," he said. "They're two different things. In one case, you're receiving, rectifying, storing RF energy in order to power some sort of transducer, or to power a transmitter of some sort. While we do have some IP in that area, and we do some work in that space, we're primarily focused on backscatter, which is in essence reflecting an RF signal and chopping up that reflection so it looks like a standard pack of data protocol. And that's done in real time. There's no storing of the energy necessary. It's a very, very low-power way to move data from an endpoint, a sensor interface, to a conventional standard radio.

"What's necessary to do that is this introduction of a new element to the topology, a device we call the Companion. Companion is the source of that RF energy. It sends out a continuous wave, a constant tone at a single frequency. We use that energy at the remote sensor endpoint to backscatter the data from the sensor. So we're not generating an RF signal local to the sensor; we're scattering the signal that comes from somewhere else. That's the key difference."

The result is that "we're lowering the power requirement," he said. "We're sending that data from the sensor very dramatically — about a thousandfold below the power requirement for even a Bluetooth Low Energy radio. We can send tens of kilobits of data per second, up to about a megabit per second, for less than 100 microwatts of power during continuous transmission. You compare that to a low-power Bluetooth signal, which is on the order of 10 milliwatts or so during transmitting. We're three orders of magnitude less power than that.

"When you talk about such low power, it enables some rather novel things, one of them being that you are now in the realm of being able to power such a system through harvesting of RF energy. That's where our RF harvesting comes in, because it makes a lot more sense when it's that small amount of power.

"But even then, harvesting RF energy at long range is an exceedingly difficult task. In general, if you're going to be under FCC constraints and you're limited to the amount of power you're able to radiate, and the ISM band, that's about a watt of power you're allowed to radiate. If we were to limit ourselves to that kind of constraint, it would short-circuit the most valuable thing about backscatter, which is that it can work at very long range." ■

Always-On Voice Processing Brings Hands-Free Functionality to the Forefront

Syntiant Corp.
Irvine, California
Creation: 2017
www.syntiant.com

By Jeff Dorsch

"Alexa, tell me about Syntiant."

"Syntiant supplies always-on voice processors powered by custom artificial intelligence silicon."

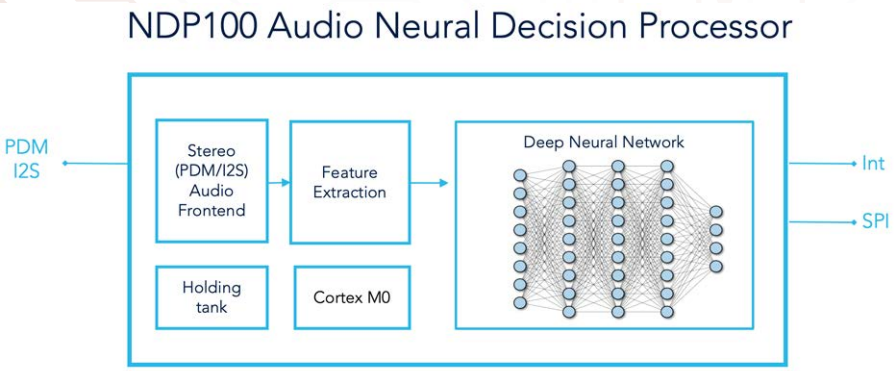
Syntiant is a fabless semiconductor startup in Irvine, California. The company was founded in 2017 and has raised a total of $30.1 million in private funding, including a Series B round of $25 million in the fall of 2018. Its investors include Amazon's Alexa Fund, Applied Ventures (the venture capital arm of Applied Materials), Intel Capital, M12 (formerly Microsoft Ventures), Motorola Solutions Venture Capital, and Robert Bosch Venture Capital. Other investors are Digital Horizon Capital (DHVC), Embark Ventures, and Seraph Group, an angel investor fund.

The company's product is the NDP10x line of Neural Decision Processors, which are in production with Amazon's Alexa Voice Service firmware. The startup started sampling its processors in the summer of 2018. Orders from volume production began last September.

Kurt Busch *(Image: Syntiant)*

Kurt Busch is Syntiant's chief executive officer. He previously served as president and CEO of Lantronix and was senior vice president and general manager of the high-performance analog business unit of Mindspeed Technologies. Pieter Vorenkamp, the company's chief operating officer, has held leadership positions at Broadcom and Cadence Design Systems.

Stephen Bailey is the vice president of software engineering, chief architect, and chief technology officer. He was the CTO at Sandburst, which was acquired by Broadcom, and later served as Broadcom Switch's chief technologist. Jeremy Holleman serves as Syntiant's chief scientist while also directing the Integrated Silicon Systems Laboratory at the University of North Carolina, Charlotte, where he is an associate professor.



(Image: Syntiant)

Syntiant currently has about 65 employees, according to Busch.

The CEO described Syntiant's mission as the "intelligence of things," adding, "It could be IoT 2.0. The idea when we started the company is that the world needs a new kind of processor for machine learning at the edge. The traditional architectures that are in Arm's or multicore DSPs really are not well suited for edge and inference. Our role is that if you want to make ML pervasive, we need a new kind of processor.

"When we started in 2017, if you wanted to take advantage of machine learning, you had to go to the cloud. But the cloud has a lot of disadvantages. If we could put everything into the device, we could greatly improve battery life, responsiveness, reliability, and privacy. That was really the main mission of where we were: Let's move AI from the cloud into the device."

Machine learning "really doesn't care what the application is," Busch added, so Syntiant "decided to build a voice application. Our thought process was kind of as follows: The keyboard was our interface to MS-DOS, and the mouse was our interface to Windows. The touchscreen gave us the smartphone, and I think voice is the next-generation interface. What we do today is kind of clunky. It typically goes to the cloud from a smart speaker or a cellphone, and there's kind of a delay. It's not a real-time sort of thing. Our thought is that if we had real-time voice interfaces, things like keyboards and touchscreens could go away. It's our most natural way of communicating; we're communicating now."

Syntiant means to maximize megahertz, and that's why Intel chose to invest in the company, Busch said. The NDPs are not Arm-based chips or Intel processors.

"You can't just go out and buy deep learning," he said. "You can get to market very quickly. Of course, there's no such thing as a free lunch. It just does deep learning. And the reason why it can always compete on these traits is that it just does that. It's not a general-purpose processor. It does deep learning really, really well." Busch then added, "The oil that runs AI, the gas that runs AI, is the data."

What challenges did Syntiant face in its early history? "The first big challenge was in 2017; very few chip companies had been funded," said Busch. "When I told my friends that I was starting a chip company, they said, 'That's really funny; no one's started a chip company since Atheros 20 years ago. Why don't you try the SaaS thing? That's really the way to go.'"

Building the data pipeline was the second big challenge, he added. "We've done this effort to build the pipeline and collect the data. We did what other guys won't, so in the future, we can do things the other guys can't." ■

BACK IN PRINT!

Get your FREE subscription to the re-launched EE Times Europe Magazine

EE Times Europe Magazine delivers the latest news, articles, special reports, and features to cover every facet of today's challenging and disruptive technologies, software, and components.

Our team of editors brings together

China Fabless to Watch

SILICON 100

China's Fabless Chip Companies Live in a Vibrant Ecosystem

By Echo Zhao

Since 2002, EE Times China has charted the development of China's fabless semiconductor industry and honored its innovators through the annual China IC Design Awards. The 2020 China IC Design Awards, which will be held in Shanghai on June 28, will recognize outstanding design companies, upstream service providers, modules/design solutions, and products. A China IC Leader Summit will be held in tandem with the awards event, which itself coincides with the release of EE Times' Silicon 100 list of global startups to watch.

Our list of honorees in China's fabless IC industry includes products, executives, and design teams. To shed light on the diversity of China's IC industry, in this feature, we highlight 23 companies in four categories:

- Top 10 China IC Brands;
- Top 5 China Most Innovative IC Design Companies;
- Top 5 China Most Promising IC Design Companies; and
- Top 3 China Outstanding Technical Support IC Design Companies.

Honorees are nominated by industry peers and selected online by electronics engineers. The awards committee then compiles a "shortlist" of candidates based on those nominations, and winners are chosen through a combination of online voting and committee discretion. For the 2020 awards, voting was open to our online community from Dec. 19, 2019, through Jan. 19, 2020. We received more than 30,000 responses. The final list is 90% based on voter input; our editors stepped in only to resolve cases in which, for example, candidates received votes in more than one category.

To be selected as a Top 10 China IC Brand, a company's brand must be known to most users in the Chinese market. The honored companies provide comprehensive information about their products and services through the internet, printed matter, and various activities. They develop breakthrough products and/or technologies that change or are changing the performance/price curve of certain key products or technologies in electronics. The companies have taken a leading role in business activities or management practices in areas

such as product development, hardware/software design, equipment or system manufacturing, human resource management, marketing, public relations and media relations, sales, and/or distribution.

The Top 5 China Most Innovative IC Design Companies have made noteworthy technological breakthroughs, have obtained patents, and are unanimously recognized in their industry segments. Their products are sold in the market and have had a generally positive reception, with high customer acceptance. They maintain a high proportion of R&D investment. Their activities have been reported in internationally renowned media.

The same selection criteria, with the exception of market sales, apply to the Top 5 China Most Promising IC Design Companies.

The Top 3 China Outstanding Technical Support IC Design Companies have demonstrated an ability to respond to customer inquiries in a timely manner and provide a good customer experience during the sales process. They provide products or technologies of excellent quality that significantly improve reliability. They have established a service network in China to ensure the best customer service and help their customers succeed in product development and market acceptance.

Top 10 brands: Repeat winners outnumber newcomers

It takes a while to build brand loyalty, so perhaps it shouldn't be surprising that when we compared the Top 10 China IC Brands of 2020 with 2019's list, we found six repeat honorees: Unisoc, SG Micro, BYD Microelectronics, Huada Semiconductor, VeriSilicon, and Galaxycore.

Among the newcomers is Giantec Semiconductor, which provides E2PROM chips and has landed design wins in cameras for smartphones from companies including Samsung, Huawei, Vivo, OPPO, Xiaomi, Lenovo, and ZTE.

Rounding out the Top 10 are newcomers GigaDevice, Allwinner Technology, and ISSI. We were not surprised to find that our readers voted for GigaDevice and Allwinner Technology; both have great influence in China's industry.

GigaDevice is well-known for its flash memory. The company also has a large share of the market for 32-bit general-purpose MCUs. GigaDevice gained attention when it rolled out general-purpose RISC-V MCUs. It is now testing DRAM chips, with tape-out planned for 2021.

Allwinner, meanwhile, has seen its system-on-chip designed into nearly almost all mainstream smart speakers in China, including those from Ali, Baidu, JD, Tencent, and Xiaomi. Its SoCs integrate DSP, neural processing units (NPUs), and even Arm's artificial intelligence processing unit (AIPU).

ISSI, whose primary products are high-speed and low-power SRAM and low- and medium-density DRAM, has had a bit of a complicated history. It was a U.S.-based public company that traded on the Nasdaq, but it was purchased for $780 million and taken private by a Chinese company in 2015. Ingenic then acquired ISSI last year. Although ISSI today is the seventh-largest DRAM company in the world, its market share is tiny. Nonetheless, it is held in high regard in the global storage industry.

Innovation and promise

Newcomers swept the categories for Top 5 China Most Innovative IC Design Companies, Top 5 China Most Promising IC Design Companies, and Top 3 China Outstanding Technical Support IC

Design Companies.

The top five innovators were Allystar, with its Beidou Navigation chips; Shanghai ChipON, with its KungFu core MCU, based on internally developed IP; General Processor Technologies (GPT), which provides IP for heterogeneous computing; and Telink and Kangxi Communication Technologies, which provide solutions for IoT applications. Intel Capital invested in Telink and Kangxi, respectively, in 2015 and 2016.

In 2019, readers seemed to prefer well-funded AI companies when selecting the most promising IC design houses. This year, they were more pragmatic, voting for companies that have done a great job in a specific market (such as Bestechnic, which focuses on the Bluetooth market) or focus on technologies that China lacks. The latter, rounding out the top five, include XTX Technology and Dosilicon, both targeting memory; Autochips, which focuses on automotive; and Phytium Technology, which has zeroed in on CPUs.

Companies honored for outstanding technical support, reflecting our readers' preferences, included SMIT Group, Montage Technology, and SmartSens Technology. SMIT Group is involved in security chip design and application, FPGA rapid prototyping verification and simulation, system R&D and application, and third-generation semiconductor product R&D and production, providing chip solution implementation service to system houses.

Montage targets cloud computing and AI. Its memory interface technology delivers high-speed, large-capacity memory buffer solutions from DDR2 to DDR4 for data center applications. JEDEC adopted Montage's DDR4 fully buffered "1 + 9" distributed architecture as an international standard.

SmartSens Technology is a high-performance CMOS image sensing (CIS) chip design company. It offers a suite of proprietary technologies, including full-color night vision, DSI pixel, and global exposure built on voltage domain architecture and stack BSI processes.

Echo Zhao *is chief analyst of AspenCore*

Top 10 China IC Brands

北京兆易创新科技股份有限公司
GigaDevice

www.gigadevice.com

CEO: Zhu Yiming

GigaDevice was founded in Silicon Valley in 2005 and successfully completed its IPO on the Shanghai Stock Exchange in 2016. A pioneer of SPI NOR flash memory, the company is currently ranked No. 3 in the world in this market segment, with more than 1 billion units shipped every year. GigaDevice provides advanced memory technology and IC solutions, including SPI NOR flash, SPI NAND flash, and MCUs for use in embedded, consumer, and mobile communications applications.

紫光展锐科技有限公司
Unisoc

www.unisoc.com

CEO: Chu Qing

Unisoc, based in China, aims to be the backbone of the digital world. The company says that building a foremost ecosystem is the core strategy; 5G and AI are the two main technological orientations. Unisoc established three business units to support corresponding areas: the Consumer Electronics Business Unit to enrich personalized experience, the Industry Electronics Business Unit to enable society, and the Connectivity Device Business Unit to empower limitless innovation.

圣邦微电子（北京）股份有限公司
SG Micro Corp.

www.sg-micro.com

CEO: Zhang Shilong

SG Micro Corp specializes in high-performance, high-quality analog IC design, marketing, and sales and offers innovative solutions for a broad range of applications in the wireless communication, consumer, medical, automotive, and industrial markets.

深圳比亚迪微电子有限公司
BYD Microelectronics

www.byd.com/en/

CEO: Chen Gang *(President)*

BYD Microelectronics has been building insulated gate bipolar transistors (IGBTs) since 2015.

珠海全志科技股份有限公司
Allwinner Technology

www.allwinnertech.com

CEO: Mike Zhang

Allwinner Technology, founded in 2007, provides intelligent application SoCs, high-performance analog components, and wireless connectivity ICs. It is headquartered in Zhuhai, China, with other R&D centers and offices in Shenzhen, HongKong, Xi'an, Beijing, and Shanghai.

华大半导体有限公司
Huada Semiconductor Co., Ltd.

www.hdsc.com.cn/en/

CEO: Dong Haoran

Huada Semiconductor Co., Ltd. is a wholly owned subsidiary of China Electronic Information Industry Group Co., Ltd. A professional sub-group of the integrated circuit business, its products cover power devices, smart cards and security chips, MCUs, and high-end analog circuits.

芯原微电子（上海）股份有限公司
VeriSilicon Microelectronics (Shanghai) Co., Ltd.

www.verisilicon.com

CEO: Wayne Dai

Founded in 2001 and headquartered in Shanghai, China, VeriSilicon Microelectronics (Shanghai) Co., Ltd. (VeriSilicon) provides one-stop custom silicon services and semiconductor IP licensing services leveraging its in-house semiconductor IP. Its business covers consumer electronics, automotive electronics, computer and peripherals, industry, data processing, IoT, and other applications. The company has five design and R&D centers in China and the United States, as well as 10 sales and customer service offices worldwide.

聚辰半导体股份有限公司
Giantec Semiconductor Corporation

www.giantec-semi.com

CEO: Laurence Zhang

Giantec Semiconductor Corporation currently has four product lines — EEPROM, MCUs/smart cards, VCM drivers, and OPAs — which are sold worldwide. Its main end customers include Huawei, Haier, Hisense, Lenovo, CSOT, VTech, Foxconn, Samsung, Sharp, AUO, and BOE, and the company is also one of the qualified suppliers to the Ministry of Housing and Urban-Rural Development. Giantec's R&D, manufacturing, marketing, and sales teams are located in Shanghai, China, with sales branches in the U.S., Taiwan, and Hong Kong.

北京矽成半导体有限公司
Integrated Silicon Solution Inc.

www.issi.com

CEO: KY Han

ISSI designs, develops, and markets high-performance ICs for automotive, communications, digital consumer, industrial, and medical markets. Its primary products are high-speed and low-power SRAM and low- and medium-density DRAM. The company also designs and markets NOR flash products and high-performance analog and mixed-signal ICs. ISSI targets high-growth markets with cost-effective, high-quality semiconductor products.

The company has expanded its presence in the Asian market by adding design groups in China, Korea, and Taiwan, where it now employs more than 80 design, product, and test engineers.

格科微电子（上海）有限公司
Galaxycore Shanghai Limited Corporation

www.gcoreinc.com

CEO: Stanly Zhao

Founded in 2003, Galaxycore focuses on CMOS image sensors, AMOLED/LCD display drivers, high-end embedded multimedia systems-on-chip, and application systems.

Top 5 China Most Innovative IC Design Companies

深圳华大北斗科技有限公司
Allystar Technology (Shenzhen) Co., Ltd.

www.allystar.com/en/

***CEO: Sun Zhongliang** (General Manager)*

Allystar Technology (Shenzhen) Co., Ltd. is a spinout from the GNSS chipset designing department established in May 2013, as a subsidiary to China Electronics Corporation (CEC) — among the world's Top 500 enterprises.

华夏芯（北京）通用处理器技术有限公司
General Processor Technologies Inc.

www.hxgpt.com

CEO: Keyi Li

General Processor Technologies (GPT) is China's only IP licensing company providing CPU, DSP, GPU, and AI accelerator cores for a wide range of performance levels, all optimized for heterogeneous computing.

上海芯旺微电子技术有限公司
Shanghai ChipON Micro-Electronic Co., Ltd.

www.chipon-ic.com

CEO: Xiaobing Ding

Shanghai ChipON Micro-Electronic Co., Ltd. focuses on the research and development of high-reliability and high-quality 8-bit MCUs and 32-bit MCUs and DSPs based on independent IP KungFu kernel architecture. The company is headquartered in Shanghai, with branches in Shenzhen, Chongqing, and Xiamen.

泰凌微电子（上海）有限公司
Telink Semiconductor (Shanghai) Co., Ltd.

www.telink-semi.com

CEO: Wenjun Sheng

Founded in 2010, Telink develops highly integrated low-power radio frequency and mixed-signal system chips for internet of things applications. Its product portfolio serves markets including smart lighting, home automation, and smart cities and includes 2.4-GHz RF SoCs for Bluetooth Smart, Zigbee, 6LoWPAN/Thread, and Homekit. Telink has offices in California, Shanghai, Shenzhen, Taiwan, and Hong Kong.

康希通信科技（上海）有限公司
Kangxi Communication Technologies (Shanghai) Co., Ltd.

en.kxcomtech.com/en/

CEO: Peng Ping

Kangxi Communication Technologies (Shanghai) Co., Ltd (KCT) was founded in September 2014 and is currently located in Zhangjiang High-tech Park. In August 2016, it became a wholly owned subsidiary of Grand Chip Microelectronics Co., Ltd. (GCM). The company offers high-performance, high-efficiency, and highly integrated RF front-end IC products, as well as optimized RF place-and-play solutions, for WLAN infrastructure, 5G NR, and the IoT.

Top 5 China Most Promising IC Design Companies

合肥杰发科技有限公司
Autochips Inc.

www.autochips.com

CEO: Pal Wan

Autochips Inc. provides SoC and all-in-one turnkey solutions for the global automotive electronics industry — including in-vehicle infotainment (IVI), telematics, ADAS, and intelligent cockpit. Other solutions include Body Control Module, Body Safety Module, and Vehicle Gateway MCU.

深圳市芯天下技术有限公司
XTX Technology (Shenzhen) Co., Ltd.

www.xtxtech.com

CEO: Mark Long

XTX Technology (Shenzhen) Co., Ltd. offers NAND MCP, EEPROM, and SPI NOR flash.

东芯半导体股份有限公司
Dosilicon Co., Ltd.

www.dosilicon.com

CEO: Cynthia Xie

Dosilicon is primarily engaged in R&D and sales of memory chips, including NAND and NOR.

恒玄科技（上海）股份有限公司
Bestechnic

www.bestechnic.com

CEO: Liang Zhang

Bestechnic focuses on the R&D, design, and sale of smart audio SoCs. It provides customers with edge intelligence chips with voice-interaction capabilities for AIoT, and its products are widely used in low-power smart Bluetooth earphones, Type-C earphones, and smart speakers.

天津飞腾信息技术有限公司
Phytium Technology Co., Ltd.

www.phytium.com.cn

CEO: Dou Qiang *(General Manager)*

Phytium Technology Co., Ltd. is a fast-growing Chinese IC design company headquartered in the Tianjin Binhai High-Tech Industrial Development Area, with operations, marketing services, and research centers in Beijing and Guangzhou, China. The company is focused on the design, manufacture, and sale of high-performance and low-power IC chips, while also providing secure, reliable, high-performance, low-power CPUs, ASICs and SoCs; IP; and total system solutions. Phytium's customer base includes government, telecommunications, banks, energy enterprises, ITS, and internet companies.

Top 3 China Outstanding Technical Support IC Design Companies

国微控股有限公司
SMIT Group (Shenzhen) Co., Ltd.

www.smit.com.cn/en

CEO: Huang Xueliang

SMIT Group Ltd. is a semiconductor holding company that mainly covers security chip design and application, FPGA rapid prototyping verification and simulation, system R&D and application, third-generation semiconductor product R&D and production, and chip solution implementation services for systems houses.

澜起科技股份有限公司
Montage Technology Co., Ltd.

www.montage-tech.com

CEO: Howard Yang

Montage Technology provides high-performance IC-based solutions for cloud computing and AI markets. Since 2016, the company has been cooperating with Tsinghua University and Intel to develop the Jintide CPU. A high-performance Jintide server platform combining a Jintide CPU with Montage's hybrid security memory module (HSDIMM) has realized real-time security-monitoring functions at the silicon level. This architecture also incorporates advanced heterogeneous processing and interconnect technologies for future AI and big data applications.

Established in 2004, Montage Technology is headquartered in Shanghai and has branches in Kunshan, Xi'an, Macao, Silicon Valley, and Seoul, South Korea.

思特威电子科技有限公司
SmartSens Technology Co., Ltd.

www.smartsenstech.com

CEO: Dr. Richard Xu

SmartSens Technology Co., Ltd., founded in 2011, is a high-performance CMOS image sensing (CIS) chip design company. Its products are applicable to security and surveillance, automotive, machine vision, consumer electronics (sports cameras, drones, automatic vacuums, smart home), and other application fields. The company is headquartered in Shanghai and has both research centers and sales offices in various cities around the world, including Beijing, Shenzhen, Hangzhou, Hong Kong, Hsinchu, and San Jose, California.

SmartSens owns a suite of proprietary technologies, including full-color night vision, DSI pixel, and global exposure built on voltage domain architecture and stack BSI processes, among many others.

EE Times

Silicon 100

Co-Editors-in-Chief
Bolaji Ojo
Junko Yoshida

EDITORS

North America

Brian Santo
Editor-in-Chief, EE Times

Gina Roos
Editor-in-Chief, Electronic Products

Richard Quinnell
Editor-in-Chief, EDN

Majeed Ahmad
Executive Editor, EDN

Barb Jorgensen
Editor-in-Chief, EPS News

Jessica MacNeil
George Leopold
Gary Hilson
Cabe Atwell
Kevin Krewell
Jim McGregor

Europe

Nitin Dahad
Editor-in-Chief, Embedded.com

Maurizio Di Paolo Emilio
Editor-in-Chief, EEWeb & Power Electronics News

Sally Ward-Foxton
Editor-in-Chief, EE Times Weekend

Anne-Françoise Pelé
Editor-in-Chief, EETimes.eu

Asia Pacific

Yorbe Zhang
Head of AspenCore APAC

Echo Zhao
Chief Analyst of AspenCore China

Judith Cheng
Chief Editor of EE Times & EDN

Taiwan/Asia
Steve Gu
Lefeng Shao
Fendy Wang
Luffy Liu
Jenny Liao

Yvonne Geng
Challey Peng
Momo Zhong
Clover Lee
Illumi Huang
Franclin Zhao
Elaine Lin
Demi Xia

Susan Huang
Anthea Chuang
Matthew Burgess
Alan Patterson

Chief Copy Editor
Lori O'Toole

Senior Copy Editor
Diana Scheben

Production Team
Alexis Bickford
Adeline Cannone
Giulia Fini
Joe Trentacosti

Creative Director
Peter Cannizzaro

Editorial Design
Emanuele Mariani
Creative Director, Hyperbold Studio

Federico Mariani
Creative Director, Hyperbold Studio

Vice President & General Manager Arrow Digital SaaS — Arrow Electronics
Martin Chatterton

Founding Editor-in-Chief and Publisher Emeritus
Victor Gao

© 2020 ASPENCORE
ALL RIGHTS RESERVED

CAMBRIDGE, MA
1-408-330-7575
silicon100@aspencore.com