



# CB DIGEST FOR TECHNOLOGY

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Every week CB DIGEST scours many of newspapers, magazines, and websites, searching for the most intriguing tech stories and the most thoughtful things – left, right, and in-between. The CT DIGEST also reports on what the smartest people are saying about the world.

**CHAMBIZ** 

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### **Xiaomi to further 5G and AI investment pot to tune of £5.3bn – reports**

Chinese hardware manufacturer Xiaomi is set to invest more than 50 billion yuan (£5.3bn) in 5G and artificial intelligence (AI) in the coming five years, according to reports. As first reported by Reuters, Xiaomi CEO Lei Jun posted the news on official social media accounts but fell short of disclosing specific investment details. The company has long held a vision around the convergence of 5G, artificial intelligence, and Internet of Things, advocating for an ‘all in AIoT’ (AI + IoT) approach. At Xiaomi’s most recent annual developer conference in November, Lei described the three technologies as ‘the next generation of super Internet.’ This time last year, Xiaomi set aside 10 billion yuan (£1.08bn) into this sector over five years, meaning the ante has been upped going into 2020.

**Goldman Sachs, the 150-year-old investment bank and Wall Street giant, is staking its future on a mobile app.** Last week, Goldman Sachs released a long-awaited app for customers of its Marcus consumer bank. Adam Dell, Goldman Sachs partner and head of product at Marcus, said [the app may prove to be far more important to Goldman than its credit-card partnership with Apple](#), because the app lets customers check balances and set up recurring transactions and will one day serve as the bank’s storefront and one-stop shop for an array of digital banking services. Adam Dell, an entrepreneur and brother of billionaire Michael Dell, joined Goldman in 2018 after he sold startup Marcus to the bank for \$100 million. Goldman Sachs launched the Marcus savings and loans app on January 10, 2020.

**Journey to Space: Japanese billionaire Maezawa and founder of Retailer Zozo, is seeking a girlfriend for SpaceX voyage.** Japanese billionaire Yusaku Maezawa, founder and chief executive of online fashion retailer Zozo, who has been chosen as the first private passenger by SpaceX, is searching for a girlfriend to join him on a voyage around the moon. The voyage, which will be the subject of a new documentary program is in the latest attention-grabbing stunt by the entrepreneur. According to the information on his website, Maezawa, who is 44, said he’s looking for a “special woman” to join him on Elon Musk’s mission around the moon. Maezawa is seeking single women over 20 for the show, which will be shown on streaming service AbemaTV

**Microsoft issues critical Windows security fix after tipoff from NSA.** Microsoft Corp on Tuesday rolled out an important security fix after the U.S. National Security Agency tipped off the company to a serious flaw in its Windows 10 operating system, officials said. The agency [reported](#) on its website that it discovered a major security flaw that could let hackers intercept seemingly secure communications in Microsoft’s Windows 10 operating system. Known for keeping security flaws to its chest, this time the agency tipped off Microsoft so that it can fix the system for everyone. “This vulnerability may not seem flashy, but it is a critical issue. Trust mechanisms are the foundations on which the internet operates – and CVE-2020-0601 permits a sophisticated threat actor to subvert those very foundations,” the agency said.

**Tesla plans to open China design and research center.** [Tesla](#) continues to make waves in China. Tesla’s first factory outside the United States is in the eastern city of Shanghai, and it started delivering China-made Model 3 vehicles this month. Now the electric car maker said it plans to open a design and research center in China to make “Chinese-style” vehicles, the company said in a recruitment notice on its official WeChat account. “In order to achieve a shift of ‘Made in China’ to ‘Designed in China’, Tesla’s CEO Elon Musk has proposed a very cool thing – set up a design and research center in China,” the statement reads. The company does not provide any timeline on when the center will begin operations.

**PepsiCo Plans to Achieve 100% Use of Renewable Energy In The U.S this year.** Beverage giant [PepsiCo](#) announced that it plans to achieve 100% renewable energy use for all of its direct operations in the U.S. this year. The U.S. currently accounts for nearly half of PepsiCo’s total global electricity consumption. PepsiCo’s efforts in the U.S. build upon its global progress in switching to renewable electricity around the world. For example, nine countries in

PepsiCo's European direct operations already meet 100% of their electricity demand from renewable sources. Additionally, in 2018, 76% of the electricity needs of the PepsiCo Mexico Foods business were delivered via wind energy.

### **McAfee Switches CEOs in Possible IPO Preview**

McAfee announced it is changing CEOs, appointing tech industry veteran Peter Leav to replace Chris Young, who is stepping down from a role he had held since 2017 when former parent Intel spun out the cybersecurity company. The announcement suggests that McAfee has scrapped any near-term plans it may have had to be acquired, as it was reportedly considering last summer.

Leav, who was previously CEO at Polycom and BMC Software, and has also worked at Cisco Systems and Motorola, brings experience that could help if McAfee decides to go public again, as has also been reported.

McAfee was the second-largest cybersecurity company after Symantec when it was acquired by Intel for \$7.7 billion. Now, with a new CEO, McAfee will try to re-establish itself as a top player in a market where younger companies like CrowdStrike and Zscaler are getting an increasing amount of attention.

### **Omnivision and Artilux to Collaborate on Ge-on-Si Sensors for Smartphones**

OmniVision and Artilux announce their execution of a formal letter of intent to collaborate on GeSi-based 3D sensors, after a series of evaluation and analysis. The main objective of this collaboration is to combine OmniVision's CMOS imaging technology and market position with Artilux's GeSi 3D sensing technology, and accelerate the delivery of comprehensive RGB and 3D imaging solutions to the mobile phone segment.

The new product offerings will not only cover the mainstream light sensing spectrum from visible light to 850nm/940nm, but will further extend to 1350nm/1550nm, for improved outdoor experience and eye safety for multiple growing digital imaging market segments.

### **Artificial Intelligence Software Market to Reach \$126.0 Billion in Annual Worldwide Revenue by 2025**

Artificial intelligence (AI) within the consumer, enterprise, government, and defense sectors is migrating from a conceptual "nice to have" to an essential technology driving improvements in quality, efficiency, and speed. According to a new report from Tractica, the top industry sectors where AI is likely to bring major transformation remain those in which there is a clear business case for incorporating AI, rather than pie-in-the-sky use cases that may not generate return on investment for many years. "The global AI market is entering a new phase in 2020 where the narrative is shifting from asking whether AI is viable to declaring that AI is now a requirement for most enterprises that are trying to compete on a global level," says principal analyst Keith Kirkpatrick. Annual global AI software revenue is forecast to grow from \$10.1 billion in 2018 to \$126.0 billion by 2025.

### **Apple has quietly acquired low-power AI startup Xnor.ai for about \$200M**

Apple Inc. has shelled out around \$200 million for a Seattle startup specializing in power-efficient artificial intelligence, according to a new report. GeekWire cited multiple sources as saying that the iPhone maker has bought three-year-old Xnor.ai Inc. (*Chambiz DF 7/17/17 & 10/25/19*), which began its life as a spinout from the Allen Institute for Artificial Intelligence. The Allen Institute is a nonprofit research center based in Seattle that operates an in-house startup incubator. It launched 2014 with a \$125 million grant from late Microsoft Corp. co-founder Paul Allen.

Xnor.ai has developed a software platform that reduces the amount of power it takes to run machine learning models. It works by converting the mathematical calculations an AI algorithm uses to process data into binary operations, the simplest type of operation a processor can perform. Xnor.ai's binary-based representation of a given mathematical problem thus takes fewer steps to execute than if it were described in standard code, which has the end result of improving power efficiently.

The startup demonstrated some promising early applications for its technology last year. In February of 2019, Xnor.ai managed to reduce a computer vision algorithm's energy requirements to the point that it could be installed on a tiny solar-powered chip (pictured) light enough to be lifted by a balloon. The startup said at the time that its software will in the future make it possible to fit neural networks on chips costing as little as \$1.

### **Livongo backer's new firm closes on \$87M for debut healthtech fund**

Monday marks the kickoff for what some call the Super Bowl of healthcare investing events. J.P. Morgan's annual, weeklong conference in San Francisco is expected to bring together more than 4,000 investors and some 400 companies, both public and private. Investors are gathering at a time of unprecedented dealmaking in healthtech, a market that saw a record-setting \$7.6 billion bet on US venture-backed startups last year across 659 deals, according to PitchBook.

Lynne Chou O'Keefe, a former health-focused partner with Kleiner Perkins, will be on hand at J.P. Morgan talking up her new firm, Define Ventures, which is focused on early-stage digital health activity and just raised \$87 million to close its first fund. O'Keefe led Kleiner's investment in Livongo, the diabetes- and hypertension-management platform company that went public last year after raising more than \$230 million in venture funding.

**Zipari Raises \$22.5M in Series B Financing.** *Zipari*, an insurtech startup and a provider of consumer experience platform built specifically for health insurance, has raised \$22.5 million in a Series B funding round. Vertical Venture Partners, an early-stage venture capital firm investing in enterprise technology companies that target vertical markets, led the financing round, which included Health Velocity Capital, an investor in healthcare software and service innovators, Healthworx, the healthcare investment and innovation arm of CareFirst BlueCross BlueShield, and Horizon Healthcare Services, Inc. (Horizon), New Jersey's oldest and largest health insurer.

**Ovation launches validation tool to ease regulatory burden of clinical laboratory teams; also raises \$3M in new funding.** *Ovation*, a tech startup that provides data and operations solutions to researchers, scientists and labs throughout the life sciences industry, today unveils a revolutionary new validation tool for clinical laboratories called Automated Systems Validation (ASV). ASV allows laboratories to automate their computer system validation each time a new iteration of the software is released, removing a painful regulatory burden from the lab. In addition to the launch, the company also announced a \$3 million of additional funding and significant expansion of its Product and Clinical Affairs teams. Founded in 2009 by Barry Wark and Winston Brasor, the Boston, MA-based Ovation offers researchers cloud based storage for data related to experiments and analyses that enables easy collaborations within and between labs, and technology that allows researchers to describe and visualize the relationships between their data.

**Aptos to be Acquired by Affiliates of Goldman Sachs' Merchant Banking Division.** [Aptos](#) today announced that funds affiliated with the Merchant Banking Division of Goldman Sachs have reached a definitive agreement to acquire the company from funds advised by Apax Partners (the “Apax Funds”). Aptos, Inc., a recognized market leader in retail technology solutions, delivers innovative, cloud-native and comprehensive omni-channel solutions to more than 1,000 retail brands in 65 countries. The Apax Funds backed Aptos CEO Noel Goggin to spin-out the business from portfolio company, Epicor, in 2015. Since then, Aptos has thrived as an independent company having more than doubled their customer base to become one of the largest global enterprise software providers focused exclusively on retail.

**Israeli agritech startup CropX buys CropMetrics.** CropX, an Israeli global soil sensing and agricultural analytics startup, has acquired CropMetrics, a Lincoln, Nebraska-based provider of cloud-based, precision-irrigation tools. The amount of the deal was not disclosed. As part of the acquisition agreement, current CropMetrics and CropX partners and customers will now have access to an enhanced combination of in-soil data, advanced farm management analytics and decision-support tools. CropMetrics adds more than 500,000 acres under management and over 10 years of in-depth U.S. farm data to the CropX farm management platform.

**Visa Acquires FinTech Startup Plaid for \$5.3 Billion.** Financial giant [Visa](#) announced yesterday that it has acquired fintech startup Plaid for \$5.3 billion. Founded by Duke University alum, Plaid makes it easy for people to securely connect their financial accounts to the apps they use to manage their financial lives. Plaid will help expand its access to financial-technology firms while accelerating its movement outside of cards, Visa CEO says. Plaid's products enable consumers to conveniently share their financial information with thousands of apps and services such as Acorns, Betterment, Chime, Transferwise and Venmo. Consumers rely on these apps and services to help plan their spending, increase their savings and monitor their investments. For example, when a user sets up a Venmo account, it is Plaid that enables the user to link their bank account to their Venmo account.

**Dublin-based tech startup Effective Software rebrands as Engage EHS; secures 1.5 million Euros in funding.** [Effective Software](#), a Dublin-based startup and provider of web-based safety software solutions and training and assessment platforms, announced today it has rebranded under the company name Engage EHS to reflect the value it is driving for its customers in addressing changing EHS challenges. In conjunction with the rebranding, Engage EHS also announced it has secured 1.5 million euros in a recent round of funding from existing venture capital and strategic private investors. Founded in 2007, Engage EHS's cloud based system focuses on serving the EHS market in a wide variety of industries including manufacturing, engineering, logistics and supply-chain and construction.

**New York-based CredSimple Buys Glenridge Health.** [CredSimple](#), a cloud-based healthcare credential verification startup, has acquired Glenridge Health to create the industry leader in provider network management. The Columbia, MD-based Glenridge Health is a provider of technology-enabled provider network management solutions company. The amount of the deal was not disclosed. This acquisition expands CredSimple's capabilities to include comprehensive provider network development and management services. Through the deal, CredSimple will combine its National Committee for Quality Assurance (NCQA) certified Credentialing Verification Cloud (CVC) platform, with Glenridge Health's proprietary network management technology to build and manage provider networks that are compliant, efficient, and aligned to the health plans strategic goals.

**Latvian FinTech startup Jeff App raises €150,000 to match borrowers with lenders in South-East Asia.** [Jeff App](#), a Latvian FinTech startup that offers a loan brokerage solution which utilizes alternative data to boost financial inclusion and has its focus set on South-East Asia, announced it has raised 150,000 Euros to further evolve its “Tinder for loans” solution in Vietnamese market, as well as expand to Indonesia later in 2020. The round was led by a number of European business angels. Backers in this funding round include Tadas Langaitis (co-founder at Nortal, LHV, angel investor at Kilo Health, Not Perfect, advisor at Debitum, NOIA). The company is advised by Raimonds Kulbergs (ex-Funderful, Salto Network). This is the startup's funding round to date.

**Obvious Ventures, a new venture fund founded by Twitter co-founder and early Beyond Meat investor, announces \$271.8 million for its third fund.** Obvious Ventures, a new venture fund founded by Twitter co-founder and early Beyond Meat investor, just raised \$271,828,182 for its third fund (OV3), bringing its total size to about \$585 million. The firm made the [announcement](#) on Medium today. So, what is the significance of \$271,828,182? This number is probably obvious for some of us with love for Mathematics. For people who are not familiar with Math, the number “e” is one of the most important numbers in mathematics. The first few digits are: 2.7182818284590452353602874713527 (and more ...) It is often called Euler’s number after Leonhard Euler (pronounced “Oiler”). e is an irrational number (it cannot be written as a simple fraction). Obvious Ventures chose the new funding amount for the reason. As Ev Williams said on Medium, “In the Obvious tradition, this fund size has an interesting number: \$271,828,182. It’s a nod to one of the most important constants in mathematics: Euler’s Number, universally known as e.”

**Amazon pledges \$1 billion to small businesses in India.** Amazon CEO Jeff Bezos announced a \$1 billion investment in India, even as the e-Commerce giant faces a fresh antitrust probe and waves of protests in the country. Bezos said the \$1 billion investment will be used to digitize small and medium-sized businesses in the country and that Amazon hopes to export \$10 billion worth of India-made goods around the world by 2025. “I predict that the 21st century is going to be the Indian century,” Bezos said on stage, while wearing traditional Indian attire. “The dynamism, the energy... this country has something special. The most important alliance is going to be the alliance between India and the United States, the world’s oldest democracy and the world’s largest democracy.”

**Host raises \$450,000 seed funding to connect corporations with certified and insured bartenders for their events.** [Host](#) is the first application-based platform connecting corporations with certified and insured bartenders, today announced it has closed \$450,000 in funding from a stellar consortium of private domestic investors. The funds will be used to scale, expand market share and focus on product development. Co-founded by Michelle Carazas and Brian Megill, the Host application helps corporate businesses secure trusted bartenders for their events on-demand. Host launched in 2018 with a multi-sided platform application. Through the application, corporations can post details about their event and secure a bartender. Host has become a go-to corporate resource as every bartender has been previously evaluated and selected through a five-step process and covered with liquor and general liability insurance to assure corporate compliance with management buildings’ requirement.

**Mobile voice startup Spoke Phone raises \$4.5 million in Series A funding.** [Spoke Phone](#), an Auckland, New Zealand-based mobile voice company, raised \$US4.5m in Series A funding to further enhance the capability of its existing business phone solution, accelerate expansion in Australia and the United States, and commercialize Spoke Phone for enterprise, a new solution that allows large customers to move legacy phone systems to the cloud. The round was led by Australian venture capital firm, Marbruck Investments, with participation from New Zealand-based Icehouse Ventures and Sir Stephen Tindall’s K1W1 fund. Founded by Jason Kerr and Kieron Lawson, Spoke Phone provides a mobile-first business phone system that offers features and integrations usually available to desktop users.

**Secfi secures \$550M to launch first pre-wealth management platform to help startup employees navigate financial decisions from offer to IPO.** [Secfi](#), the first pre-wealth management platform helping startup employees navigate financial decisions from offer to IPO, Secfi announced it has secured a \$550 million investment facility from Serengeti Asset Management. The \$550 million in capital will be used to power Secfi’s business growth to help executives, employees, and shareholders preserve and diversify their wealth. Founded in 2017 by serial entrepreneur and World Economic Forum Global Shaper Wouter Witvoet, Secfi has raised \$7 million in venture capital from lead investors Rucker Park Capital, Social Leverage and Serengeti Asset Management.

#### **Visa Makes Fintech Move With \$5.3B Plaid Buy**

Visa has agreed to acquire fintech startup Plaid for \$5.3 billion in a move to accelerate its push into connecting consumers to financial services. Plaid provides API software that enables customers including peer-to-peer payment

app Venmo, mobile investing app Robinhood, and cryptocurrency exchanges Coinbase and Gemini to interface with customers' bank accounts. Visa CEO Al Kelly said Plaid has seen a compound annual growth rate of roughly 100% since 2015 and the acquisition was a "long-term" play that would position Visa for the next decade.

"This acquisition is the natural evolution of Visa's 60-year journey from safely and securely connecting buyers and sellers to connecting consumers with digital financial services," he said in a news release. "The combination of Visa and Plaid will put us at the epicenter of the fintech world, expanding our total addressable market and accelerating our long-term revenue growth trajectory."

According to Visa, connectivity between financial institutions and app developers has become increasingly important, with 75% of internet-enabled consumers using a fintech app to transfer money in 2019 compared to 18% in 2015.

"Plaid has been a leader in enabling this connectivity at scale," Visa noted. "Today, one in four people with a U.S. bank account have used Plaid to connect to more than 2,600 fintech developers across more than 11,000 financial institutions."

San Francisco-based Plaid was founded in 2013 and valued at \$2.7 billion in a 2018 Series C funding round that raised \$250 million. According to Forbes, its 2019 revenue was between \$100 million and \$200 million.

### **UPMC Enterprises To Invest \$1B**

UPMC Enterprises plans to deploy \$1 billion to develop new drugs, diagnostics and devices by 2024. UPMC Enterprises will seek investments and partners globally that complement the scientific and commercial work already underway in Pittsburgh. The commitment includes \$200 million that has funded an immunotherapy-focused partnership with the University of Pittsburgh.

"The common link among our investments will be that each has a direct and powerful impact on how we care for patients, while generating a significant financial return," UPMC Enterprises Executive Vice President Jeanne Cunicelli stated, who previously served as managing director at Bay City Capital in San Francisco. "As important as the funding is the unparalleled scientific and medical expertise backing our ideas, thanks to resources provided by UPMC and our academic partner, the University of Pittsburgh."

Over the past two years, UPMC Enterprises has formed five companies in the translational sciences sector and invested in external biotech company Werewolf Therapeutics, as well as more than 30 research projects internally. With an initial focus on the use of immunotherapies for cancer, transplantation and diseases related to aging, the investment group has expanded its focus to include retinal and respiratory disease, autoimmune diseases, neuroinflammation and others. UPMC has invested more than \$800 million in its entrepreneurial efforts to date, primarily in digital health solutions, which have returned more than \$1.5 billion.

### **Blackstone rolls dice with \$4.6B deal for MGM, Mandalay Bay**

A joint venture between Blackstone and MGM Growth Properties has agreed to acquire the Las Vegas real estate assets of the MGM Grand and Mandalay Bay hotels for \$4.6 billion. MGM Growth, which is a publicly traded real estate investment trust, will own 50.1% of the joint venture, while Blackstone will hold the remaining 49.9% via its own REIT arm. Blackstone has also agreed to purchase \$150 million worth of shares in MGM Growth. The deal values the MGM Grand's real estate at about \$2.5 billion and Mandalay Bay's assets at more than \$2 billion, according to The Wall Street Journal. Upon the deal's close, the Blackstone-MGM Growth joint venture will lease the properties back to MGM Resorts, which will maintain operational control.

The deal is quite similar to Blackstone's agreement in November to acquire the real estate assets of the Bellagio in a joint venture with MGM Resorts that valued the fellow Las Vegas icon's real estate assets at \$4.25 billion, with MGM Resorts again continuing to operate the property through a sale-leaseback agreement. Both moves continue to build

out Blackstone's presence on the Strip, an effort that began in earnest when the firm acquired the glitzy Cosmopolitan hotel for \$1.7 billion in 2014.

**Dottid Raises \$3.85 Million in Seed Funding Round to Disrupt Commercial Real Estate Industry.** [Dottid](#), a commercial real estate (CRE) SaaS technology platform which provides a single location for owners, brokers, and tenants to seamlessly transact throughout the leasing process, has raised \$3.85 million in a seed round of funding. The emerging technology company brought together a collaboration of investors including, David Ridley, Founder and former CEO of Invesco Real Estate, Laurie Dotter, current investment board member for two public Texas pension funds, and David Farmer, former COO of Invesco Real Estate, marking the first time several leading local real estate industry insiders have made an investment of this kind in a PropTech company.

**Epsagon secures \$16 million in Series A to provide automate monitoring for cloud microservices.** Born in the cloud and made for the cloud, [Epsagon](#), a cloud analytics startups that specializes in automated tracing for cloud microservices, today announced it has raised \$16 million Series A funding led by new investor U.S. Venture Partners (USVP), with participation from previous investors Lightspeed Venture Partners and StageOne Ventures. The round, which brings the company's total amount raised to \$20 million, will be used to fuel the next phase in Epsagon's growth, including accelerating product innovation for the company's automated, distributed tracing technology, and investing in sales and marketing to meet global demand from new and existing customers.

**NextNav Raises \$120 Million in Latest Round of Funding to Launch Phased 3D Geolocation Services Across U.S.** [NextNav](#), a provider of 3D geolocation services startup, has closed \$120 million in debt and equity financing. Funds managed by affiliates of Fortress Investment Group, LLC ("Fortress") led the round, with NextNav's existing investor base, including Columbia Capital, Telcom Ventures, funds managed by Goldman Sachs Asset Management, L.P., NEA, Oak Investment Partners and Future Fund, all participating. Founded in 2008 by Arun Raghupathy, Ganesh Pattabiraman, and Subbu Meiyappan, NextNav offers urban and indoor positioning services for public safety and commercial applications.

#### **SoftBank's Secret \$750 Million Investment in GoPuff**

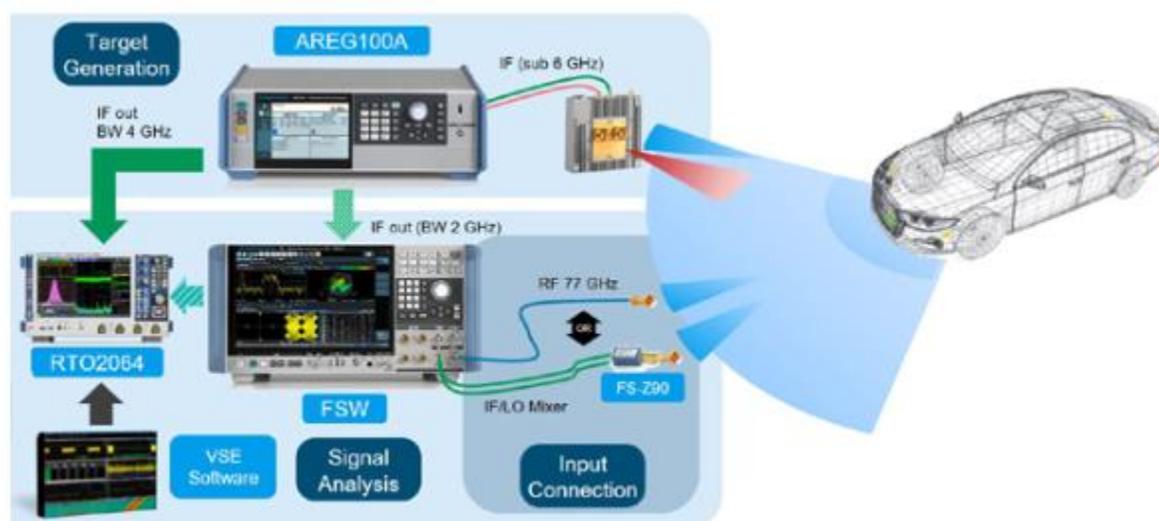
SoftBank's Vision Fund made one of its largest U.S. venture investments last year in a Philadelphia-based startup that has developed a big following on college campuses for its deliveries of junk food, alcohol and other convenience store items. The Vision Fund led a \$750 million investment in goPuff last August, two people familiar with the matter said, and kept an option to invest an additional \$250 million this year, an approach SoftBank has used before. The sizable deal, which also included previous goPuff investor Accel, according to one of the people, shows that SoftBank has maintained a strong appetite for logistics and delivery startups, at least as of last summer, even as the sector has grown crowded, with several companies burning through cash to compete.

By Patric Hindle

Here are what some of the leading RF/microwave companies were featuring at the event including our special Frequency Matters episode covering these companies:

**Rohde & Schwarz** was demonstrating the latest test and measurement solutions for Automotive Radar, C-V2X and material testing. Here is a summary of their demos:

- Over-The-Air (OTA) validation and characterization of Uhnder's brand new 4-D Radar Chip: With a fully shielded test chamber R&S®ATS1500C and the target generator R&S®AREG100A, Rohde & Schwarz enables complete validation and calibration of automotive radar modules. The CATR System has a remarkably compact size and still allows measurements in far-field conditions even for premium MIMO sensors. It is carefully designed to eliminate ghost targets within the chamber during target simulation tests and provides a highly accurate positioner for angular measurements. Uhnder is bringing to market an innovative radar-on-chip, with its 192 virtual channels and pioneering high contrast resolution (HCR), to redefine the key radar technology for safer driving and pave the way towards driverless cars of the future. Radar Test solutions for development and validation
- Radar Test Solution: Featuring a variety of Rohde & Schwarz instruments, including Spectrum Analyzer with a frequency range of up to 90 GHz, performance Signal Generator and performance Oscilloscopes we will demonstrate setups and measurements for all of your Radar development tasks including:
  - Simulation of an ideal clock with the R&S®SMA100B
  - Analysis of FMCW signals with the R&S®FSW
  - Testing MIMO radar systems with the R&S®RTP
  - Developing interference scenarios with the R&S®SMW and pulse sequencer option and more



- Automotive radars are usually mounted behind bumpers or radomes. When selecting the materials, care must be taken to ensure good signal penetrability in the desired frequency band. The use of lower quality radomes can impair signals to such an extent that angular errors, distortions and strong signal attenuation

occur. They showcased the R&S®QAR that offers an ideal way to quickly and reliably filter out lower quality bumpers and radomes in production. It furthermore features the possibility of producing spatially resolved mmWave images of the reflectivity and transmittivity of the radome material to detect inhomogeneities within the material.

- Analyzing, simulating, and testing C-V2X communication applications: Rohde & Schwarz, together with our partner Vector demonstrated a complete C-V2X Application Layer Tester. The combined solution covers all layers. The 3GPP Radio Access Layers for C-V2X Mode 4, the region specific ITS protocol layers (EU ITS-G5, U.S. WAVE, Chinese-ITS) and the ITS application message sets.

**Keysight** concentrated on transportation innovations such as Vehicle-to-Everything (V2X) communications, Internet-of-Things (IoT) and 5G. Instead of showing products, Keysight showed how attendees could experience the following:

- Car Electronics Through Time: Attendees can travel through time to see the increase in vehicle electronics over just 10 years.
- Vehicle-to-Everything (V2X): Attendees can discover how many communications links a car needs to support and their many uses.
- Self-Driving Experience: Attendees can interact with a simulated self-driving vehicle to understand the big impact of small variations.
- IoT in a Car: Attendees can discover how the fusion of humans, IoT and cars enables personalized driving experiences

**Qorvo** was showcasing its advancements for IoT, Wi-Fi 6 and automotive this week at CES. Here is a summary of their releases:

- In partnership with **Nordic Semiconductor**, Qorvo expanded its IoT portfolio with two RF front-end modules that support the NB-IoT and LTE-M cellular standards. Featuring the industry's smallest integrated dual-band module, this expanded portfolio accelerates global connectivity by helping manufacturers add cellular IoT capability to a range of new devices.
- Qorvo launched the smallest, highest-performing Wi-Fi 6 solution with seamless IoT integration. The Qorvo QPK8642 kit provides leading Wi-Fi performance in capacity and coverage, along with Zigbee, Thread and Bluetooth® Low Energy connectivity, all while minimizing cross-radio interference in the connected home.
- Qorvo also introduced a full suite of products to enable a reliable vehicle-to-everything (V2X) link in the Telematics Control Unit (TCU) and antenna. The Qorvo V2X suite includes the first Band 47/Wi-Fi bulk acoustic wave (BAW) coexistence filter, which enables Wi-Fi coexistence with the V2X 5.9 GHz band. This capability is critical to establishing reliable links between vehicles and their surroundings. It also includes two integrated front-end modules (FEM) that support C-V2X and DSRC systems, a digital step attenuator, transmit/receive switch and low noise amplifier (LNA).



**Skyworks** announced that its proprietary solutions are powering essential connectivity in platforms across the growing smart home security segment. Leading brands including Amazon, Arlo, Google, Honeywell and Ring have adopted Skyworks' highly integrated architectures in their newest surveillance systems and video doorbells. Skyworks also announced that its family of connectivity modules

are powering the rapidly emerging 5G Massive Internet of Things (Massive IoT) market. Some products they recently introduced included:

- The SKY85746-11 is a highly integrated, 5 GHz front-end module (FEM) incorporating a 5 GHz single-pole, double-throw (SPDT) transmit/receive (T/R) switch, a 5 GHz low-noise amplifier (LNA) with bypass, and a 5 GHz power amplifier (PA) intended for mobile/portable 802.11ax 1024 QAM applications and systems. The LNA and PA disable functions ensure low leakage current in off mode. An integrated logarithmic power detector is included to provide closed-loop power control within the system. The device is provided in a compact, 16-pin 2.5 x 2.5 mm Quad Flat No-Lead (QFN) package.
- The SKY66318-11 is a high-efficiency power amplifier (PA), designed for the stringent requirements of enterprise small cell applications. The PA offers wide instantaneous bandwidth and is fully input / output matched with high gain and efficiency. Active biasing circuitry is also integrated to compensate for PA performance over temperature, voltage, and process variation. With a compact 5 x 5 mm package, the SKY66318-11 is ideal for 4G LTE and 5G NR systems operating from 3300 to 3600 MHz. The SKY66318-11 is available on major transceiver reference designs. The SKY66318-11 is part of a high-efficiency, pin-to-pin compatible PA family supporting major 3GPP bands.
- The SKY66405-11 is a high-performance, fully integrated RF front-end module (FEM) designed for Zigbee, Thread, and Bluetooth (including Low Energy) applications. The SKY66405-11 is designed for ease of use and maximum flexibility. The device provides a power amplifier, low-noise amplifier, low-loss bypass path, transmit/receive switches, and digital controls compatible with 1.6 V to 3.6 V CMOS levels. The RF blocks operate over a wide supply voltage range from 1.7 V to 3.6 V that allows the SKY66405-11 to be used in battery powered applications over a wide spectrum of the battery discharge curve. A functional block diagram is shown in Figure 1. The SKY66405-11 is provided in a small 1.9 mm x 1.9 mm x 0.56 mm Multi-Chip Module (MCM) package.

**NXP** had guided customer tours including the following:

Connectivity Tour: How has Ultra-Wideband evolved and where is it heading? What are the latest advancements in 5G, WiFi6, and NFC? NXP connectivity experts answered these questions and more during a journey into secure connectivity for a smarter world. Attendees experienced emerging connectivity uses for mobile, IoT and industrial applications – and learned how NXP seamlessly and securely is connecting cars to the outside world.

AI and Machine Learning Tour: Machine learning is a centerpiece of the digital transformation in our homes, workplaces and the vehicles that take us there. NXP experts gave an exploration into the latest advancements in voice, vision and anomaly detection backed by the EdgeVerse portfolio that includes hardware, development tools and a software development environment, which enables most NXP silicon to work across multiple inference engines, neural network compilers and optimized libraries.

Security Tour: Cybersecurity is at the core of devices that anticipate your needs, adapt to your environments and automate your life. Whether you're designing a connected thermostat or a connected car, a secure-by-design approach is vital. NXP experts gave a guided tour of their EdgeVerse edge computing and EdgeLock security portfolios which demonstrated how NXP helps make deployment of security easier, scalable and upgradable.

NXP also announced secure edge processing and connectivity solutions products:

- NXP announced their new safe and secure S32G vehicle network processors that unlock the potential of vehicle data with service-oriented gateways that can transform the automotive industry with new business opportunities, enhanced safety and security, improved user experiences and upgradeable vehicles.
- The first in the series of their EdgeVerse portfolio with an integrated neural processing unit for machine learning, advanced vision and multimedia to bring your business vision to life, from reliable industrial IoT solutions to stunning cinematic audio experiences and more secure homes and cities. It provides multi-

object surveillance, recognizes 40,000 English words voiced in different accents and can detect human emotions and moods.

**Vayyar Imaging** announced the first 60 GHz automotive-grade MIMO radar-on-chip. The 60 GHz solution offers the complete functionality of Vayyar's leading 79 GHz reference-design, enabling the automotive industry to meet global EU NCAP and US Hot-Car needs. Vayyar's solution displays the dimension, location, breathing pattern and movement of people, utilizing proprietary 4D point-cloud VOXEL imaging. This high-resolution, high-performance ROC enables complete classification of the car's environment, regardless of line-of-sight, bad lighting or harsh weather conditions, offering unparalleled in-cabin safety.

Vayyar's automotive-grade radar-on-a-chip has up to 48 transceivers and an internal DSP for real-time signal processing. It is a low-cost sensor that is easily integrated into the existing automotive framework, and due to its multi-functionality, reduces the number of sensors needed as well as the amount of wiring required, providing more value while reducing the overall vehicle cost. For deployed vehicles, more functions can be added over time, with simple OTA software upgrades.

By Junko Yoshida

**Teraki has developed software technology that can resize and filter data, for more accurate object detection and machine learning.**

Big data is an essential element in connected devices. Nevertheless, most vendors are struggling to deal with the exponential growth in data volume, specifically in paying for a CPU inside a system powerful enough to process data, and to send big data to the cloud for AI training.

One answer comes from Teraki, a Berlin, Germany-based startup. Its mission in life is to tackle challenges in edge data processing. Teraki applies signal processing to enable embedded systems that can leverage incoming data more efficiently — by minimizing latency and maximizing algorithm accuracy.

When EE Times first met Teraki last week at CES, we were a little overwhelmed by the trifecta of “big data,” “artificial intelligence” and “quantum computing” that appears to be the foundation of Teraki’s technology.

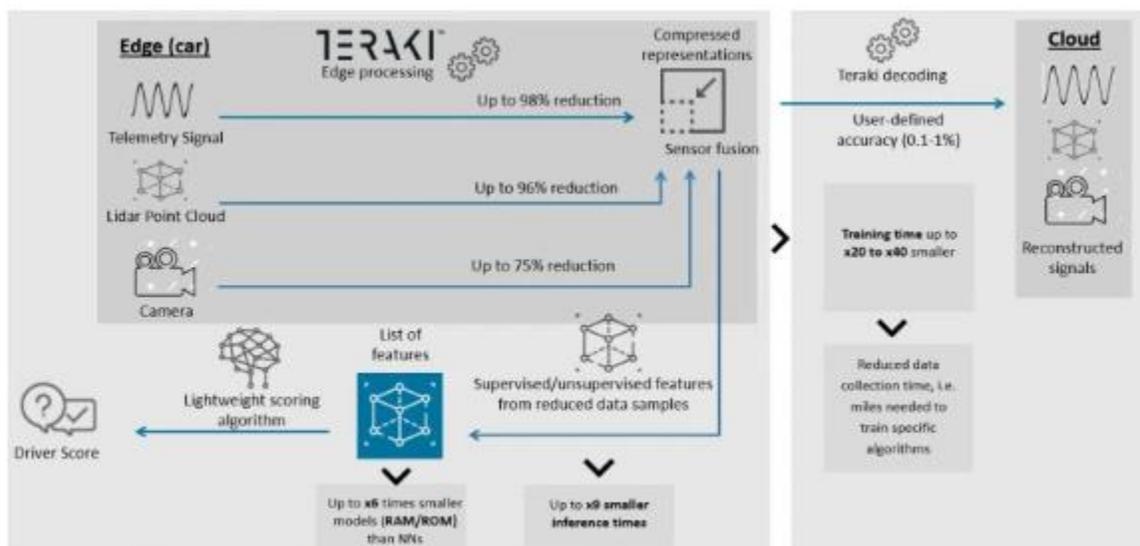
However, the good news is that Teraki isn’t trying to turn this bewildering combination into a marketing pitch. Rather, Teraki, founded by Daniel Richart — formerly a researcher in Quantum Optics at Max Planck Institute — is focusing on the technology.

In that light, Richart explained that the idea of quantum information theory isn’t actually so far from what’s required for today’s edge computing.

Just as quantum computing needs to find a quality, stable “qubit state” out of a lot of noise plaguing atoms, IoT and electronics manufacturers must be able to “extract information — fast enough, at the quality they need,” said Richart, “for data processing.”

Richart and his team started dabbling with Teraki’s basic concept in 2014 and formally established a company in 2015.

Teraki certainly isn’t the first company to talk about edge computing. But everyone is grappling with big data, said Richart.



Teraki guns for efficient embedded processing (Source: Teraki)

Consider highly automated vehicles. If little pre-processing occurs at the sensor level, for example, carmakers could pay dearly for heavy-duty sensor fusion in a vehicle because it will require a more powerful and costly central computing unit.

Sending and storing a lot of data to the cloud for AI training could also cost OEMs serious money. Add to this the issue of latency, which could trigger delays and inaccuracy in object detection.

**Software to reduce data**

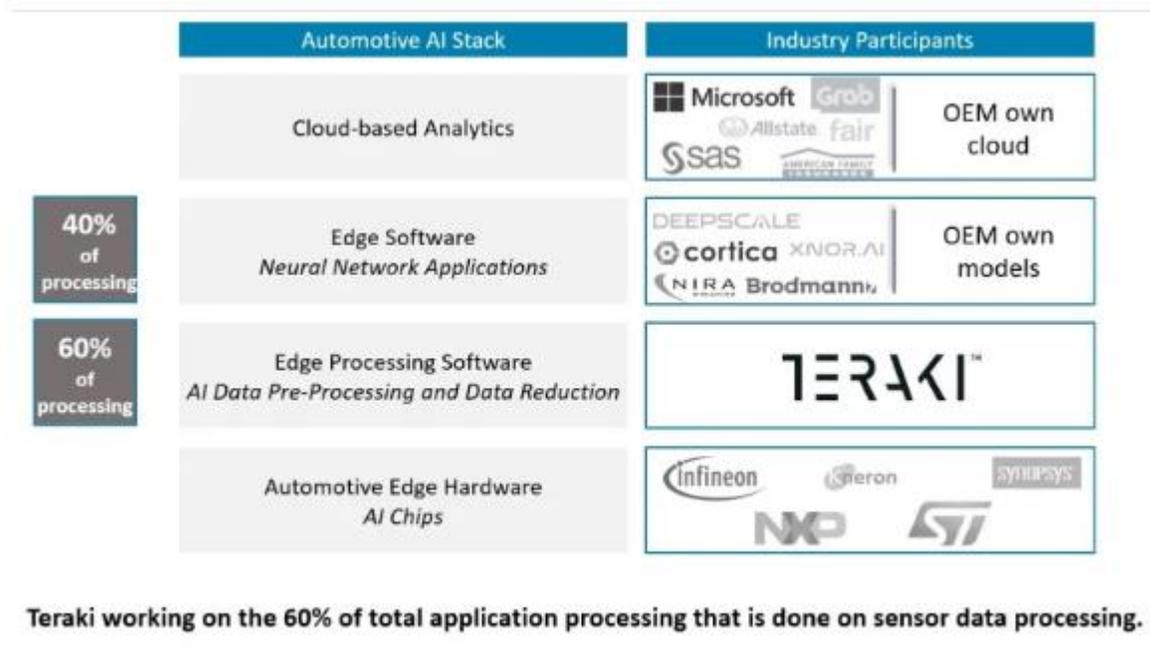
Focused on embedded edge processing, Teraki has developed software technology that can reduce data on signals from three different types of sensors: telematics, cameras and lidars/radars.

Teraki said that its software can run on a standard automotive chipset such as NXP Semiconductors’ Bluebox and Infineon’s Aurix microcontroller. Even better, “the first OEM design wins are underway,” according to Teraki.

Teraki’s software can reduce telematics signals 90-97 percent, the company claims. Once reduced, what is the data used for? It’s good for “predictive maintenance, monitoring driver behavior or crash detection,” according to the company.

Teraki has also developed software that pre-processes 2D image signals from cameras. By processing video frames “prior to an existing codec such as H.264,” Teraki claims it can reduce data up to 75 percent. Allegedly, that would result in enhancing video-based perception. This software development is already complete. OEM customers are now testing it.

The most promising of Teraki’s software innovations might be its solution to 3D point cloud data, generated from lidars, time-of-flight sensors and radars. “We are engaged with many lidar companies now,” said Richart. This software, currently in demo, will be commercially available in the first quarter this year, according to Teraki.



*Where Teraki sits in the ecosystem (Source: Teraki)*

What's the secret in Teraki's data reduction technology? The company isn't just blindly reducing bits by compression. Pre-processing of sensory signals can't be allowed to degrade the data quality and accuracy required for training and running machine learning models.

Richart said, "The key is in the technology that can adaptively resize and filter data, for more accurate object detection and machine learning." He added, "It's to know what to extract at the quality you need."

The reduction of data early in processing sensory data in an embedded system leads to faster inference time and a smaller RAM/ROM requirement. Further, it substantially reduces training time.

### **Frame-based vs. event-based camera**

But if reducing latency is so critical to safety in highly automated vehicles, why spend time in pre-processing frames from a conventional frame-based camera? We asked, "How about using an event-based camera such as those engineered by Prophesee?"

Richart, fully aware of advances in neuromorphic engineering, said, "We think we complement each other. Event-driven image sensors excel in latency domain so that it can function as an early warning sign. Meanwhile our software can be much more adaptive in extracting information from any sensors — at a latency below 10 milliseconds."

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### **Overview**

*Teraki is a key driver for scaling of Insurance, Predictive Maintenance and Autonomous Driving Applications by enabling access to more qualitative data. Teraki begins doing so, by identifying most relevant data already at the embedded side and transmitting this data in the most compact form possible. This is done while maintaining the customers key KPIs based on latest state of the art AI based data processing schemes. As such, Teraki's software enables to fulfill low-latency SLAs required by the end-user and ultimately to adapt key KPIs such as cost-per-mile at the highest precision and lowest latency. Teraki enables to bridge the gap towards true autonomy, bridging the gap of 5G and automotive hardware cost efficiency.*

*Just last month, Teraki closed \$11 million in Series A funding. The round was led by Horizons Ventures, joined by strategic investors. Among these are a leading Japanese technology company, US-based State Auto Labs Fund managed by Rev1 Ventures, Bright Success Capital and Castor Ventures. Prior investors Paladin Capital Group and innogy Ventures also participated. This brings total capital invested in Teraki to \$16.3 million.*

**To unleash the promise of digital transformation, businesses need to embrace automation and software-defined networking as well as improve security.**

By Zeus Kerravla

Digital transformation has increased the importance of the network, particularly the edge, where customers, employees, cloud applications and IoT devices connect to the enterprise. The legacy static and non-differentiated network edge of years past is no longer sufficient for many reasons, so as companies embark on digital-transformation plans, their networks must evolve.

Networking pros should be looking at, among other things, improving security and embracing software-defined networking (SDN) that supports propagating changes quickly across the network in order to accommodate the many challenges digital transformation creates.

### **Digital-transformation hurdles**

Applications have been reengineered and are moving to public and private clouds, and at the same time applications now rely on services located across clouds. These cloud services are tied together by the network, which must be always available because any disruption of the network means applications won't perform as expected.

The internet of things (IoT) has moved out of the operational-technology shadows and has become a core component of most businesses' digital-transformation strategies. As IoT adoption increases, so will the number of connected endpoints.

Almost all of these devices connect at the network edge, so problems at the edge could significantly impair IoT applications. Historically, network value was considered highest in the data center and lowest at the edge because the data center is where applications and data resided. IoT changes that and evenly distributes the value of the network.

Wireless advances also have an impact. With Wi-Fi 6 access speeds at parity with wired connections, Wi-Fi is shifting from a convenience to an essential method of connecting to the network. In addition, many mobile and IoT devices are wireless-only – they have no wired interface. The combination of these trends has made Wi-Fi the primary access method, with the edge being where all these devices connect with the company network.

Mobile devices, IoT endpoints and cloud computing have created many new entry points and shifted them to the network edge, which creates new security issues. Legacy networks had a single ingress/egress point, which meant putting a massive firewall there and scanning all traffic coming and going. Now network security must shift to the network to maximize its effectiveness.

Here's what to do.

### **Automate**

Manual processes have been the norm as long as there have been networks, but they will be the death knell for companies if they aren't replaced by faster, forward-looking automation. First, automation removes a time-consuming burden and enables network engineers to focus on more strategic initiatives. Also, automating repetitive tasks involved in running a network is the first step in evolving to an intent-based network where the network responds automatically to admins' requests.



Many things could be automated, but a good first step would be to automate tasks that are most time consuming, including firmware updates, operating-system upgrades, applying patches and implementing policy changes.

### **Embrace SDN for agility**

Today's networks need to be highly agile so changes can be propagated across the network in near real-time, enabling it to keep up with the demands of the business. Network agility comes from having centralized control where configuration changes can be made once and propagated across the network instantly. Ideally, network changes could be coordinated with application changes so the lagging performance doesn't slow the business down.

Achieving a higher level of agility will likely require a refresh of the infrastructure if the network is more than five years old, and that means adopting SDN. Traditional infrastructure had an integrated control and data plane, so changes had to be made on a box-by-box basis. This is why networks took so long to configure and lacked agility.

With an SDN model, the control plane is separated from the data plane, centralizing control so network engineers define a change and push it out across the entire network at once.

Older equipment isn't designed to be software-first, so look for infrastructure that is built on a modernized operating system like Linux and that can be programmed using current languages such as Python and Ruby.

### **Learn the APIs on networking gear**

As the network moves to software, it needs to take on software characteristics. One of these is exposed APIs that let the network talk directly to applications, which can create a higher level of automation. For example, a videoconferencing application could signal to the network to reserve bandwidth while a call is taking place and then remove the reserve when the call ends.

Network engineers should seek out infrastructure with a rich set of APIs and, importantly, learn the necessary skills to take advantage of them. Most network engineers have never made an API call and have relied on home-grown scripts. It's critical to learn modern software skills in order to leverage the simplicity and speed of APIs.

### **Intrinsic security**

Rather than being implemented as an overlay, intrinsic security is tightly coupled with the network. With this type of security, the network itself acts as a security platform that incorporates a broad ecosystem of best-of-breed tools that can deliver integrated and automated compliance checks, threat detection, and mitigation. Intrinsic security protects networks from the moment a new device is onboarded until its session is terminated.

While the network will never take the place of a next-generation firewall, there is a tremendous amount of security that the network can provide. Because network infrastructure sees all traffic flows, it can gather enough data to determine when traffic deviates from the norm, which could indicate a breach.



For example, if an IoT device communicates with the same cloud service daily and then one day tries to interface with an accounting server, that could signal a malicious intrusion. A network with intrinsic security could quarantine the device and direct a security tool to further diagnose the issue.

### **Refresh for success**

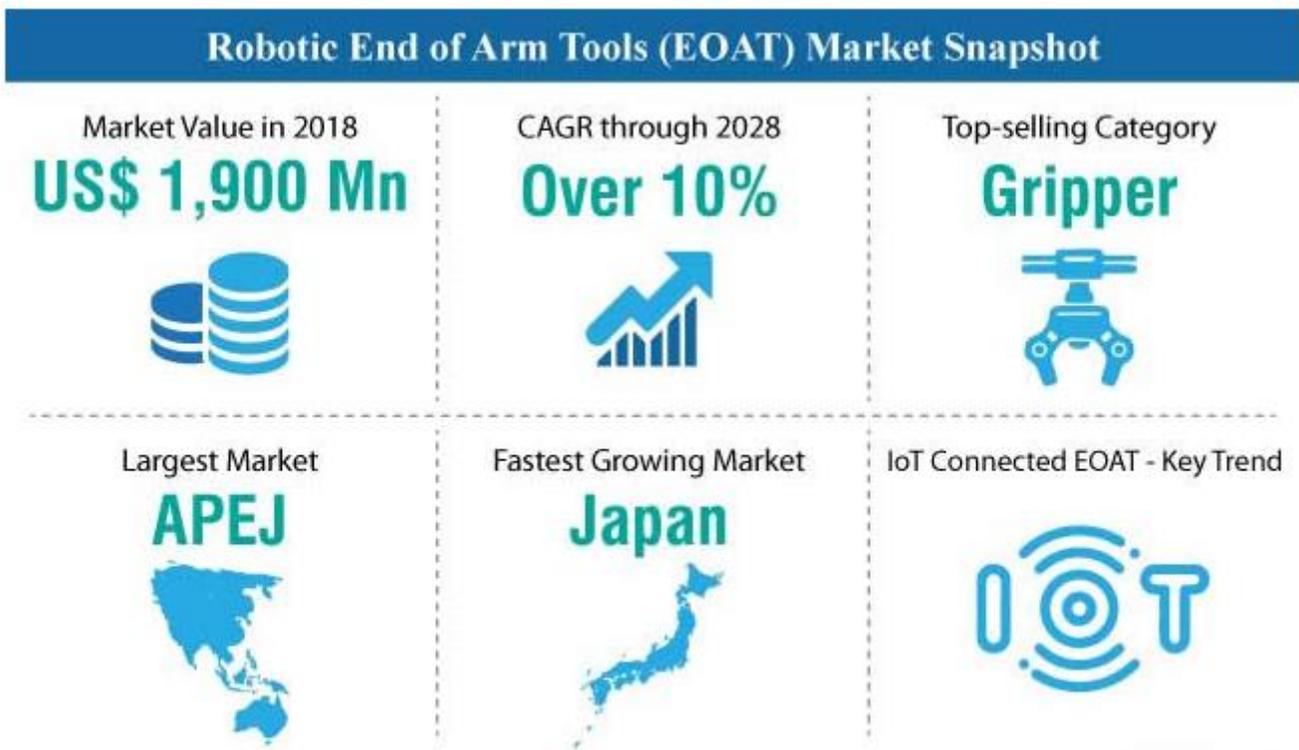
Success in the digital world requires investment in many new technologies, all of which are highly dependent on the network. Networks currently in place were never designed for the rigors of digital business, and they need to be refreshed but also operated and managed differently. Businesses willing to invest in the network and re-train engineers will maximize their success with digital transformation. Those that don't will struggle because application performance and user experience will suffer, and the likelihood of a breaches will grow exponentially.

Source: Fact.MR

Robotic End of Arm Tools (EOAT) Market Size will Grow at a Lucrative CAGR of 10% by 2028, Fact.MR Study  
 Source: Fact.MR01/13/20, 05:37 AM | Industrial Robotics, Factory Automation | EOAT, Research and Reports  
 A recent research study by Fact.MR estimates global sales of robotic end of arm tools (EOAT) to surpass US\$ 2,000 Mn in 2019, up from US\$ 1,900.3 Mn in 2018. This growth in sales can be attributed to the ever-evolving demand of industrial ecosystems for high productivity via industrial robotics.

With industrial ecosystems facing the constant pressure to enhance productivity and reduce operating costs, the demand for collaborative robots is higher than ever. Subsequently, evolving roles for collaborative robots bring robotic end of arm tools (EOAT) into the fore with a crucial role to play i.e. offering the desired functionality to the robot systems.

“As the quality of robotic end of arm tools (EOAT) is closely tied to the performance of robotic frameworks, the end-use industries are seeking lighter, faster, and cheaper models to boost their ROI benefits. This, in turn, has prompted the manufacturers in the robotic end of arm tools (EOAT) market space to meet diverse requirements of the end-use industries who are functioning in an increasingly competitive environment”, says the Fact.MR report.



Source: Fact.MR

Fact.MR

As per the Fact.MR analysis, grippers remain the ‘top-selling’ robotic end of arm tools (EOAT), with global demand estimated to exceed US\$ 1,140 Mn in 2019. The demand for various types of grippers, such as jaw grippers, niddle grippers, magnetic grippers, bellows grippers, and others, varies according to the target application and associated specifications. According to the report, growing demand for grippers can be attributed to the high importance of ‘pick and place’ applications in the automation space.

According to Fact.MR, demand for robotic end of arm tools (EOAT) in the automotive industry is estimated to surge, as automakers are rapidly gravitating toward robotic systems to handle complex manufacturing tasks. Automakers across the globe seek flexibility of robots to perform uninterrupted multi-tasking, which makes robotic end of arm tools (EOAT) a viable investment, both in terms of cost reduction and superlative performance.

### **APEJ to Remain the Largest Market for Robotic End of Arm Tools (EOAT)**

As per the Fact.MR report, APEJ will be highly lucrative region for the manufacturers in the robotic end of arm tools (EOAT) market, as the end-use industries in APEJ aim to stay at the forefront of the 'Industry 4.0' trend. This, in turn, is creating untapped potential for the manufacturers in the robotic end of arm tools (EOAT) market to reap sizeable profits.

Flexibility, controlled pressure, and cycle times remain three among the key considerations of end-use industries while opting for robotic end of arm tools (EOAT), unveils the Fact.MR report. By taking into account the aforementioned, manufacturers are adopting a collaborative approach for successful development of products that are well-aligned with the end-user requirements.

Apart from strategic collaborations and product launches, the manufacturers in the robotic end of arm tools (EOAT) market are participating in exhibitions and conferences to demonstrate on their new product launches. This helps them in branching out to business-to-business trade and tapping into new customer segments.

Additional key players operating in the global robotic end of arm tools (EOAT) market include ABB Ltd., DESTACO, Bastian Solutions LLC, J.H. Benedict Co. Inc., ASS End of Arm Tools, Inc., FIPA GmbH, Festo AG & Co. KG, SCHUNK GmbH & Co. KG, EMI Corporation, OnRobot A/S, Soft Robotics Inc., IPR - Intelligente Peripherien fuer Roboter GmbH, and other market players.

**Microsoft Teams is getting a smartphone walkie-talkie app. The feature is expected to launch in private preview by mid-2020.**

By Jonathan Dame

Workers will soon be able to turn their smartphones into a walkie-talkie using Microsoft Teams. The feature is one of several Microsoft unveiled this week targeting so-called frontline workers, such as retail associates, nurses, housekeepers and plumbers. The walkie-talkie feature will let groups of employees speak to each other by pressing a button in the Teams mobile app. The audio will travel over Wi-Fi and cellular networks, meaning users will be able to communicate with colleagues anywhere in the world. The feature will be available in private preview in the first half of 2020.

Many retailers, hospitals, airlines and hotels still rely on physical walkie-talkie devices. In recent years, startups like Orion Labs and legacy vendors like Motorola Solutions have begun selling smartphone walkie-talkie apps. Those mobile apps come with benefits like location tracking and integration with other business technologies. Microsoft's smartphone walkie-talkie feature is not innovative. But if it works well, the capability could help Microsoft boost adoption of Teams among workers who otherwise wouldn't use the app. Microsoft has made targeting frontline workers a priority since late 2018.

In addition to the walkie-talkie app, Microsoft said Thursday it would add to Teams a task feature for creating and assigning small projects to employees. The system will give businesses a dashboard to track tasks in real time across multiple departments or store locations. It will launch in the first half of 2020.

Microsoft will also expand the scheduling capabilities of Teams by integrating the app with popular workforce management platforms by Kronos and JDA Software. Those integrations will let businesses keep existing scheduling software in place while giving workers the ability to swap shifts and request time off through Teams.

Microsoft is not the only collaboration vendor targeting frontline workers, said Rob Arnold, analyst at Frost & Sullivan. But Microsoft has a leg up on competitors because it can offer businesses so many complementary cloud services. Those include the customer relationship manager Dynamics 365 as well as e-commerce and Internet of Things (IoT) platforms within Microsoft Azure.

#### **New identity and access features for Microsoft Teams**

Additional features targeting frontline workers include SMS sign-in, off-shift access controls and shared-device sign-out. These features will roll out between now and the middle of the year. Workers will soon be able to sign into their Azure Active Directory account (which controls access to Teams) using only a mobile phone number. IT admins will decide which groups of employees use the method.

IT admins will also be able to prevent frontline workers from accessing Teams when they are not on the clock. Temporarily blocking access will help businesses comply with labor laws.

Finally, for Android, Microsoft will add an "end shift" button to shared mobile devices and tablets that will clear app logins and browser sessions. Purging that data will prevent employees from accessing information they shouldn't.

Collectively, the latest features show that Microsoft wants to take Teams beyond the 30% of corporate employees who work in offices, Irwin Lazar, an analyst at Nemertes Research, said. "I think Microsoft is aggressively trying to expand the reach of Teams."



In an attempt to gain access to new technology, Comcast announced yesterday the launch SportsTech, a global accelerator for early stage sports technology startups. According to the announcement, the SportsTech will feature an unprecedented partnership of three of Comcast NBCUniversal's sports brands – NBC Sports, Sky Sports and Golf Channel – alongside NASCAR and two US Olympic sports organizations: U.S. Ski & Snowboard and USA Swimming.

The new accelerator program will also give the cable giant and its partners the opportunity to acquire or pilot new technology and to get an early look at new sports-tech trends. Selected startup will receive \$50,000 of investment capital and an additional \$1.7 million total in perks.

The SportsTech accelerator program will begin in August 2020 and offer a three-month custom-tailored program for up to 10 startups. Comcast is encouraging all early stage startups from around the world to apply for the inaugural class, which will begin in August, at [www.comcastsportstech.com](http://www.comcastsportstech.com).

Comcast Ventures, the company's San Francisco-based venture capital arm, will round out the partnership. Each partner will serve on an advisory committee that influences the innovation priorities of SportsTech, and each will provide startups with direct access to strategic industry relationships, mentorship, and partnership opportunities.

Based in The Battery Atlanta/SunTrust Park, where Comcast Cable's Central Division headquarters are located, the new accelerator is designed to provide sports tech startups with the resources and relationships to succeed by giving them access to a broad international consortium of advisors, a custom sports tech curriculum shaped by industry experts, and investment capital. Partners will have early exposure to emerging sports tech trends and technologies that cross multiple sports, gaining insight into how these technologies can potentially reshape and benefit their businesses.

SportsTech is the third accelerator created by Comcast NBCUniversal in the last three years, joining LIFT Labs Accelerator, powered by TechStars, based out of the company's global headquarters at the Comcast Technology Center in Philadelphia, and The Farm, powered by Boomtown, located in Atlanta.

"We are delighted to introduce SportsTech to our suite of accelerators to help founders build sports technology and products, refine their business models, tell their stories, and benefit from the unique assets and talent of Comcast NBCUniversal," said Sam Schwartz, Chief Business Development Officer, Comcast Cable. "Comcast NBCUniversal has some of the most prominent sports brands and we are excited to partner with founders through SportsTech."

"The demand for sports technology across the globe has never been greater, yet most sports startups don't have access to the resources they need to succeed nor an ability to develop relationships with the right people inside the industry," said Jenna Kurath, Vice President of Startup Partner Development, Comcast Cable. "SportsTech will provide the curriculum and platform for founders to develop their ideas while obtaining mentorship from leaders in multiple sports, enabling them to further deploy their technologies to dramatically improve sports experiences for athletes and audiences alike."

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## *My Predictions for the Next Decade*

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By Sam Lessin

Right before 2010 began, I made a set of thematic predictions about 2020 and then backed them up with 86 specific claims. Having just reviewed and graded my now decade-old calls, it is time to make a new batch of predictions for 2030.

The optimist in me believes that having already done this exercise once as an adult, my hit rate on predictions should be higher for the coming decade. The pessimist in me worries that my age and experience is clouding my ability to see clearly what a world full of nearly 50-year-old millennials will look like.

**Before diving in, one note on the format of these predictions:** Having read a lot of the forward-looking thematic pieces by venture capitalists and company builders in the last month, I would urge anyone attempting a similar personal exercise this month to try to back up big-picture thinking with specific and measurable claims about 2030 as much as possible. From my own earlier exercises, I found that it is the specific claims related to the themes that are the most interesting to look back at in the future—because you can always squint at themes and justify them in the future.

Without further ado, here is my vision of 2030 in technology as of today.

### **The Big-Picture Social Challenges of 2030**

The world will be defined for the next decade by “flight”—away from the massive and somewhat dissociating scale of the internet. If the last two decades were about the coming together of people globally online, we are now going to go through a reversal of that (and are already seeing the signs of this movement). For the first few years of the decade, many will position that trend as a healthy rebalancing of the world after a period of massive consolidation. But by 2030 they will view it as a social crisis of its own. Broadly, this flight will mean an intensification of identity politics and an escape into personalized realities and virtual reality. As the decade progresses, it will also present challenges in keeping people engaged in the real world.

**Identity politics will continue to spread and intensify:** I think a big portion of the identity politics we see today stems from an attempt of people to right-size their communities to smaller, more manageable segments. That helps people feel a sense of purpose and place, as opposed to facing the mass of humanity online.

**The breakup of the internet will accelerate:** The internet is already clearly fracturing into different spheres—the American, Chinese and to a lesser extent European internets are all different and play by different rules. This fracturing will intensify. And because of the general trend toward smaller-scale community and personal identity, there isn't going to be much social pressure from people to hold the internet together.

**Social spaces will be seemingly depressurized by fragmentation:** For a globalist and humanist, the plus side of this is that at least good fences make good neighbors. In the physical world, people can isolate themselves from those they disagree with and surround themselves with neighbors like them. This makes them feel safe. In mass social spaces like the internet, people are constantly forced to see and interact with people whose ideology and identity conflict with their own. I believe that the flight to smaller social enclaves will continue and it might make people happier with their experience of the internet overall.

**We will face a crisis of engagement in reality:** The extreme version of flight to microcommunities and identity politics is people choosing to occupy fully personalized realities distinct from the broader real world. There is an argument that technology broadly, and VR in particular, is going to make personalized fantasy worlds far more

compelling than reality to most people. This is already true to an extent on platforms like Instagram. Professional friends with touchups living amazing lives are far more compelling than photos from your “real” friends. The technology of the next decade is going to make this pattern more compelling and bring it mainstream. People are going to choose to live at scale in personal VR most of the time. Within 10 years I think this will be recognized as a legitimate social crisis.

**The flight from reality will have recognized economic and political consequences:** The birthrate is going to go down, as will sex, human friendships and employment in the west.

**A public conversation will start about how to entice people back to reality and engagement with the physical world:** For the first time in history, reality is going to have to compete head to head with fantasy for the attention of people, at scale. In many ways, personalized fantasy is going to be more compelling. Those that believe in the physical world and reality will start a public conversation about how to improve or change reality for people to get them to reengage in it.

**The current “depression” narrative will shift to focus on social structural issues rather than technology alone:** Depression will still be seen as a disease, but a recognition of social structural issues will confound debates about treatment. The debate will move beyond blaming technology to looking at how lack of opportunity, low wages, lack of sense of purpose, low birthrates and other factors are driving social and community depression.

### **Technopolitical Regulation**

The politics around the internet and technology will continue to intensify. Chinese regulation and control of the digital sphere will be deep and complete. Regulation in the U.S. will not be effective but will cause many intense press cycles and a lot of national tension.

**Antitrust regulation in the U.S. will fail:** None of the major technology companies will be broken up in the U.S., though they will be practically barred from new major acquisitions. This generation of tech companies will have learned from Microsoft and will weather the regulatory storm better than Microsoft did.

**Internet regionalization:** Facebook will not have any consumer-facing services running in China and will be banned from at least five other countries. At least one of the big three internet companies (Google, Facebook and Amazon) will choose to turn off a major service in the EU rather than face its regulatory regime. At least a third of connected people in Africa will use Alipay. The U.S. will block the major Chinese internet players from entering the country in any meaningful way.

**Digital citizenship:** China and the U.S. will offer some form of digital citizenship to noncitizens that extends certain rights and inclusions within the legal frameworks of the respective countries. As part of this, China will in some form require foreign companies exporting from China to pay suppliers for goods using digital RMB—thereby driving the expansion of that currency. The U.S. will respond with some form of digital USD.

**Privacy regulation will be nationalized in the U.S.:** The U.S. will adopt a national privacy framework and the California Consumer Privacy Act will be phased out. The American internet framework will sadly look a lot like the European framework. This will stifle innovation and generally strengthen the current incumbent internet players.

**Encryption and its limits:** While the U.S. will allow Facebook to encrypt all its messenger products, the trifecta of encryption, targeting and ephemerality will be legally prevented and/or blocked.

### **Deepfake regulation**

The U.S. and Europe will have strong regulation around the production and distribution of deepfakes on the internet. However, the regulation will be ineffectual because most attention and engagement (and the sharing of deepfakes) will have moved to encrypted private messaging services where enforcement is not feasible. This will kick off an even more intense debate about the rights of citizens to have private spaces and communication.

**Major internet services will remain fundamentally centralized:** While cryptocurrency will have a role to play (more on that later), no major internet service will really be decentralized. The techno cycle of centralization followed by decentralization has been broken. There will not be a clear path back toward openness.

**Political advertising on the web will be formally regulated:** That will occur by regulating the specificity of targeting rather than the content. And political advertising will be more evenly experienced in the future than it is today.

**Content moderation role of central platforms:** The major platforms will be forced to walk back commitments against deepfakes and types of speech from a feasibility standpoint and because of inconsistency of policy application. There will be a lot of political tension around moderating speech deemed “public.” We will wrestle with how to manage truth in speech, and it will ultimately be left unresolved and highly contentious.

**There will be a discussion around the fundamental challenge of techno regulation:** There will be a meaningful mainstream intellectual debate (meaning articles in outlets like The Atlantic) about the fundamental problem with regulation in our technological age. Legal rules work like code. Technology allows for enactment of far more complicated rules than ever before—and for the first time allows for near-perfect enforcement of those rules. However, technology also makes removing or refactoring rules extremely difficult.

### **Personal Hardware and Interfaces in 2030**

The incumbent large hardware firms will dominate both the existing and already clearly emerging hardware segments. The speculative platforms like augmented reality will not deliver. VR will be the exception and will be dominated by Facebook. China will develop a competing and meaningful alternative ecosystem and will export it to Africa. My personal hardware usage will not change much in the coming decade.

**Personal computers:** Apple and Microsoft will continue to dominate globally. I personally will use a MacBook daily as I do today and it will continue to be my primary interface, though the vast majority of connected people globally will be phone only.

**Phones:** iOS will continue to dominate in the U.S. and Android will continue to be the biggest platform globally, the same as today. There will be one Chinese phone software platform that is a close second to Android in Africa but that is not available in the U.S.

**Tablets:** While the iPad brand will still exist in some form, tablets will no longer be seen as a category distinct from personal computers and phones. The current tablet market will dissolve into the personal computer and phone markets.

**VR:** Oculus will be the dominant platform. Unit sales will look similar to current console sales (about 30 million units a year) and Facebook will have over 50% market share.

**Visual AR glasses:** Apple, Google, Facebook and others will all have “glasses” products in the market. Magic Leap will not be in business. Of the visual AR glasses market overall, less than 5 million units will ship per year. It will be a niche product for business users and will not have meaningful consumer use.

**Earbuds:** Apple will sell more AirPods than iPhones per year. They will be nearly ubiquitous and will prove a limited but meaningful platform for developers.

**Home devices:** In the U.S., Amazon, Google and Apple will still be the three home ecosystem providers of smart speakers, cameras, and home services. Share will be reasonably split between the three. Facebook will not have a play and will have shut down its Portal device. Apple and Amazon are likely to have come to some sort of truce and be collaborative, while Google will continue to go it alone.

**Forms of human production:** The majority of my input will still be in the form of a physical keyboard. Onscreen keyboards will still be how we interact with phones. Voice recording will be ubiquitous in meetings, but voice commands will not have evolved much from where they are today. Gesture-based input will only be meaningful in VR environments. There will be zero consumer use of direct brain-interface devices. I will not type by thinking.

**Forms of human consumption:** Phones will dominate most people's digital time, but the laptop will dominate mine. My desktop screen will be no more than 20% bigger. VR will be less than 10% of my digital time.

### **Core Software and Services in 2030**

The incumbents will continue to dominate their respective zones of strengths. The experience of software will be much the same in 2030 as it is today. The exception is that things like virtual private networks and other privacy-focused technologies like password managers will go fully mainstream.

**Email:** Gmail will be the dominant email provider in the U.S. and globally. Email will continue to be the professional default for text-based communication, and my personal default mode of communication.

**Messaging:** iMessage will dominate in the U.S. but Facebook will dominate everywhere else. There will be very little change from today in terms of how messenger apps look and feel, except that the Facebook family of messengers will be integrated across products and will be encrypted by 2030 (though it will take a long time and be a huge point of regulatory tension).

**Identity and login:** There will be little change. Google will dominate service login globally. Facebook pixels and email will still be the primary keys for business customer relationship management and advertising.

**Traditional work productivity suite:** Google will broadly dominate the traditional white-collar work productivity suite (docs, spreadsheets and so on). A long list of already-in-existence work and productivity software companies will have slices of the collaboration ecosystem, including Asana, Airtable and Zapier (each of which will be worth between \$5 billion and \$25 billion).

**Maps:** Google Maps will be the largest mapping service (and the one I use). Apple Maps will be the only other relevant mapping engine. Google and Apple will both stop driving custom vehicles on the roads for mapping updates and will instead leverage clouds of car-embedded cameras and sensors for continuous updates.

**Photos:** Google and iCloud will dominate photos. Facebook will still be the place where most photos are shared daily, but it will not have a core photo-storage solution.

**Privacy tech:** Fifty percent of Americans will be using some sort of VPN provider for 80% of their internet usage. The major internet players will each offer their own. A quarter of Americans will be using a password manager distinct from the built-in options offered by iOS and Android. Five percent of Americans will rely on some form of a paid disinformation service that [uses deepfake technology](#).

**Use of VPNs in alternative jurisdictions:** As is the case today in mainland China, most of the San Francisco technorati will run personal proxies or VPNs in at least one other jurisdiction globally for access to information or services they can't get at home. I already do that today, and by 2030 I likely will maintain two.

**Social networking services:** The Facebook family of applications will continue to be the largest social networking platform by a wide margin. There will be at least 4 billion monthly active users on Facebook products (about 50% of the world population). There will be at least 10 non-Facebook-owned properties globally with a billion-plus users. Neither Twitter nor Snap will have a billion users. There will be at least 10 new social applications with 25 million-plus users in the U.S. as people add new social experiences on top of broad-based social networking.

**Commerce and payments:** Amazon will dominate e-commerce, obviously. Shopify will be a \$200 billion company. Square will be a \$100 billion company.

**Video-streaming platforms:** The ecosystem will look shockingly like it does today. YouTube, Netflix, and Amazon will be the largest players. Services like Disney Plus will exist and be healthy. Much as with social services, the average household will subscribe to three-plus video services.

**Videoconferencing:** Zoom will be a great business but will get more commoditized than it is today (one of the rare services on the list that will do so). Videoconferencing will feel embedded and commoditized in applications by 2030, much like voice is today.

### **Technology-Enabled Real-World Services**

It will be a hard decade for real-world tech-enabled services. Many of the services we have today will survive, but they will not achieve the same growth trajectory or command the same sky-high valuations as the pure software services (where I expect pure software to compound its lead).

**Transportation:** Scooters will prove to not be a viable business. They will exist in cities as low-margin utilities. Ride-sharing services will exist but will refractionalize. Uber and Lyft will be the largest in the U.S. and will still be multibillion-dollar companies, but will have been hemmed in by regulation to perpetually low-margin utility status.

There will be a popular premium player other than Uber.

**Self-driving cars:** Self-driving cars will not be meaningfully deployed on the road, though there will likely be some demonstration deployments at low volumes on specific routes. Alphabet will have divested its self-driving assets.

**Food delivery:** This will prove to be a very difficult business for the next decade just as it has recently. Doordash, Uber and Amazon will consolidate the market and be the last three standing in the U.S., having consolidated the other players in the market. Things like Zume Pizza will fade away.

**Broad commerce delivery:** This will look much as it does today. Amazon Prime Now will be rolled out further but will not be ubiquitous in the U.S. Drone delivery will not be done in major cities and neither will sidewalk bot delivery.

**Cloud kitchens:** These will not be a meaningful part of food delivery in 2030. Less than 5% of food volume will come from a cloud kitchen, though kitchen sharing and utilization will increase.

**Hotels and housing:** Airbnb will be a strong business, but much like other services that touch the real world, it will face continuously challenging regulatory issues that will prevent it from being a greater than \$100 billion company in 2030.

**Office space:** The on-demand or monthly rental model popularized by WeWork will continue to grow rapidly. The number of workers working out of shared office space will grow five times from today. The most popular office space company will be a franchise model.

**Education:** U.S. college enrollment will drop as a percentage of 18- to 24-year-olds. The average cost of a four-year college education will have declined (finally). At least 10% of education will be financed through income sharing agreements.

**Banking:** Of the five top U.S. banks, four will still be top banks. At least five branchless consumer financial services players will be valued at between \$5 billion and \$25 billion, but none will be worth more than that.

## **Social Networking, Speech and Media**

**Large social networking services such as Snap, Facebook and Instagram will be professionalized:** Most public content engagement on social networks will be with celebrities, characters and professional brands rather than friends. Professional friends are more entertaining. Private messaging and groups will subsume true personal content.

**Influencers:** The Rock will be the No. 1 most followed person on social media services, and will have 400 million-plus followers personally. Per my comments [here](#), I believe that in the wake of an explosion of social capital, the winners on platforms like Instagram have been established and volatility in power will decrease. Seven of the top 10 influencers—defined by how much they are paid per post—will be female. Ten percent of the top 100 influencers on Instagram will not be real humans but synthetic characters. The Sussex Royals will have a bigger digital footprint than the mainline monarchy.

**Advertising:** Google and Facebook will remain dominant in the U.S. by a wide margin. Instagram will be Facebook's biggest revenue-generating property. Google will have shed most of the Alphabet "other bets" and will be the most profitable company in the world.

**Subscriptions:** There will be at least 50 digital subscription brands with over \$50 million in revenue. There will be thousands of people supporting themselves full time on micro subscription services.

**News publications:** The current top brands for news—Wall Street Journal, New York Times and so on—will continue to be the dominant big brands. There will be several publications like The Information worth at least hundreds of millions of dollars, but without broad reach. BuzzFeed, Vice and their brethren will still exist as brands but will not be able to merge. They will be in decline from a traffic standpoint.

**Music properties:** Spotify, Apple Music and Youtube Music will be dominant in 2030, just as they are today. The music ecosystem will not meaningfully change/ There will not be another significant entrant.

**Video platforms:** Again, I expect little change. Netflix and Amazon will be the biggest platforms. Hulu and others will continue to knock around. Disney Plus will be in good shape. If it were anyone other than Apple, I would expect that Apple TV Plus would be shut down, but my sense is that Apple will continue to invest in the service. I don't expect much consolidation, and I do expect that the insane investment in content will continue in similar form. It might pull back a bit, but not very much. I do not believe there will be another meaningful entrant.

**Social media:** I will be engaged in at least six real social network products. The average person in the U.S. will consider themselves engaged in four. Facebook and Instagram will still be the largest platforms. The next-generation services coming up will focus on curation and moderation, IRL experiences and new formats. VR will not lead to a new dominant social platform replacing Facebook.

## **Business Technology Platforms and Human Work Clouds**

**Human clouds:** Clouds of people rather than machines will be the big business narrative by 2030. Just as the computer cloud dominated the story of the last decade, the next decade will see many of the computer cloud innovations adopted on the human side.

Many companies will have private human clouds organized around the idea that they employ people and can deploy structured processes against them, much the way they deploy code against servers today. This will mean that companies like Amazon and Google will run far more explicitly backed human-powered services to support their own products. Amazon, Google and maybe Salesforce will have at least semipublic clouds where they run human-

driven work processes for third parties. Technology companies will acquire some forward-thinking business process outsourcers like TaskUs.

**Middle management jobs will disappear:** Automation and technology will make it easier for fewer managers to successfully manage far more people. This will remove the bulk of middle management jobs by 2030 and destroy historical job ladders in most knowledge work industries.

**Human process instrumentation and measurement:** The instrumentation of human work (such as the queue-based measurement that Fin Analytics applies to industrial processes) will be a major driver of efficiency and growth, as well as an enabler of human clouds. By 2030, at least 33% of workers in the U.S. will have process instrumentation of their everyday work.

**Professional passive audio recording and transcription:** This will be standard in meeting contexts and possibly more broadly. Speech commands will not be meaningfully more sophisticated or used than they are today—when people use them as cooking timers and for placing calls and selecting media to watch—but speech as a dataset and for recall will become second nature at work.

**Other key human process cloud services:** There will be the beginnings of standardized languages for human process documentation, and something like a GitHub for human processes, where people will write process, share it, fork it and so on. Work prioritization and routing will also be a key input to the human cloud. There will be at least 10 new billion-dollar companies in this space.

**Robotic process automation:** The RPA companies will exist, but will be seen as the first version of a larger and longer theme. At some point during the decade, a large enterprise player will acquire UiPath. Microsoft will be the leader in RPA by revenue and deployment.

**CRM:** Salesforce is going to have an awesome decade. By 2030, it will be at least three times as valuable as it is today. There will be at least five other vertical CRMs, founded since 2015, that are public companies and worth at least \$10 billion.

**Business messaging:** The race by 2030 will be for brands to have personalized messaging and support experiences backed by humans and machines, not pure artificial intelligence. Companies will understand the loan-to-value ratio of each customer individually and will be able to look at service as an economic function to drive LTV.

### Macro Economy, Society and Cities

**The U.S. prison population will be down:** It has to come down.

**Business cycles:** We will not have a technical recession in the 2020s. Expanded government spending will drive the next boom.

**Interest rates:** These will largely look like they do today. Several countries will be running negative interest rates, but the U.S. will be very low—roughly where it is today.

**Climate:** We will sadly not have made much progress. The Chinese will be seen as the most forward-leaning on climate, not the U.S., which will continue to be hamstrung. By 2030, climate change will replace abortion as the most important single issue in American politics.

**Taxes:** The top marginal tax rate in the U.S. will be higher than it is today, and separate capital gains taxes will go away. We will not have a meaningful wealth tax.

**Employment:** Unemployment will register about as low as it does today (around 3%), but about 50% of workers in the U.S. will be stuck within 20% of minimum wage.

**Inflation:** This will remain very low. Again, I don't think the macroeconomy as it is measured is going to change much in the coming years.

**Inequality:** This will continue to grow. The Gini coefficient will continue to rise in the U.S. The increase in inequality will create more social unrest.

**Immigration will be more open than it is today:** It has to be. People will see that we face an increasing decline in birthrate and we will need more people.

**San Francisco and New York:** Neither will experience the skyrocketing cost of living and housing they saw in the last decade. Both will stagnate on those metrics. However, they will overall change less than people think. Many people will leave both cities for cost-of-living reasons, but many more will still be showing up to live in both places—especially San Francisco.

**New tech cities:** There will be at least two different next-generation technology cities founded on virgin ground—as opposed to taking over an existing city—by groups of Silicon Valley billionaires.

**Unions:** There will be a rise of labor activism. In the gig economy, this will look more like the lightning strikes. Technology companies will face a wave of issues at their hubs, but having a more globalized and distributed workforce than today's will buffer them. Very high-skilled employees will have an ecosystem of self-service human resources and paid professional advocates and agents rather than relying on company-sponsored resources.

**Healthcare:** The fundamental structure of healthcare in the U.S. will sadly not have changed much from the current course and speed.

### **Edge Tech**

**AI:** Hard short. We will not have anything like artificial general intelligence. The “state of the art” will mean pretty good image and speech recognition, and good deep-learning execution of games—but none of the fantasies people hope for. Many of my friends are far too optimistic here. They forget that just as with unlocking the secrets of life and DNA, there tends to always be another layer to unpeel.

**Self-driving cars:** This will not happen by 2030 in a meaningful way in the U.S. No self-driving car will drive down my street in San Francisco without a safety driver behind the steering wheel. I will not travel in one except in closed demos or for novelty. There will be a handful of dedicated routes or highways where self-driving vehicles will travel regularly.

**Drones:** These will still primarily be toys. They will not be seriously used in business or logistics. The Federal Aviation Administration will license them to fly roads and do surveillance and mapping work.

**Electric airplanes:** I will fly on one at least once in the next decade. They will not be widely used, but there will be hundreds of them in the world that are in regular commercial use.

**Space:** We will not be doing space mining. We will have reasonable space-based internet. We will have landed on the moon again—the Chinese will be there first in the decade. We will have found at least one planet that is believed to have life on it.

### **Public Companies and Venture Capital**

**Trillion-dollar companies:** There will be ten trillion-dollar companies in the world. Apple, Microsoft, Amazon, Alphabet and Facebook will make up half the list.

**Big-tech leadership:** Sundar Pichai will run Google. Mark Zuckerberg will run Facebook. Tim Cook will not run Apple and Jeff Bezos will not run Amazon. Jack Dorsey will live in Nigeria.

**Late-stage funding:** The trend toward vertical integration will continue, and venture capital firms will look more and more like investment banks. There will not be an actively investing SoftBank vision fund.

**Early-stage funding:** The death of seed funds will have been greatly overstated. I expect there will be more early-stage funds than there are today. And while some companies will opt in early to vertically integrated capital stacks, many will work with seed funds for their first financing needs. My mantra of early-stage capital raising—that most high-school marriages end in messy divorce—will be broadly accepted.

### **Digital Currency**

**Dominant crypto ecosystem:** Bitcoin will be the most valuable crypto coin or token and the largest ecosystem by 10 times, as it is today. And it will be at least 10 times more valuable than it is today, but less than 100 times where it is today.

**Privacy coins:** These will exist and be used, but generally not by Americans.

**Usage of crypto:** There will not be meaningful DApps. Bitcoin will be a store of value, which is infrequently traded. There will be layer 2 distributed solutions like Lightning, and then more-centralized digital-less-distributed coins for daily use.

**Crypto-speech platforms:** The exception is that there will be some sort of distributed Twitter. It will not be heavily used, but it will exist, and it will be valuable in a world where the major social products are forced to lock down speech.

### **Computer Cloud**

**The centralized cloud:** This will continue to be dominated by Amazon Web Services. Microsoft will be in second place. Google will have either spun out its business or reframed it strategically away from being a public cloud offering toward something more integrated with its business service offering.

**The edge cloud:** This is clearly what you need to deal with 5G. Things like self-driving cars and VR will be dominated by whoever can successfully boot and manage the biggest network of points of presence. Given the political issues surrounding big technology, this is the one place it is possible a smaller company could come out of nowhere and make it to the \$1 trillion mark in the next decade, though the massive capital requirements to do so would be a challenge. If a big company ends up dominating the edge cloud, I think it will be Microsoft or perhaps Facebook. Microsoft could succeed because it is the least objectionable, but Facebook might step up because it will need the edge cloud for its own use the most, due to its VR play. If it is a small, already existing company, it could be someone like Cloudflare. It could also be someone new.

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*Sam is currently an intern at The Information and co-founder and co-CEO of Fin. He also invests in tech startups through Slow Ventures, where he is a partner. He was formerly a vice president of product management at Facebook from 2010 to 2014, where he managed the People, Places, and Things product group and the Identity product group. Prior to joining Facebook Sam founded drop.io, a file-sharing platform that was acquired by Facebook in 2010. Before drop.io Sam was an associate at Bain and Company.*

By Duncan Riley

Venture capital investments in the U.S. may be slowing a bit, and so are startup “exits” such as initial public stock offerings and acquisitions, but both remain near record highs as investors keep betting on continued growth in the tech sector.

That’s the upshot of two different reports on the VC and startup funding business that were released tonight. They also found, not surprisingly, that software and internet companies, particularly cloud software-as-a-service companies, dominated the venture investing field.

According to data published in the quarterly PitchBook-NVCA Venture Monitor, venture capital funding closed above \$130 billion for the second straight year and overall exits hit a new high. VC investments in the fourth quarter of 2019 came in at \$34.2 billion invested across 2,215 deals, bringing the total for 2019 to \$136.5 billion across 10,777 deals.

The overall number was down from \$140.2 billion invested in 2018. The investment market, as noted in the third-quarter figures, is slowing somewhat, but the level is still at near-record highs.

Another tally, from the PwC/CB Insights MoneyTree Report, showed much the same trends, albeit with somewhat different numbers. That report says fourth-quarter U.S. VC funding fell 9% from a year ago, to \$108 billion, while the number of deals fell almost 10% from a year ago, to 1,324.

Although so-called “mega-deal investments” dominated the year, investment rose across the board. Some 237 mega-deals, investments of more than \$100 million, were recorded during the year, up from 212 last year, according to PitchBook/NVCA, while PwC/CB Insights pegged the total at 213. Valuations on all rounds also rose, according to PitchBook/NVCA, with the average deal valuation coming in at \$8 million for angel and seed rounds, \$29.4 million on early VC and \$88 million on late VC rounds, all three the highest levels ever recorded.

The amount invested in angel and seed rounds in 2019 came in at \$9.1 billion, slightly down from the record \$9.2 billion invested last year, with the number of deals remaining steady at 4,556. While possibly reflective of a slight slow down, startups are also waiting longer to raise angel and seed capital with the 75th percentile and median coming in at 5 years and 2.9 years respectively, the latest ever recorded and nearly double the figures from 2012.

Where money was invested also shifted through the year with companies in the Mid-Atlantic region, which includes New York City, obtaining 24.2% of venture capital in 2019 versus 14.5% in 2018. The West Coast, by comparison, saw its deal value drop from 62.3% to 50.2% of the overall market.

By market segment, software companies not surprisingly continued to lead the pack with \$43.5 billion invested in 2019, although the number of deals dropped slightly from 2018. Health tech booked \$7.6 billion in VC during the year, its highest ever recorded on 658 deals, also a new record. As PwC/CB Insights noted, the top U.S. VC deal in the quarter was Minneapolis-based health insurance company Bright Health Inc., which raised a \$635 million Series D round.

Cybersecurity saw \$5 billion invested in the year, also a record, although the number of deals remained flat as rounds became bigger. Pharma and biotech went in the opposite direction. Although it recorded its highest-ever number of deals with 866, the amount invested came in a \$16.6 billion, down from \$18.6 billion in 2018.

Exits

In the fourth quarter, exits — meaning initial public offerings of stock as well as mergers and acquisitions — came in at \$18.8 billion across 174 deals. That was down from \$35.4 billion in exits during the previous quarter and the second straight quarter the figure has declined. The largest exit in the fourth quarter was PayPal Inc.’s acquisition of Honey Science Corp. for \$4 billion in November.

In 2019 in total, exits came in at a record high of \$256.4 billion across 882 liquidity events. IPOs were the primary driver behind the record figure even though IPO activity dropped off in the fourth quarter.

The drop is attributed to the lackluster performance of some IPOs putting a damper on other companies going public. Direct listings were also noted to have gained momentum in 2019, with the report predicting that the method of taking companies public will likely find more favor among unicorns in the year ahead as an alternative to a traditional IPO.

Venture capital funds raised \$45.1 billion across 258 vehicles in 2019, the second-highest level raised by VCs in the last decade but down significantly from the \$58 billion raised in 2018. While direct fund raising declined, the funds themselves grew to a median size of \$77 million in the year thanks to strong distributions elevating net cash flows.

“2019 showed that industry trends from the historic 2018 are the new normal for the venture industry, with mega-rounds and mega-funds becoming increasingly common trends in the startup ecosystem,” Bobby Franklin, president and chief executive officer of NVCA, said in the statement. “While there are lingering uncertainties surrounding global macroeconomic trends, U.S. public policies and the 2020 election that could impact the industry, the flood of exit dollars going back to LPs, the robust fundraising environment, and large amounts of dry powder available at many venture firms should allow the industry to sustain this new level of investment activity in 2020.”

**The list includes a potential economic downturn, board diversity, corporate reputation, pay equity, cybersecurity, and corporate innovation.**

By David McCann

Preparation for an economic downturn is among the issues that will dominate the attention of corporate boards of directors in 2020, according to law firm Akin Gump Strauss Hauer & Feld's [annual look](#)<sup>1</sup> at top board matters.

“Certain challenges commonly associated with economic downturns, such as a reduction in access to public and private capital markets, may be difficult for corporate boards to fully hedge against,” the Akin Gump report says.

Directors should familiarize themselves with any limitations on the company's ability to raise capital, such as those arising from agreements with lenders or shareholders, the law firm counsels.

Additionally, debt covenants should be continually reviewed “to provide warning signs regarding defaults or thin cushions and/or prompt early negotiations” in the event of changing financial conditions.

Directors also should understand that a weak economic environment “may enlarge the group of shareholders with standing and motivation to bring a derivative claim for breach of fiduciary duty,” the report says.

Here are some of the other priorities for boards this year.

### **Board Diversity**

While diversity and inclusion can provide a competitive advantage and enable growth, the proportion of women and minorities serving on boards still doesn't reflect the makeup of the general population, Akin Gump notes.

Diversity has been a top concern for boards for several years because it's also a focal point for such stakeholders as investors, employees, and customers. Yet at the same time, 72% of male directors believe that investors are too focused on diversity, according to a 2019 survey by PricewaterhouseCoopers that the report cites.

Statutes imposing quotas on public-company boards are still being implemented. But, the report notes, it's too soon to gauge whether they will have a meaningful impact on improving diversity.

For one thing, mandated quotas could end up being interpreted as violating the Equal Protection Clause of the U.S. Constitution as well as state constitutions.

Further, “quotas are not necessarily supported by members of the business community, even women. They have been criticized as micromanaging business and adding ‘token’ women to boards over other qualified candidates.”

### **Corporate Reputation**

The Internet has, of course, made it possible for anyone to falsely attack a company's products, brands, leadership, and overall integrity.

Unfortunately, as found by a recent Pew Research study, 45% of Americans today get their news from a single social media platform.

False attacks “can now originate on an obscure electronic bulletin board — and be ‘trending’ on social media in a matter of hours. From there, Internet news providers, with none of the checks and filters of the mainstream media, can give an online media assault legitimacy that would have been unimaginable a generation ago.”

Boards should monitor the electronic marketplace. “Dealing with false allegations before they expand into a broader forum and threaten real harm requires a high level of vigilance,” Akin Gump says.

Also, allegations that begin to circulate online may be offensive and seem fundamentally unfair but basically true, the report stresses. “When the facts are bad, go to work on fixing the underlying problem and make no secret of what you are doing.”

### **Pay Equity**

Recently enacted state and local laws aim to eliminate pay differences according to gender and race. Determining a company’s vulnerability to equal pay claims and making adjustments where needed is one way to mitigate risk and create a positive public narrative, the report advises.

Aside from litigation risk and negative publicity, perceived pay inequality and lack of transparency create problems within companies, according to the report.

“Employees may feel undervalued, which can decrease productivity, stifle innovation, increase turnover, and create a toxic us-against-them culture,” the report says. “As the workforce struggles, a company’s bottom line also suffers.”

Before undertaking a pay equity analysis, a company should cloak the effort as attorney-client privileged, Akin Gump counsels. “Deliberately document the study as centered upon obtaining legal advice about vulnerability to equal pay claims — not simply to review current pay and make adjustments.” That helps avoid creating discoverable evidence that could be used against a company in future litigation.

Also, companies should seek to make pay adjustments without alerting anyone to the fact that they may have been underpaid.

“Consider a situation where a company performs a pay equity study and identifies that some women are paid, on average, 18 cents less than per dollar than men in substantially similar positions,” says the report. “If no action is taken and an Equal Pay Act lawsuit is filed, companies may be unable to avoid an automatic doubling of back pay as liquidated damages.”

In such a case, closing the pay gap might not require immediately raising the women’s pay by 18 cents. However, a short-term and long-term action plan will need to be developed that ultimately aims to close the gap through merit-pay increase cycles and adjusts starting pay for those hired or promoted, according to the report.

### **Cybersecurity**

This has been increasingly on boards’ radar screens in recent years, and for good reason. In addition to the potential for vast reputational damage as a result of security breaches, the European Union’s General Data Protection Regulation imposes penalties of up to 4% of worldwide revenue for non-compliance.

The new California Consumer Privacy Act is not as onerous, but it does impose penalties of \$2,500 per negligent violation and \$7,500 per intentional violation.

“However,” the report states, “the likely game-changer is the private cause of action: Individuals now can sue for certain data breaches where companies did not have ‘reasonable security,’ with statutory damages of \$100 to \$750 per incident, per customer.”

In addition to staying current on cybersecurity compliance, boards should insist that companies step up the use of internal controls to stop wire fraud and seek cyber insurance to mitigate risk, Akin Gump advises.

### **Corporate Innovation**

Since today's business environment is largely driven by technology, boards must continually harness strategic innovation to stay competitive.

Akin Gump expects that in 2020 companies will add directors with meaningful technology-related background and experience, so that the board can fully understand the risks and benefits of adopting emerging technologies and an innovation mindset.

An emergent best practice for boards involves regular updates from the company's chief information officer or chief technology officer, the report notes.

"While many boards initially focused on the need for director technology expertise in the context of evaluating cybersecurity and data privacy risks," Akin Gump observes, "some companies are starting to appreciate [that] tech-savvy board members [can] assist not only in protecting against risks but also in guiding innovative strategies and opportunities that positively impact the company's business."

And ...

Rounding out the list of top concerns for boards in 2020 are the presidential race and impeachment proceedings; international trade deals expected to launch or be negotiated this year; and environment, social, and governance (ESG) issues.

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*Annual look' – Please find enclosed "Top 10 Topics for Directros in 2020" pdf file*

By Dani Ellenby, Okinawa Institute of Science and Technology

Over the last few decades, machine learning has revolutionized many sectors of society, with machines learning to drive cars, identify tumors and play chess—often surpassing their human counterparts.

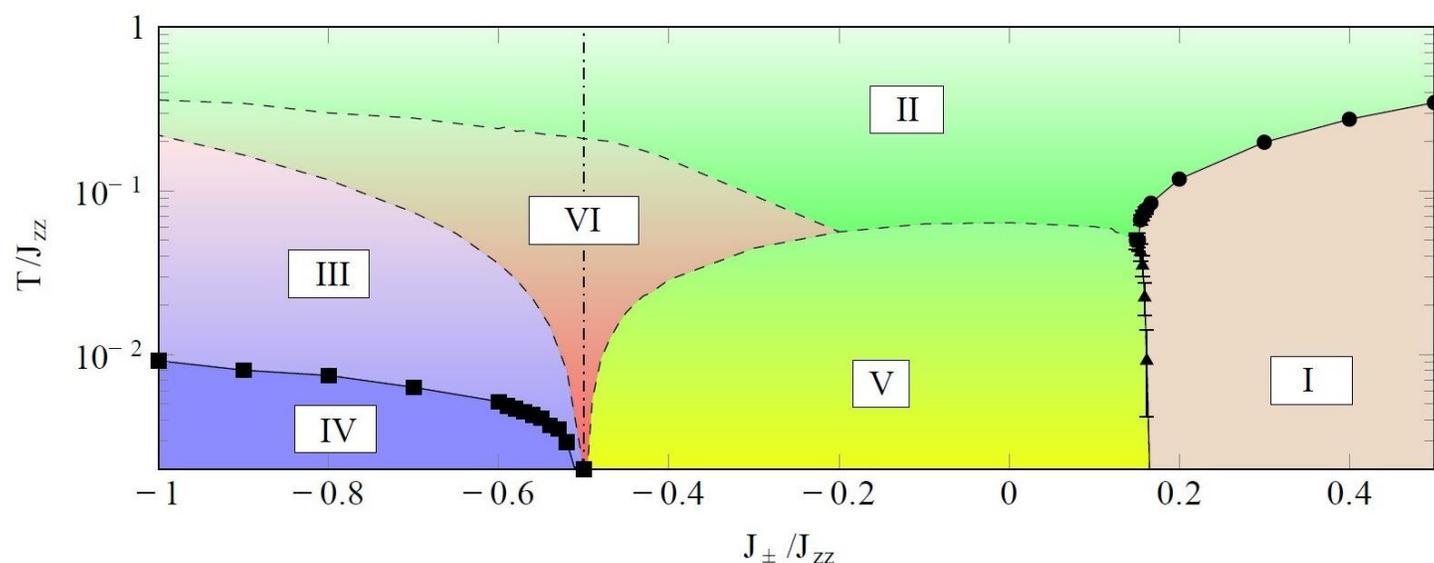
Now, a team of scientists based at the Okinawa Institute of Science and Technology Graduate University (OIST), the University of Munich and the CNRS at the University of Bordeaux have shown that machines can also beat theoretical physicists at their own game, solving complex problems just as accurately as scientists, but considerably faster.

In the study, recently published in *Physical Review B*, a machine learned to identify unusual magnetic phases in a model of pyrochlore—a naturally-occurring mineral with a tetrahedral lattice structure. Remarkably, when using the machine, solving the problem took only a few weeks, whereas previously the OIST scientists needed six years.

"This feels like a really significant step," said Professor Nic Shannon, who leads the Theory of Quantum Matter (TQM) Unit at OIST. "Computers are now able to carry out science in a very meaningful way and tackle problems that have long frustrated scientists."

### The Source of Frustration

In all magnets, every atom is associated with a tiny magnetic moment—also known as "spin." In conventional magnets, like the ones that stick to fridges, all the spins are ordered so that they point in the same direction, resulting in a strong magnetic field. This order is like the way atoms order in a solid material.



The phase diagram produced by the Theory of Quantum Matter unit at OIST, showing all the different magnetic phases that exist in the simplest model on a pyrochlore lattice. Phase III, VI and V are spin liquids. Credit: Image reproduced with permission of the American Physical Society from *Phys. Rev. X*, 2017, 7, 041057

But just as matter can exist in different phases—solid, liquid and gas—so too can magnetic substances. The TQM unit is interested in more unusual magnetic phases called "spin liquids", which could have uses in quantum computation. In spin liquids, there are competing, or "frustrated" interactions between the spins, so instead of ordering, the spins continuously fluctuate in direction—similar to the disorder seen in liquid phases of matter.

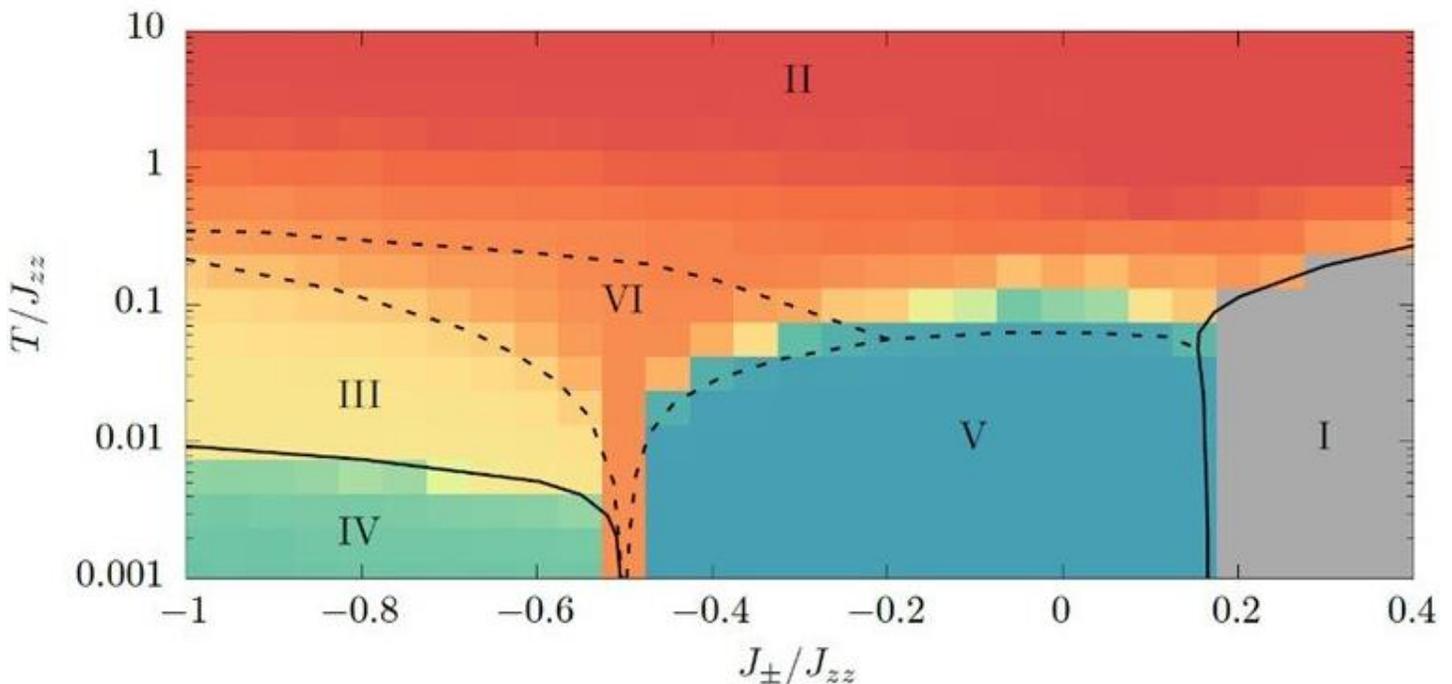
Previously, the TQM unit set out to establish which different types of spin liquid could exist in frustrated pyrochlore magnets. They constructed a phase diagram, which showed how different phases could occur when the spins interacted in different ways as the temperature changed, with their findings published in *Physical Review X* in 2017.

But piecing together the phase diagram and identifying the rules governing the interactions between spins in each phase was an arduous process.

"These magnets are quite literally frustrating," joked Prof. Shannon. "Even the simplest model on a pyrochlore lattice took our team years to solve."

### Enter the machines

With increasing advances in machine learning, the TQM unit were curious as to whether machines could solve such a complex problem.



The phase diagram reproduced by the machine. For comparison, the phase boundaries previously determined by the scientists without the machine have been drawn over the top. Credit: Image reproduced with permission of the American Physical Society from *Phys. Rev. B*, 2019, 100, 174408

"To be honest, I was fairly sure that the machine would fail," said Prof. Shannon. "This is the first time I've been shocked by a result—I've been surprised, I've been happy, but never shocked."

The OIST scientists teamed up with machine learning experts from the University of Munich, led by Professor Lode Pollet, who had developed a "tensorial kernel"—a way of representing spin configurations in a computer. The scientists used the tensorial kernel to equip a "support vector machine", which is able to categorize complex data into different groups.

"The advantage of this type of machine is that unlike other support vector machines, it doesn't require any prior training and it isn't a black box—the results can be interpreted. The data are not only classified into groups; you can also interrogate the machine to see how it made its final decision and learn about the distinct properties of each group," said Dr. Ludovic Jaubert, a CNRS researcher at the University of Bordeaux.

The Munich scientists fed the machine a quarter of a million spin configurations generated by the OIST supercomputer simulations of the pyrochlore model. Without any information about which phases were present, the machine successfully managed to reproduce an identical version of the phase diagram.

Importantly, when the scientists deciphered the "decision function" which the machine had constructed to classify different types of spin liquid, they found that the computer had also independently figured out the exact mathematical equations that exemplified each phase—with the whole process taking a matter of weeks.

"Most of this time was human time, so further speed ups are still possible," said Prof. Pollet. "Based on what we now know, the machine could solve the problem in a day."

"We are thrilled by the success of the machine, which could have huge implications for theoretical physics," added Prof. Shannon. "The next step will be to give the machine an even more difficult problem, that humans haven't managed to solve yet, and see whether the machine can do better."

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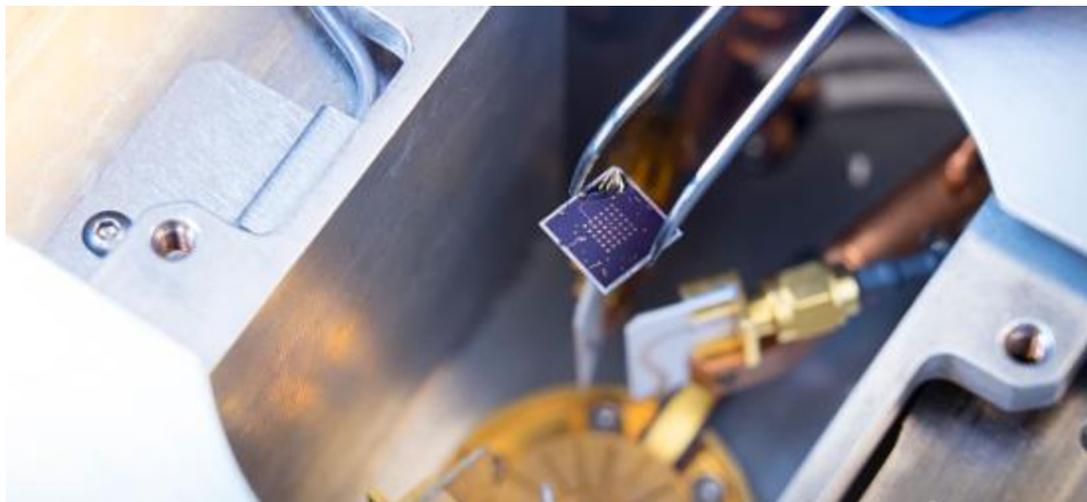
**More information:** *Jonas Greitemann et al, Identification of emergent constraints and hidden order in frustrated magnets using tensorial kernel methods of machine learning, Physical Review B (2019). DOI:*

[10.1103/PhysRevB.100.174408](https://doi.org/10.1103/PhysRevB.100.174408)

**Journal information:** [Physical Review B](#)

## **New 2D materials made into synapse-like devices for future neuromorphic chips**

By Samuel K. Moore



*Ferroelectric semiconductors could be the basis of a high-density memory for neuromorphic .*

Engineers at Purdue University and at Georgia Tech have constructed the first devices from a new kind of two-dimensional material that combines memory-retaining properties and semiconductor properties. The engineers used a newly discovered ferroelectric semiconductor, alpha indium selenide, in two applications: as the basis of a type of transistor that stores memory as the amount of amplification it produces; and in a two-terminal device that could act as a component in future brain-inspired computers. The latter device was unveiled last month at the IEEE International Electron Devices Meeting in San Francisco.

Ferroelectric materials become polarized in an electric field and retain that polarization even after the field has been removed. Ferroelectric RAM cells in commercial memory chips use the former ability to store data in a capacitor-like structure. Recently, researchers have been trying to coax more tricks from these ferroelectric materials by bringing them into the transistor structure itself or by building other types of devices from them.

In particular, they've been embedding ferroelectric materials into a transistor's gate dielectric, the thin layer that separates the electrode responsible for turning the transistor on and off from the channel through which current flows. Researchers have also been seeking a ferroelectric equivalent of the memristors, or resistive RAM, two-terminal devices that store data as resistance. Such devices, called ferroelectric tunnel junctions, are particularly attractive because they could be made into a very dense memory configuration called a cross-bar array. Many researchers working on neuromorphic- and low-power AI chips use memristors to act as the neural synapses in their networks. But so far, ferroelectric tunnel junction memories have been a problem.

"It's very difficult to do," says IEEE Fellow Peide Ye, who led the research at Purdue University. Because traditional ferroelectric materials are insulators, when the device is scaled down, there's too little current passing through, explains Ye. When researchers try to solve that problem by making the ferroelectric layer very thin, the layer loses its ferroelectric properties.

Instead, Ye's group sought to solve the conductance problem by using a new ferroelectric material—alpha indium selenide—that acts as a semiconductor instead of an insulator. Under the influence of an electric field, the molecule

undergoes a structural change that holds the polarization. Even better, the material is ferroelectric even as a single-molecule layer that is only about a nanometer thick. “This material is very unique,” says Ye.

Ye’s group made both transistors and memristor-like devices using the semiconductor. The memristor-like device, which they called a ferroelectric-semiconductor junction (FSJ), is just the semiconductor sandwiched between two conductors. This simple configuration could be formed into a dense cross-bar array and potentially shrunk down so that each device is only about 10 nanometers across, says Ye.

Proving the ability to scale the device down is the next goal for the research, along with characterizing how quickly the devices can switch, explains Ye. Further on, his team will look at applications for the FSJ in neuromorphic chips, where researchers have been trying a variety of new devices in the search for the perfect artificial neural synapse.

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## Startups smash annual record for VC-backed exit value with 2019's IPO onslaught

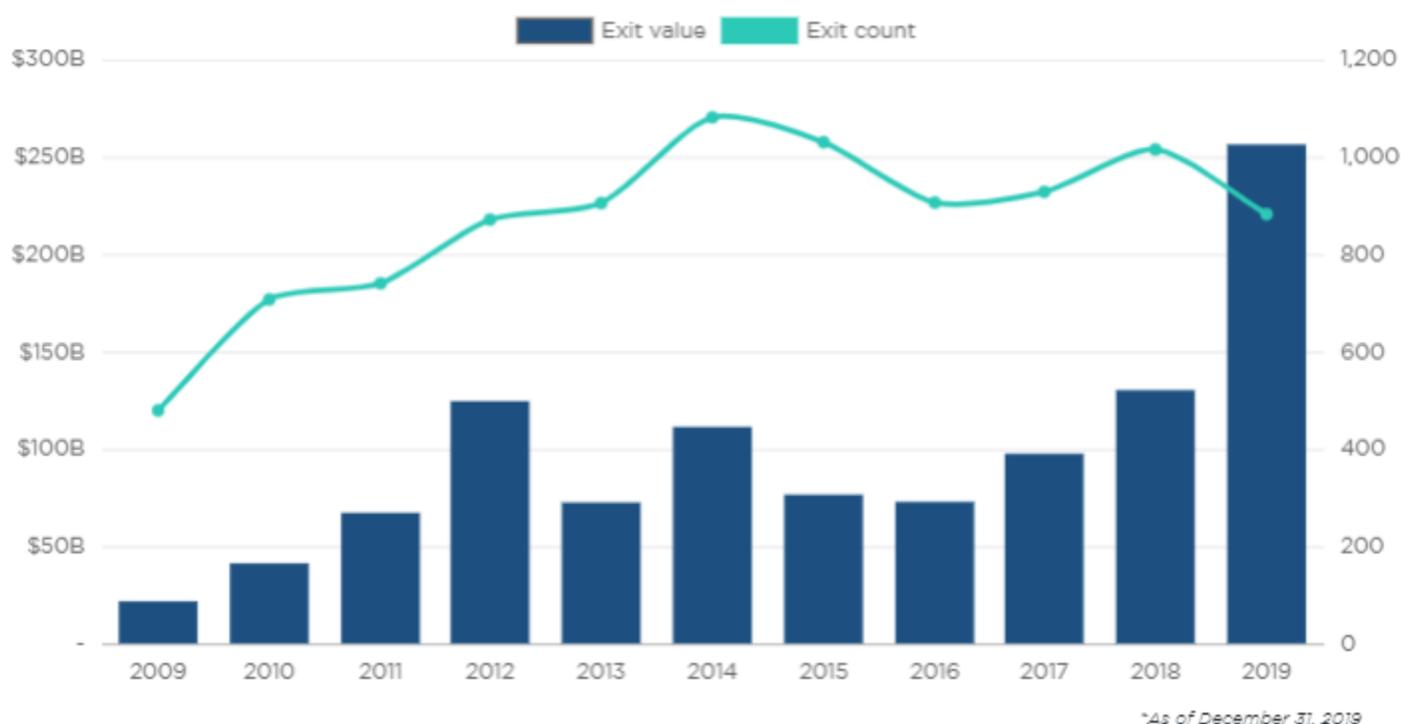
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By James Thorne

Venture-backed startups proved their worth in 2019 by following through on successful exit strategies, despite a slowdown in activity near the end of the year.

The value of all exits for venture-backed companies, which includes IPOs, buyouts and acquisitions, hit a record \$256.4 billion across 882 deals, according to the 4Q 2019 PitchBook-NVCA Venture Monitor. That value was nearly double the \$130.2 billion in 2018, which was itself a record at the time.

Initial public offerings accounted for 78% of the total value, or \$198.7 billion—more than the previous four years combined. The pre-money valuations of Uber, Lyft and Slack collectively contributed \$112.5 billion, garnering huge IPO valuations despite subsequently dismal reception by public investors.



Sourced: PitchBook

Following those high-profile disappointments, IPO activity declined 26% in 4Q 2019 compared with the pace set in the first three quarters.

"Profitability, or being cash-flow positive, is now almost required," Previn Waas, US IPO Services Leader at Deloitte, told PitchBook. "Companies are thinking about right-sizing themselves, shedding some unprofitable businesses, getting out of some geographies that are perhaps not proving to be as accretive as they thought it might be, getting out some product lines, in order to right-size in advance of an IPO."

Taken as a whole, companies that pursued an IPO last year performed well following their debuts. The Renaissance Capital IPO Index, which tracks the performance of newly public companies, gained 41% in 2019 and beat major indexes like the S&P 500.

"The struggles of some companies in the IPO and pre-IPO market have gotten a lot of headlines recently. What's lost in the shuffle: most real technology IPOs are doing just fine," wrote Michael Cembalest, chairman of market and investment strategy at J.P. Morgan, in a 2020 Outlook report. Datadog, Zoom and CrowdStrike were among the tech companies to post double-digit stock price growth following their IPOs last year.

In a sign of the unicorn-heavy times, there were 54 exits valued at more than \$500 million. Acquisitions, which are by far the most popular exit strategy for VC-backed companies, dropped to the lowest share of total exits in the past decade.

Looking ahead, EY Global IPO Leader Paul Go expects IPO activity to pick up in the first half of this year, noting that many companies will want to go public before US elections in the fall. "As we head into 2020, we anticipate that some of the geopolitical uncertainties and trade tensions that plagued the IPO market in 2019 will fade," he wrote in a recent report.

Several of the most highly funded companies currently in registration for an IPO—including CHJ Automotive, Megvii and Danke Apartment—are based in China. In the US, the most prominent companies that are testing IPO conditions in the coming months include direct-to-consumer mattress business Casper and healthcare startups One Medical and Beam Therapeutics. DoorDash and Airbnb are also reportedly eyeing public offerings.

"I think 2020 is going to be a solid year. I just don't think it's going to reach the heights of last year in terms of capital raised," Waas said.

Nature paper "[Surface plasmon enhanced Organic color image sensor with Ag nanoparticles coated with silicon oxynitride](#)" by Sung Heo, Jooho lee, Gae Hwang Lee, Chul-Joon Heo, Seong Heon Kim, Dong-Jin Yun, Jong-Bong Park, Kihong Kim, Yongsung Kim, Dongwook Lee, Gyeong-Su Park, Hoon Young Cho, Taeho Shin, Sung Young Yun, Sunghan Kim, Yong Wan Jin, and Kyung-Bae Park from Samsung Advanced Institute of Technology, Dongguk University, Yonsei University, Seoul National University, and Chonbuk National University shows Samsung efforts to improve OPD pixels:

"As organic photodetectors with less than 1  $\mu\text{m}$  pixel size are in demand, a new way of enhancing the sensitivity of the photodetectors is required to compensate for its degradation due to the reduction in pixel size. Here, we used Ag nanoparticles coated with  $\text{SiOxNy}$  as a light-absorbing layer to realize the scale-down of the pixel size without the loss of sensitivity. The surface plasmon resonance appeared at the interface between Ag nanoparticles and  $\text{SiOxNy}$ . The plasmon resonance endowed the organic photodetector with boosted photon absorption and external quantum efficiency. As the Ag nanoparticles with  $\text{SiOxNy}$  are easily deposited on ITO/ $\text{SiO}_2$ , it can be adapted into various organic color image sensors. The plasmon-supported organic photodetector is a promising solution for realizing color image sensors with high resolution below 1  $\mu\text{m}$ ."

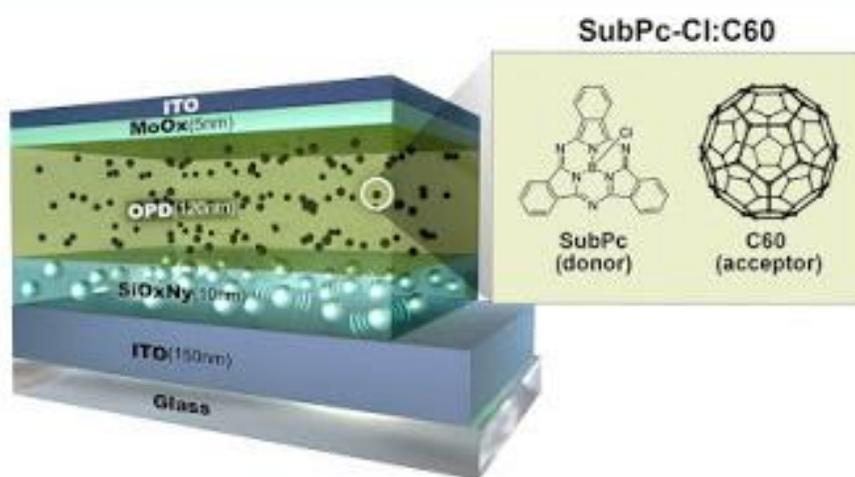


Figure 1. Structure of the OCIS with Ag/ $\text{SiO}_x\text{N}_y$  buffer layer. Glass substrate/ITO(150 nm)/Ag nanoparticles  $\text{SiO}_x\text{N}_y$  (10 nm)/blend layer(120 nm)/ITO. The blend layer is composed of C60 (acceptor) and Boron subphthalocyanine chloride (SubPc-Cl, donor).

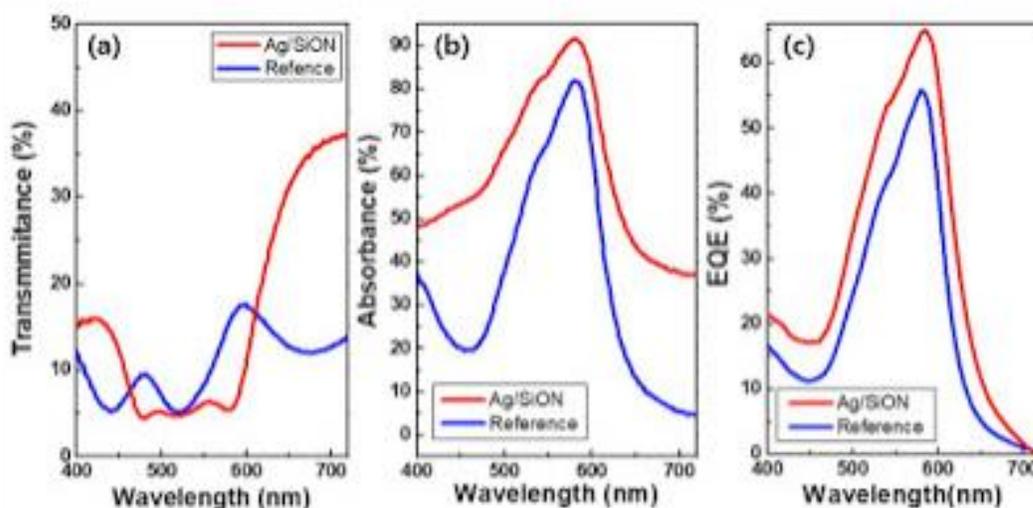
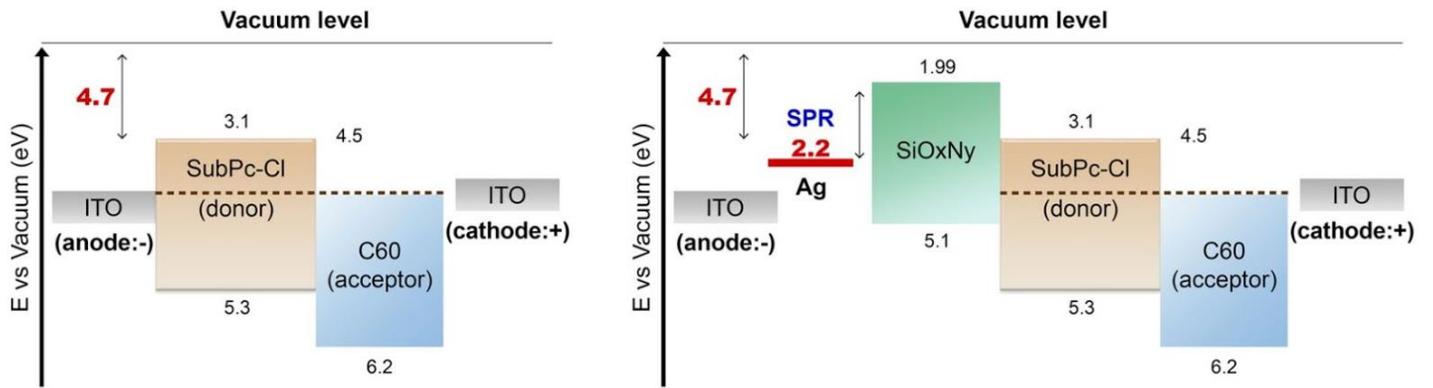
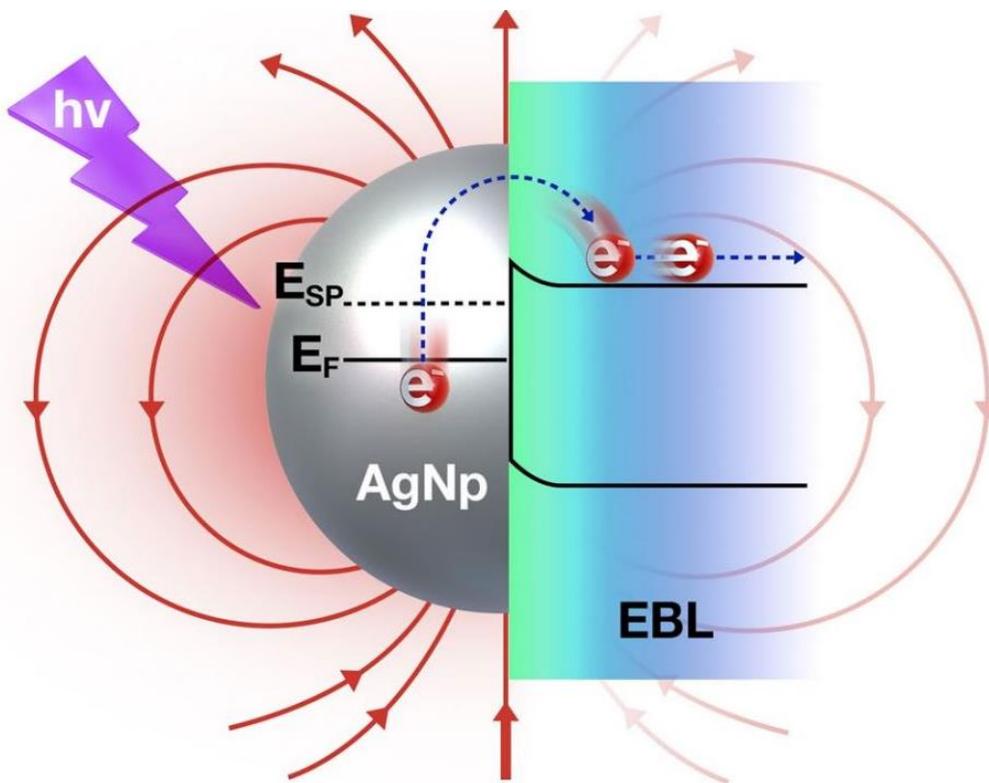


Figure 4. Optical properties of the reference sample and the OPD. (a) Transmittance curves. (b) Absorbance curves. (c) EQE curves.



**Figure 6.** Band structures of the reference OPD and OPD with Ag NP/SiO<sub>x</sub>N<sub>y</sub> layer. (a) The reference OPD (b) OPD with Ag NP/SiO<sub>x</sub>N<sub>y</sub> layer.



**Figure 7.** Mechanism of photon-absorption enhancement by surface plasmon resonance.

"In summary,... Although the effective area for receiving the incident photon is expected to decrease with the scaling-down of the pixels, the introduction of the SPR in OCIS counters the problem without losing the spatial resolution. With further systematic research conducted on the pattern and size of Ag NPs, the SPR is likely to be the sole solution for realizing OCISs with high resolution below 1  $\mu\text{m}$ ."

*By Andreessen Horowitz Editorial*

### **The Circle of Life for Health Tech Startups**

The vast majority of healthcare spend, operational transactions, and encounters occur through traditional clinics, hospitals, and insurance companies—all entities it's been very hard to sell tech to in the past, as the first cohort of health tech companies in the early 2010's learned painfully. Because of the tech immaturity of those buyers at the time, they were largely unable to absorb startups' solutions quickly enough to support high-growth, venture scale business models.

In response, the next generation of health tech startups shifted to building around the system, in the form of direct-to-consumer services and full-stack companies (primary care providers, pharmacies, insurance companies, appointment marketplaces, etc). Consumers were so fed up with what was broken in the traditional healthcare system—lack of access, convenience, and affordability—that a group of early adopters were willing to pay out of pocket to new companies for lower wait times and better customer service. That pent up demand meant that many of these startups began to experience rapid early growth—and many continue to exhibit astounding early user acquisition and revenue metrics that are unprecedented in the digital health space. But the hard truth is that there will be a limit to this trajectory, and these companies will have to face the inevitable challenge of integrating into the broader supply chain of healthcare to continue to get to true scale, both in terms of the surface area of their products, as well as their reach into broader patient populations.

Meanwhile, providers' and payors' technology infrastructure has matured significantly, along with a broad recognition that EHRs and other core systems are not fit to solve today's business challenges in delivering value-based care, care coordination, and improving customer experience. Incumbents are also at a tipping point of financial pressure, due to payment model reform and competition, compelling them to innovate in big and different ways. So we will soon see a third generation of health tech startups emerge, many as full-stack, consumer-centric companies who (thanks to that second generation!) have renewed courage to sell directly to and partner with the traditional players, with the reward of achieving massive scale and transforming the system through its core.

—Julie Yoo, General Partner

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### **Discovery v. Engineering**

Bioengineering, once viewed primarily as an academic discipline, is growing up. Tools and treatments that are engineered, not discovered, are now making their way not just into new startups but into established industry and major biopharma companies—massive organizations built on the foundations of discovery, ingesting companies built with an engineering DNA.

Now come the culture clashes. In biopharma and healthcare today, the “old” culture of discovery — the idea that science is driven by discovering new knowledge (hypothesis → test → repeat) — is clashing with the “new” culture of engineering (design → test → iterate). This clash encompasses how everything is handled, from identifying biological targets to designing clinical trials and even to how we access health care. In this article published in STAT, I talk about the 4 major culture clashes we'll see as these two worlds and mindsets increasingly intersect—driving us forward into the future. Welcome to the bioengineering culture clashes.

—Vijay Pande, General Partner

## 16 Bio Myths and Misconceptions

Tech and biotech just don't mix. At least that's the conventional wisdom. But the intersection of the worlds of biology, computer science, and engineering has created a new hybrid of tech + biotech that we simply call "bio". World, meet bio. Bio, eat world.

In this new bio world, the well-worn playbooks are out of date. Bio is blurring lines and dissolving silos across the entire healthcare industry. In this post, I tackle 16 enduring myths, misconceptions, and sacred cows that still persist in traditional tech and biotech circles when it comes to bio (e.g., Scientific founders can't be CEOs! Silicon Valley can't do biotech!)—and why they're the wrong mindsets for this new world.

—Jorge Conde, General Partner

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### The Decade of Synbio's Killer App

From 2000-2010, we saw the birth of the conceptual framework for synthetic biology, in early "toy genetic circuits"—essentially, simple tools to turn proteins production in cells on or off. Many predicted that our ability to program in genetic code would create a waterfall of new products and revolutionize every industry. While people had used microbes to produce molecules for years, the first big, concerted effort to chase an application for synthetic biology was the production of biofuels, which didn't turn out to be the best application (biofuels were too cheap of a product, scaling was too hard, etc). The biofuels bust in the early 2010's caused many companies to pivot into making more valuable chemicals like flavors and fragrances. But the sad truth about most of those chemical production applications of engineering biology is that they actually don't require the intricate complexity and full power that synthetic biology techniques are capable of: building cells that can sense, compute, even respond.

The last decade saw synthetic biology finally find a killer app for the complexity available to it: cell therapies. Some early ideas included bacteria engineered to kill tumors, or engineered cells that could sense and respond to sugar in the bloodstream to help manage diabetes—but these efforts were made too far removed from the clinical community to have a realistic path to market. In the meantime, however, Carl June's lab was doing the groundbreaking work of expressing chimeric antigen receptors (CARs) in T-cells, which normalized the idea of engineered cell therapies. Following this breaking of the ice, groups like Cell Design Labs and others applied the mindset and tools of synthetic biology (switches, logic gates, etc) to these CAR T therapies. Now the path to engineered cells with dynamic sense-and-respond capabilities is much clearer.

CAR T therapy's cancer killing ability was only the first killer app for synthetic biology tools and techniques. There are endless applications for advanced biological computation that once sounded far-fetched: patterned materials that can self-repair when they sense damage; highly parallel computation across a population of cells or molecules to outperform silicon; perhaps even an automated "cellular recorder" for what food, medicine, and exercise a patient has experienced. As we continue to see new generations of scientists and founders trained in the mindset of "engineering biology", we will see more and more clinical communities and other industries embrace these new tools, leading more and more possibilities and many new applications. The biggest obstacle is no longer technical, it's finding the right applications where the market opportunity can justify high development costs.

—Judy Savitskaya, Deal Partner

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### The Industrialization of Cell and Gene Therapies

History will remember the past decade as the coming of age moment for cell and gene therapies. A field once mired with setbacks has closed off the decade with 4 FDA approved medicines (including 2 CAR T drugs and 2 in-vivo gene therapies) and its most groundbreaking tool, CRISPR, make its way to clinical trials in humans.

This coming decade will be the golden age of translating these "living medicines" into practice. As cell and gene therapies make their way into part of our standard therapeutic armament, we will begin to see their full-scale industrialization. AI and automation will transform the laborious and bespoke elements of design (genome and cell engineering), manufacturing (e.g., vectors and cells) and delivery of these therapies (supply chain and logistics) into

much more efficient processes. The cell and gene-editing “developer community” will continue to expand our collective toolkit, allowing us to perturb and engineer biology in new dimensions and at levels of precision that were previously unscalable. New protein engineering, genetic circuits, and delivery system innovations will change the paradigm of how we use and dose these medicines.

As the infrastructure to produce these drugs matures, cell and gene therapies will start to go mainstream: treating many more chronic diseases and conditions that the vast majority of the population experience—cardiovascular and neurodegenerative disease, solid tumors, maybe even aging. On the flip side, we will also see the door open to “n of 1”, precision medicines for single patients with very specific genetic ailments (once impossible from a technological and financial standpoint). Beyond pure drugs, this technology is also ripe to help us realize many of the long promised innovations in regenerative medicine—organ replacement, tissue regeneration, and even engineering stem cells to be the foundation of new off-the-shelf cell therapies.

—Andy Tran, Deal Partner

By Christoph Hammerschmidt



The technology provider specializing in data transmission via Plastic Optical Fiber (POF) has developed an optical transmission system in automotive quality with 25 Gigabit per second.

The new standard will extend the existing 10GBASE-SR, the current IEEE standard, to establish a communication channel in 10 Gbit/s optical fiber. "Technology leaps such as electric vehicles, automated driving and V2X connections are rapidly gaining ground,"

explains Carlos Pardo. "As a result, the necessary network speed in the automotive sector is increasing enormously with the applications, workload and safety requirements. Accordingly, automotive networks are at the threshold of speeds from one to several gigabits per second".

With the approval of the IEEE 802.3 working group, the KDPOF developers have begun standardizing an IEEE 802.3 Automotive Multi-Gigabit Optical Standard in cooperation with more than 15 automotive manufacturers and component suppliers. The working group under the personal leadership of KDPOF CEO Carlos Pardo gave the starting signal last summer. The first prototypes are planned by the end of 2021. The working group will evaluate the creation of an IEEE Ethernet standard for the automotive industry with speeds from 2.5 Gbit/s to 25 or 50 Gbit/s.

The main advantages of an optical solution for specific applications with multi-gigabit speeds with in-vehicle connectivity include electromagnetic compatibility (EMC) thanks to inherent electrical isolation, light weight and low cost. Applications include the networkability of telematics control modules, redundant and secure backbones for autonomous driving architectures and advanced driver assistance systems (ADAS).

Manufacturers of optoelectronics, connectors and wiring harnesses are prepared for the new technology and have already established a competitive market with all new components that require multi-gigabit networks in the car: Physical Layer (PHY), Fiber Optic Transceiver (FOT), fiber, connectors and light sources. The technology will be scalable to enable even higher data rates such as 50 and 100 Gbps in the future. Once all areas of the new standard are optimized and combined, a good balance of complexity and cost can be achieved between all parts (CMOS IC, VCSEL, PD, sleeves, cables, in-line interconnection, optics and lenses, etc.).

KDPOF plans to demonstrate a first version of its technology at the Automotive Ethernet Congress in Munich from February 12th to 13th, 2020.

By Steve Crowe



WPI PracticePoint director Greg Fischer showcasing the facility's mock operating room. | Credit: Bogdan Vernescu, WPI

Every two weeks, Greg Fischer and some colleagues made the three-hour drive, sans traffic, from Worcester, Mass. to Niskayuna, NY. Fischer, Professor of Mechanical Engineering and Robotics Engineering at Worcester Polytechnic Institute (WPI), and the director of the Automation and Interventional Medicine Robotics

Laboratory, is a pioneer of MRI-guided surgical robots. He and his team were doing live thermal imaging experiments at GE Global Research. This was part of a grant to develop a robotic system that, operating within an MRI scanner, delivers a minimally-invasive probe into the brain to destroy metastatic brain tumors.

Things went well until the last trip that took place a few months ago. “We did some work on the robot [at WPI], packed it up, and drove off,” Fischer said. “But the robot broke by the time we got there. It got too cold outside during transit and changed the resonant frequency of the piezoelectric motors, is our theory. Then we wasted an entire day to get it fixed again.”

Roadblocks to innovation are all too familiar to robotics engineers. But the development cycle for Fischer and other medical robotics developers will hopefully now become more streamlined. WPI yesterday celebrated the opening of PracticePoint, its new R&D center for healthcare cyberphysical systems. The goal of PracticePoint is to accelerate the development of anything from smart insulin pumps to fully autonomous surgical robots. Fischer is PracticePoint's director.

PracticePoint is a membership-based facility that offers access to point-of-practice clinical suites, including a one-bedroom residential apartment, a surgical imaging suite with a top-of-the-line GE Signa Premier MRI scanner, a mock operating room, a patient care suite, a motion capture lab, an acoustic chamber for neuroscience research, and more. Current corporate members include Boston Scientific, GE Life Sciences, Karl Storz, MITRE, and more.

Announced in April 2017, PracticePoint was funded by a \$5 million grant from the Massachusetts Technology Collaborative, a \$2.5 million commitment from GE Life Sciences and a \$9.5 million investment from WPI. Construction on the facility, which is located at Worcester's Gateway Park, began in the summer of 2018.

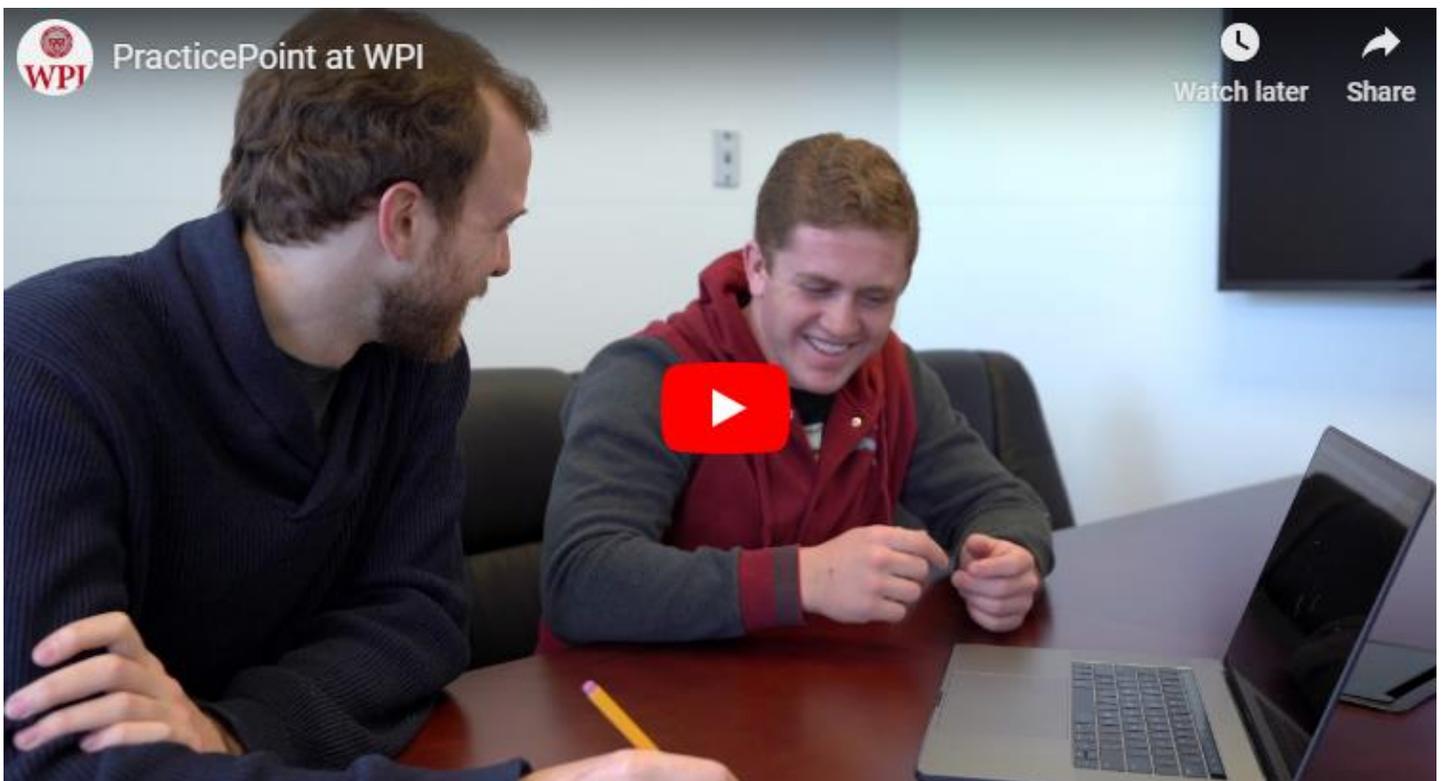
Fischer said one of the key selling points is that PracticePoint's fully-instrumented spaces have been co-located with advanced manufacturing capabilities. PracticePoint offers a variety of 3D printing, CNC manufacturing, laser cutting, and electronics assembly and test capabilities. While setting up and testing the equipment, Fischer had a little fun. He took an MRI of his brain and 3D printed the scans using the lab equipment.

“We're not a place where companies will come and just rent out a bench,” Fischer said. “We want companies to engage with us and do experiments here.”

The motion capture lab has a 10-camera Viacom system with .2MM accuracy to track body movement. It also has force plates in the floor to measure and track footsteps. Fischer said the force plates have been used during the development of a rehabilitative exoskeleton. “As you’re walking, the force plates tell you where the force is acting on your foot,” he said. “We’re using forces pads in the baseplate of the exoskeleton to figure out where you are in your gait cycle. We can then calibrate that to make sure it’s working the way it’s supposed to.”

The motion capture lab was originally intended to be used more for biomechanical research. However, it turns out a high-accuracy motion capture can also be used to characterize surgical robots. “We had an endoscope company come measure the curvature of their flexible endoscopes and a neurosurgery robot measuring the accuracy [in the motion capture lab.]”

The mock operating room is about twice the size of a normal operating room, Fischer said. But it has everything you would need to perform mock surgical processes. It has operating room lighting, medical gases (oxygen, nitrogen, compressed air), waste gas extraction, vacuum hookups and various power hookups. It even has slide rails for the motion capture system to track objects during surgery, including how accurate a surgical robot is. WPI has an older generation Intuitive Surgical da Vinci robot in the room, complete with a custom blackbox to control and measure all the setup joint locations.



The apartment has a gantry system designed to work with the disabled population. However, Fischer said it was spec'd to also support the weight of humanoid robots such as Boston Dynamics' Atlas. “I really want to bring Atlas here,” he said.

“The State has given us quite a bit of funding to act as a medical device accelerator,” said WPI Assistant Vice President Rachel LeBlanc. “So we co-located engineering capabilities with real clinical and healthcare environments. PracticePoint is a place where companies can feel at home and build a consortium to develop medical technologies.”

WPI has been developing medical devices for some time and has experienced many challenges along the way. PracticePoint is an effort to make it easier to overcome those challenges.

“You need places where great ideas can be tested,” said Worcester Polytechnic Institute President Laurie Leshin. “When we bring together creative engineers, scientists, clinicians, companies, and entrepreneurs to work together in a novel setting like PracticePoint, I believe the results will be extraordinary.”

“Iterative development is really the key,” Fischer said. “We can now test our MRI-compatible robot here and modify it in the manufacturing lab. We can then test it again and get quantitative comparison data to get things out into the world.”

**To achieve large-scale commercialization of autonomous vehicles, a new generation of high-precision 3D environment sensing solid-state LiDAR technology products will be required to fulfill the industry's strict requirements.**

By Dr. Leilei Shinohara

*Tell us about RoboSense and your role with the company.*

RoboSense (Suteng Innovation Technology Co., Ltd.) is the leading provider of smart LiDAR environment perception solutions incorporating LiDAR sensor hardware, AI algorithms, and IC chipsets, with a number one automotive LiDAR market share in Asia. Our technology transforms high cost traditional LiDAR systems to low cost and additionally provides full data analysis and comprehension. Its mission is to serve as the “eyes” for autonomous vehicles and ensure the safety of the automatic driving system.

In 2018, RoboSense won a strategic investment of over \$45 million USD from Alibaba Cainiao Network, SAIC and BAIC, setting the largest single financing record in China's LiDAR industry. RoboSense LiDAR has been widely applied in autonomous driving passenger cars, logistics vehicles, and buses by domestic and international autonomous driving technology companies, OEMs, and tier 1 suppliers. RoboSense has received numerous awards, including the CES 2020 and 2019 Innovation Awards, 2019 AutoSens Award, and 2019 Stevie Gold Award.

I joined Robosense as Co-partner and Vice President and am the director of the Automotive Product Line focusing mainly on developing an automotive-grade mass production LiDAR system.

*What are the main differences between RoboSense's solid -state and mechanical LiDAR product lines?*

Mechanical LiDAR uses a motor to spin the entire laser and detector unit to scan the environment. It is our traditional product since establishing the company. This type of LiDAR is mainly used during the customer's development projects or as a reference system for the other sensors.

RoboSense solid-state MEMS LiDAR uses a MEMS micro-mirror to steer the laser beam for scanning. The MEMS mirror is called solid-state to distinguish it from a mechanical micro-mirror device. The MEMS mirror's fabrication process is non-mechanical using similar techniques to IC chip fabrication. Therefore, MEMS LiDAR is categorized as MEMS solid-state LiDAR. The RoboSense MEMS LiDAR M1 is the first automotive grade LiDAR from our automotive product line. It is focused on active front sensing. The automotive grade sensor will support customer requirements.

*What do you feel makes RoboSense's technology different?*

First of all, RoboSense's unique capability is a smart sensor. We believe LiDAR hardware without good software is not a useful, so we focused on developing first-class perception algorithms and providing systematic LiDAR solutions with a full set of features to support our customers and get the most out of our LiDAR sensors. The Smart LiDAR Sensor's built-in sensing algorithm has passed tens of millions of different extreme and complex environmental test scenarios for rain, fog, snow, sandstorms, and other weather conditions, various traffic flow, and pedestrian testing. RoboSense has already adapted to most of the extreme conditions, ensuring that the perception system can be used in various complex driving environments. A rich and reliable real-time environment perception system is the result of this extensive testing.

Second, the talented people at RoboSense created unique high performance solutions. And lastly, our competitive price is another RoboSense advantage.

*Tell us about the core principles of your LiDAR technology?*

Ensuring autonomous driving safety is always our top priority. We make sure that when the RoboSense Smart LiDAR Sensor is integrated into the perception system of current self-driving passenger cars, it guarantees redundancy for self-driving car decision-making and eliminates car accidents, such as Tesla's recent accident, greatly improving the safety of the automatic driving system and ensuring passenger safety.

Second, we are dedicated to meet industry mass production and application requirements. LiDAR is currently limited by its large size and high cost, and we will constantly improve it to achieve automotive-grade, mass production, high-resolution performance, high stability and reliability, and low cost.

*Why do you regard LiDAR as the most important technology to enable autonomous driving?*

Conventional sensors, which include cameras and radar, all have their limitations. For example, cameras don't work well under bad ambient light conditions and radar has limitations detecting an unmoving non-metallic obstacle. Therefore, when using only radar and camera sensors, they cannot guarantee the sensing system as ASIL-D compliance. These weaknesses can be covered by LiDAR. But LiDAR cannot replace them alone since LiDAR also has limitations. Therefore, a good perception software system (like RoboSense's) is needed to fuse together LiDAR, radar, and camera data for redundancy.

You may have heard about the recent accident of the Tesla Model 3 on Autopilot, which crashed into a police car in Connecticut on December 9th. This also proves LiDAR's importance to guarantee the safety and compensate for the weaknesses that currently occur with conventional sensors. Both Audi's A8 (a Level 3 mass-produced autonomous vehicle) and the Waymo One (an autopilot ride-hailing service) have used LiDAR, which is an important industry indicator. Level 3 autonomous passenger vehicles using LiDAR will gradually become the industry standard.

To achieve large-scale commercialization of autonomous vehicles, a new generation of high-precision 3D environment sensing solid-state LiDAR technology products will be required to fulfill the industry's strict requirements, including the need for automotive-grade, mass production, high resolution, high reliability, and low cost. We expect that MEMS LiDAR will be the first generation solid-state LiDAR for autonomous driving vehicles, including RoboSense's RS-LiDAR-M1 MEMS solid-state LiDAR.

*What are your main technology and R&D milestones for this year?*

Our world's first and smallest MEMS-based solid-state LiDAR, an advanced version of the RS-LiDAR-M1 for pre-mass production will be available in the market soon. The MEMS solid-State LiDAR RS-LiDAR-M1 will start shipping by the end of 2020. This will be the biggest milestone of us in 2020. As the winner of the CES 2019 and 2020 Innovation Awards, the new RS-LiDAR-M1 is now half the size of the previous version, with dimensions of just 4.3" x 1.9" x 4.7" (110mm x 50mm x 120mm) and is equipped with enhanced performance and AI perception algorithms. It fully supports Level 3/4 driverless automated driving and also Level 2+ ADAS applications. We will also have some new products launching during CES 2020 that will cover various customer applications, so stay tuned.

*Where do you see autonomous driving 5 years from now, what are the biggest hurdles still to overcome?*

There will be step-by-step growth in autonomous vehicles. The biggest concerns are always safety and public acceptance. The SAE has defined AD vehicles into 5 category levels (L1 – L5). L2 (partial automation or advanced ADAS systems) and L3 (conditional AD) passenger vehicles will start growing significantly in 2020/21. Meanwhile, L4 (highly automated) vehicles for special uses, such as parking, Robo-taxis, and Robo-trucks, will enter the commercial stage at the same time. Fully automated vehicles (L5), I think, will still take a long time to be reached. If they are not able to prove that fully automated vehicles are safer than human drivers, there will be difficulty becoming popular. But the industry is moving in this direction step by step.

*How do you convince the average person that autonomous driving is safe?*

The biggest challenge for autonomous driving is safety. The system has to make sure it is able to reduce accidents more than human drivers. The system has to prove to the public that the accident rate is lower. To achieve this, the

surrounding environment perception is very important. This means the system must “see” further and wider and understand the environment better than a human so the system will make safer and quicker decisions.

To ensure safety, fusion with a lot of different sensors is needed. When the RoboSense Smart LiDAR Sensor is integrated into the sensing system of current self-driving passenger cars, it goes beyond current millimeter-wave radar and camera limitations to identify obstacles and eliminate car accidents, such as Tesla’s recent accident, greatly improving the safety of the automatic driving system and ensuring passenger safety.

*Who are your main industry partners and how are you partnering with them?*

RoboSense is Asia’s market leader with an over 50% market share of all LiDAR sold. Our partners include the world’s major autonomous driving technology companies, OEMs, and Tier 1s. Our strategic partners and investors, which are known publically, are Alibaba’s Cainiao Network, SAIC, and BAIC. We also have deep cooperation with top OEMs and Tier 1 companies, such as one we recently announced with China’s FAW (First Automobile Works), the world’s leading automaker, who will use RoboSense RS-LiDAR-M1 LiDAR as FAW’s proprietary next-generation autonomous driving system. There are also other ongoing projects in Europe and America, but I cannot disclose the specific names due to NDAs. What I can say, is that we work with them in multiple ways depending on their needs. Some require more in-depth cooperation, including joint development, and some require us to solely be their supplier. So far, all our partner’s feedback is very positive, and we appreciate all the suggestions from our partners to make our products even better. We will continue doing our best to serve our partners.

*What’s next for RoboSense?*

RoboSense will focus on the developing of the solid-state M1 product into automotive-grade mass-production as the first priority. We are not only developing the hardware, but also software as a comprehensive smart sensor system. The delivery of our Automotive Grade MEMS LiDAR in 2020 will be one of our biggest milestones.

Then we will continue to improve performance and price of the mechanical LiDAR product line. In addition, safety is the biggest challenge we will tackle. To ensure safety, fusion with different sensors is needed. We are also focusing on multiple sensor fusion projects. Furthermore, an AD-friendly infrastructure, such as an intelligent vehicle cooperative infrastructure system (IVICS), is also needed. RoboSense is also participating in IVICS projects to provide high precision perception systems.

RoboSense will be joining CES and CES Unveiled in January 2020, with a booth at 6138, LVCC North Hall, to demonstrate our flagship products as well as a new product launch. We are planning an off-site demo with our test car, which is equipped with all our different kinds of LiDAR sensors. Stay tuned!

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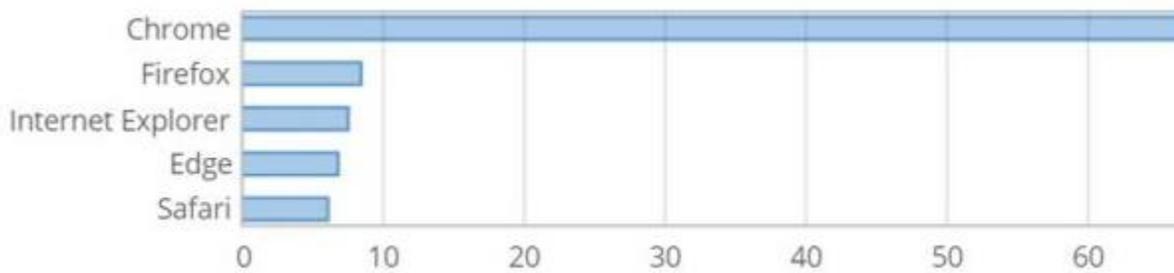
*About Dr. Leilei Shinohara*

*Dr. Leilei Shinohara is Vice President of R&D, RoboSense. With more than a decade of experience developing LiDAR systems, Dr. Shinohara is one of the most accomplished experts in this field. Prior to joining RoboSense, Dr. Shinohara worked at Valeo as the Technical Lead for the world’s first automotive grade LiDAR, SCALA®. He was responsible for multiple programs, including automotive LiDAR and sensor fusion projects. Dr. Shinohara managed an international sensor product development team for the development and implementation of systems, software, hardware, mechanics, testing, validation, and functional safety to build the first automotive grade LiDAR product.*

By Todd Bishop

As of today, Microsoft's default web browser is officially shifting to an open-source engine best known for powering a rival browser. Let that sink in for a second, and you'll get a sense for just how much the tech world has turned upside down in the last decade. A little more than a year after announcing the plan, Microsoft on Wednesday morning released its reborn Edge browser for Windows and Mac, rebuilt on the open-source Chromium project — the same underlying technology that powers Google's rival Chrome browser.

How did this happen? For starters, no one was testing with Microsoft's browser. That's a generalization, of course. Some developers were, in fact, checking their sites for compatibility and bugs in Microsoft Edge. But the successor to the once-dominant Internet Explorer wasn't a natural part of many standard testing routines.



*Desktop browser market share, via NetMarketShare*

This was due in part to the fact that Edge, the default browser for Windows 10, wasn't available on older Windows versions or the Mac. But it also spoke to the growth of Chrome and Firefox over the past decade. And the lack of testing resulted in just enough compatibility problems and user frustration that Microsoft ultimately deemed the situation unacceptable. That's the word from inside the company, and it explains how Microsoft came to announce a decision that would have been almost unthinkable in years past.

Compatibility is expected to improve measurably as a result. In practical terms, the biggest impact promises to be on Windows users currently using Chrome. The move should make it easier for those users to switch to Edge, with the ability to run Chrome-based extensions and quickly migrate saved passwords, favorites and other settings from an existing Chrome installation. But bigger picture, Microsoft's strategy shows just how much the browser market and the broader tech landscape have changed since Internet Explorer ruled the early days of the web. Web browsers, after all, were so competitive that Internet Explorer was a central battleground of Microsoft's landmark U.S. antitrust case.

With the new Edge release, Microsoft is choosing to compete not on the underlying engine but instead on higher-end features, such as the ability to annotate PDFs in Edge, and query a corporate intranet from the search experience, among other features designed for businesses.

Edge also offers advanced privacy capabilities, and a new Internet Explorer mode for better compatibility with older sites and apps. The company is hoping that the trade-off in adopting an open-source will lead to greater adoption and retention of users for its other products and services, including Microsoft Bing, enterprise management technologies and other products. The new Edge is generally available now as a manual download, and it will roll out via Windows Update in the weeks ahead.

This blog reveals how to classify pedestrians and bicyclists based on their micro-Doppler characteristics using a deep-learning network and time-frequency analysis.

By Honglei Chen, Rick Gentile, Chaofeng Wang, Sara James

This month's topic is focused on a combination of the two previous blog topics. We show how to classify pedestrians and bicyclists based on their micro-Doppler characteristics using a deep-learning network and time-frequency analysis.

This is a popular topic in automotive radar applications, where it's important to understand when a pedestrian or bicyclist is in the road. It's also a topic of active research in security applications.

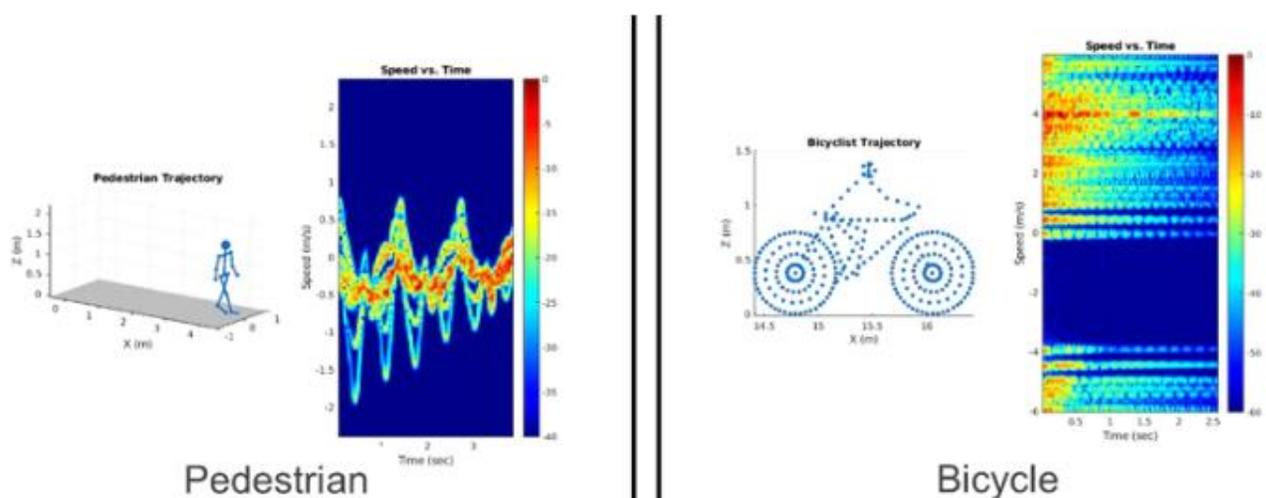
Radar data collection in the field can be time-consuming. Data synthesis can help with generating large datasets. It can also aid in generating specific scenarios that may be difficult to recreate in the field.

### Synthetic Data Generation

The movements of different parts of an object produce micro-Doppler signatures that can be used to help identify it. To illustrate this example, let's focus on a pedestrian and a bicyclist. We use two modeling components: [backscatterPedestrian](#) and [backscatterBicyclist](#) from Phased Array System Toolbox. These functions simulate the radar backscattering of signals reflected from the objects. An example of the setup code for each is as follows:

There's a Doppler plot for each of the objects (Fig. 1). These models are based on the work described in [The Micro-Doppler Effect in Radar, Second Edition](#) by Victor C. Chen, as well as Stolz, M. et al. "Multi-Target Reflection Point Model of Cyclists for Automotive Radar," 2017 European Radar Conference (EURAD), 11-13 Oct. 2017.

```
pedestrian = backscatterPedestrian( ...
    'Height',2,'WalkingSpeed',0.5, ...
    'InitialPosition',[0;0;0],'InitialHeading',90);
bicyclist = backscatterBicyclist( ...
    'NumWheelSpokes',18,'Speed',10.0, ...
    'InitialPosition',[0;0;0],'InitialHeading',90, ...
    'GearTransmissionRatio'.5.5);
```

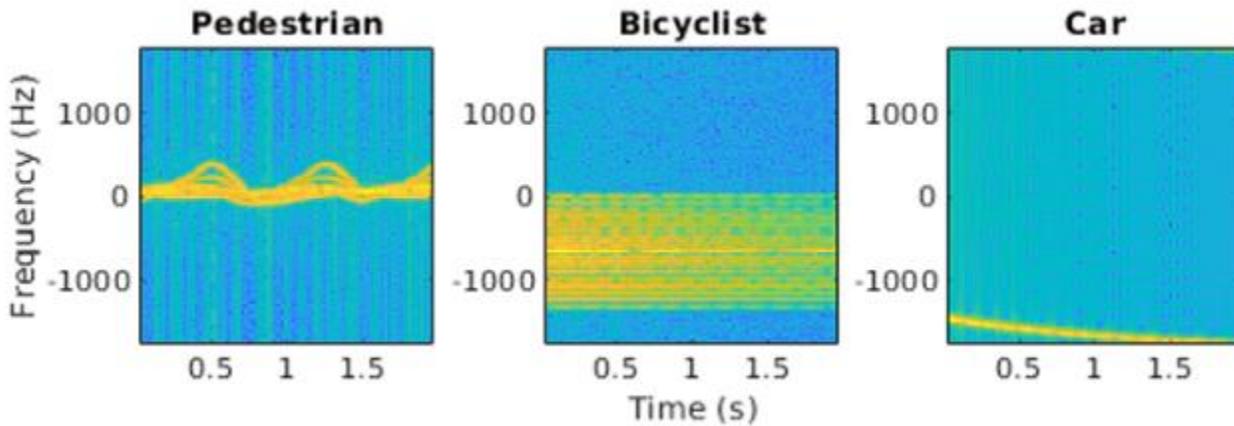


1. Micro-Doppler radar signatures for a pedestrian and bicyclist

The pedestrian model includes 16 body segments (left and right feet, left and right lower legs, left and right upper legs, left and right hip, left and right lower arms, left and right upper arms, left and right shoulders, neck, and head).

The bicyclist model includes the bicycle and its rider. The model accounts for the motion of the bicyclist and computes the sum of all reflected signals from multiple discrete scatterers on the bicyclist (>144 depending on the wheel size). The reflected signals are based on a multi-scatterer model developed from a 77-GHz radar system. Scatterers are located on five major bicyclist components (frame and rider, pedals, upper and lower legs, front wheel, and rear wheel).

Using these modeling components, we generate thousands of pedestrian, bicyclist, and car radar echoes. Figure 2 shows a representative set of time-frequency maps for a pedestrian, bicyclist, and car.

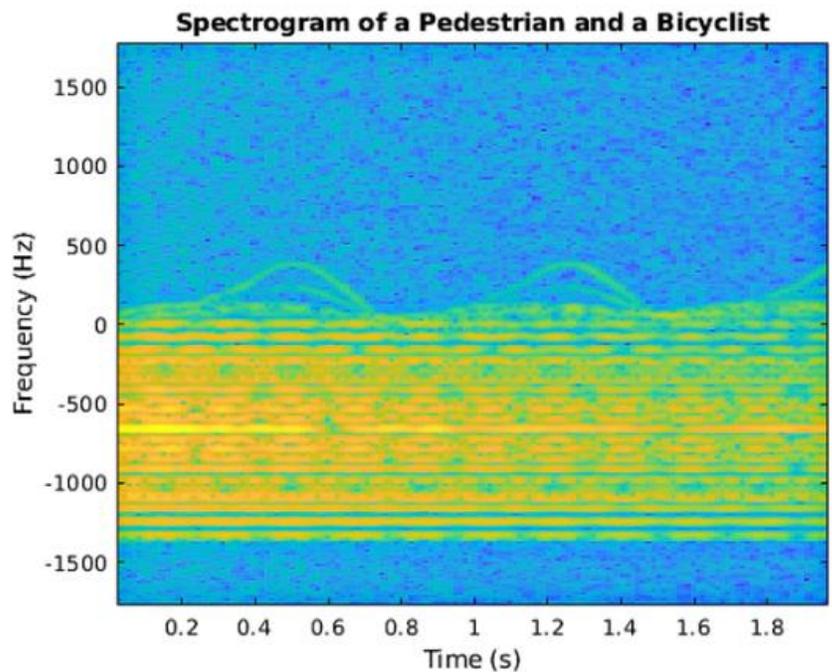


### 2. Micro-Doppler signatures for a pedestrian, bicyclist, and car

The normalized spectrograms show that the three objects have distinct signatures. Note how the spectrograms of the pedestrian and the bicyclist have rich micro-Doppler signatures caused by swinging arms and legs and the rotation of the wheels. By contrast, in this example, the car is modeled as a target with a rigid body and produces no micro-Doppler effects.

Classifying a single pedestrian or bicyclist is relatively simple, because the pedestrian and bicyclist micro-Doppler signatures are so different. The problem becomes much more challenging when we classify multiple overlapping pedestrians or bicyclists in the presence of Gaussian noise or car echoes.

If multiple objects coexist in the radar field of view, the received radar signal is a summation of the detection signals from all of the objects. As an example, Figure 3 shows the micro-Doppler signature for a pedestrian and bicyclist with Gaussian background noise.



### 3. Micro-Doppler signature for a pedestrian and bicyclist with Gaussian background noise

Because the pedestrian and bicyclist signatures overlap in time and frequency, differentiating between the two objects is difficult. This is where we will apply a classifier.

### Radar Returns

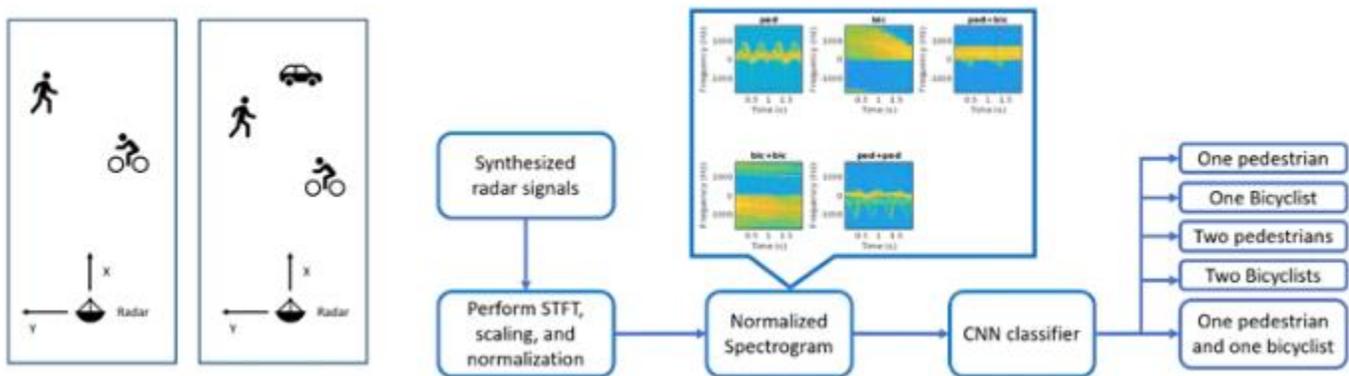
To do this, we train a convolutional neural network (CNN) by using synthesized radar returns from objects with varying properties—for instance, bicyclists pedaling at different speeds and pedestrians with different heights walking at different speeds. Other properties of the three objects are randomly tuned over a range of values; for example, pedestrians (height, heading, speed), bicyclist (heading, speed, gear transmission ratio), and cars (velocity). Another interesting point is that the bicyclist simulations include coasting, which significantly reduces the amount of micro-Doppler generated.

Radar returns reflect from different objects and different parts of objects. Depending on the configuration, some returns are much stronger than others. Stronger returns will obscure weaker ones.

Our dataset contains synthesized radar returns of the following scenes:

- One pedestrian
- One bicyclist
- One pedestrian and one bicyclist
- Two pedestrians
- Two bicyclists

As shown in Figure 4, one of the datasets is generated without car echo samples and the other includes car echo samples.



4. Workflow for classifier with and without car echoes

For the first dataset (without car echoes), the pedestrian and bicyclist signals are combined, Gaussian noise is added, and micro-Doppler signatures are computed to generate signatures for each of the five scenes to be classified. For the second dataset (with car echoes), the same process was used except that car echoes were added to half of the signatures.

Figure 6 presents the confusion matrix for the classifier results when we train and classify the objects for the first dataset (no car echoes). The overall test accuracy is 0.9530 based on 1000 scenes for each category

To understand the effects of car echoes, we classify the dataset containing car echoes with a network that was trained without car echoes. The prediction accuracy for the test dataset with the car echoes drops significantly, to around 70%, because the network never saw training samples containing car echoes. For this case, most of the

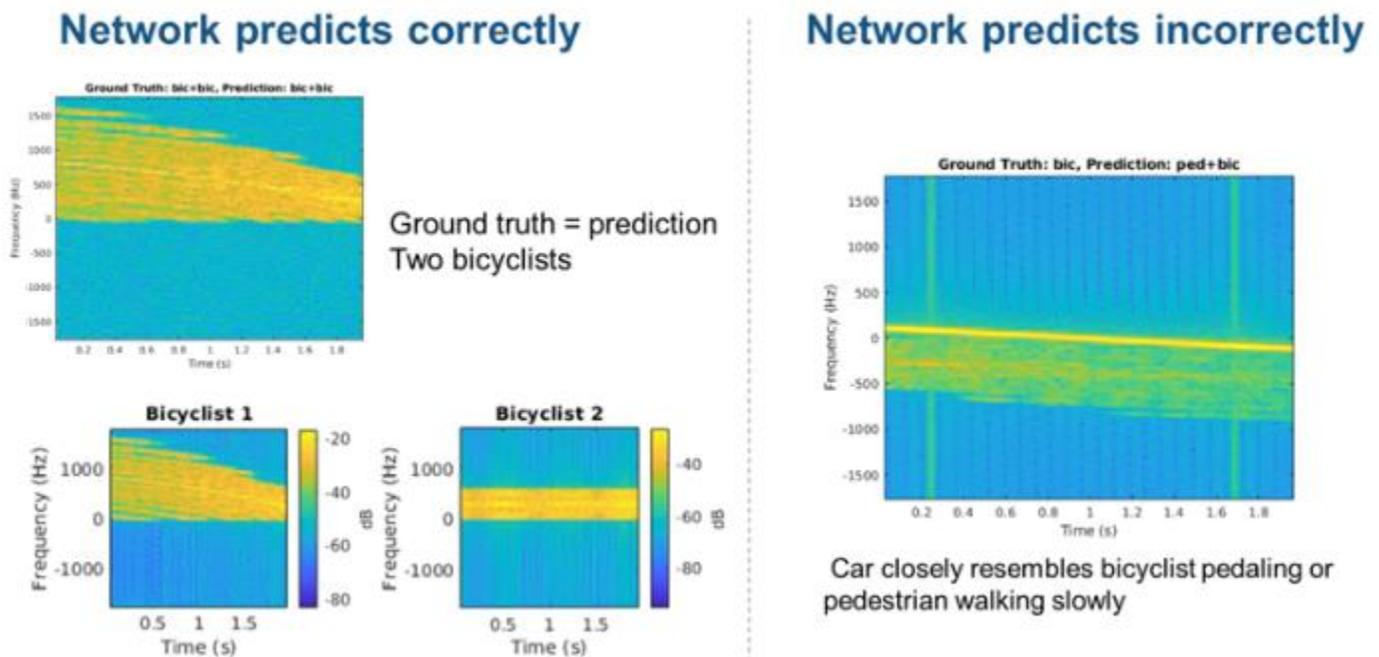
prediction errors occur when the network takes in scenes from the “pedestrian,” “pedestrian+pedestrian,” or “pedestrian+bicyclist” classes and classifies them as “bicyclist.”

True Class	ped	974			26	
	bic	2	979	8	11	
	ped+bic	3	29	933	16	
	ped+ped	58	1	5	936	
	bic+bic		48	9		943
		ped	bic	ped+bic	ped+ped	bic+bic
		Predicted Class				

6. Confusion matrix of results with no car echoes present

Car echoes significantly impede the performance of the classifier. To solve this problem, we retrained the CNN using data that contains car echoes. The prediction accuracy increases to about 87%.

To better understand the performance of the network, we can focus on performance when classifying overlapping signatures. For example, without car echoes (left side of Fig. 7), we see two bicyclists with overlapping micro-Doppler signatures. The network correctly predicts that the scene has two bicyclists, even though from the plot, the signature appears to be from only one bicyclist.



7. Network examples showing correct prediction (left) and incorrect prediction (right)

The amplitudes of the Bicyclist 2 signature are much weaker than those of Bicyclist 1, and the signatures of the two bicyclists overlap. When they overlap, the two signatures can't be visually distinguished. However, the neural network classifies the scene correctly.

As shown on the right side of *Figure 7*, the network confuses car echoes with a bicyclist. Here, the signature of the bicyclist is weak compared with that of the car, and the signature has spikes from the car echoes. Because the signature of the car closely resembles that of a bicyclist pedaling or a pedestrian walking at a low speed, and has little micro-Doppler effect, there's a high possibility that the network will classify the scene incorrectly.

Simulating micro-Doppler returns can help you predict performance in radar systems. In an upcoming blog, we will look at how data collected with an Ancortek radar compares with simulation results.

**A 28 GHz beam steering cavity-backed slot antenna array for 5G cellular phones was implemented in the metallic casing of a mobile phone. The antenna array has eight cavity-backed slot array elements excited by two 4x4 Butler matrix feed networks (BMFN) that enable beam steering in desired directions with a coverage of approximately  $\pm 22$  degrees. The measured 10 dB return loss band is from 26.2 to 29 GHz, and array element gain at 28 GHz is between 9 and 10.1 dBi.**

By Bin Yu, Kang Yang and Guangli Yang, Shanghai University, Shanghai, China, Zhanyi Qian, Huizhou Wireless Technology Co. Ltd., Huizhou, China, and Chow-Yen-Desmond Sim, Feng Chia University, Taichung, Taiwan

5G cellular networking will use mmWave technology due to the large available bandwidth at these frequencies.<sup>1,2</sup> One differentiating feature of mmWave cellular communication is the use of antenna arrays at the transmitter and receiver for directional array gain. With antenna arrays, mmWave cellular systems can implement beamforming and beam steering at the transmitter and receiver to yield higher gain, compensating for frequency-dependent path loss, overcoming noise and reducing out-of-cell interference.<sup>2</sup> The mmWave antenna for 5G smartphones is an important development for the mobile industry, and it can be regarded as one of the key enabling technologies to complete the transition from 4G to 5G networks.

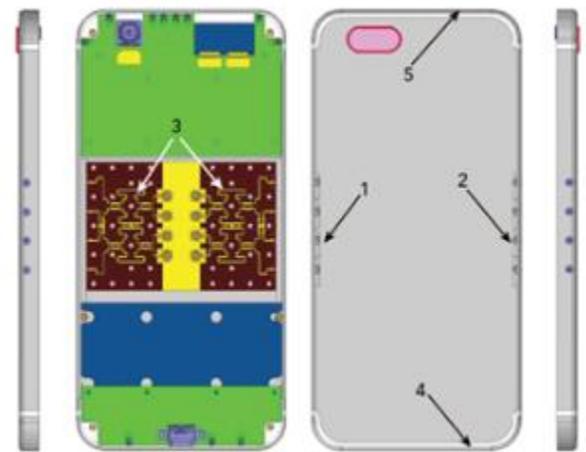


Figure 1 Front, rear and side views of the 5G cellular phone prototype.

Recent beam steering antenna designs for 5G cellular phones have yielded good performance using low-cost substrates,<sup>3-10</sup> but these antennas may not be suitable for practical cellular phones, which employ metallic frames or casings. For example, Huo et al.<sup>10</sup> use an antenna in package (AiP) module solution to realize beam scan; however, the configuration of their AiP modules is unsuitable for use in a metallic environment. Even if a glass or ceramic casing were employed, the metallic frame of the phone would still affect AiP module performance, especially its radiation pattern.

In this article, a novel 28 GHz beam steering antenna for a 5G metallic-cased phone is described. Two arrays, each with four elements, were integrated on each side of the metallic casing. To achieve the beam steering performance of the array, two 4x4 BMFNs were used. Due to the phase shifting limitation of the 4x4 BMFNs, beam steering performance is limited to four states. For a realistic cellular phone implementation, this antenna design concept can be used with a 5G transceiver for a continuous beam steering solution.

**Figure 1** shows the prototype configuration. The cover of the phone is made of a metallic material. Identical beam steering arrays (1 and 2) are built on the left and right edges of the phone, respectively. Each beam steering array comprises four cavity-backed slot antenna elements excited by a 4x4 BMFN.<sup>3</sup> The eight cavity-backed slot antenna elements are fabricated on the metallic back casing using a CNC lathe. The top and bottom metallic frames (4 and 5) are typically reserved for other antennas, such as 4G LTE main and diversity, GPS and Wi-Fi.

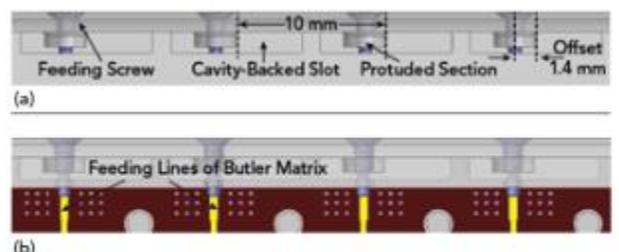


Figure 2 Beam steering array with four cavity-backed slots (a) and Butler matrix feed (b).

## ANTENNA ELEMENT AND ARRAY DESIGN

**Figure 2a** shows the design of one of the beam steering arrays, where each of the four cavity-backed slot elements is fed by a small screw structure inserted across the cavity-backed slot, via a protruded section, and soldered to one of the feeding lines of the BMFN (see **Figure 2b**). The distance between the centers of the two slot elements is nearly 10 mm, which is approximately one wavelength at 28 GHz. To achieve a good impedance match, the center of the feeding screw is offset 1.4 mm from the middle of the cavity-backed slot. This array design, located at either the left or right edge of the metallic casing, ensures a good directional radiation pattern and high gain.

**Figure 3** shows the dimensions and locations of the two identical beam steering arrays, as well as the cavity-backed slot on the metallic casing. The length and width of the cavity-backed slot are 8.8 and 1.5 mm, respectively. Because the wave reflects from the bottom of the cavity, with a depth of 4 mm, and is superimposed with the wave radiated directly from the slot, the radiation pattern is unidirectional, as desired.

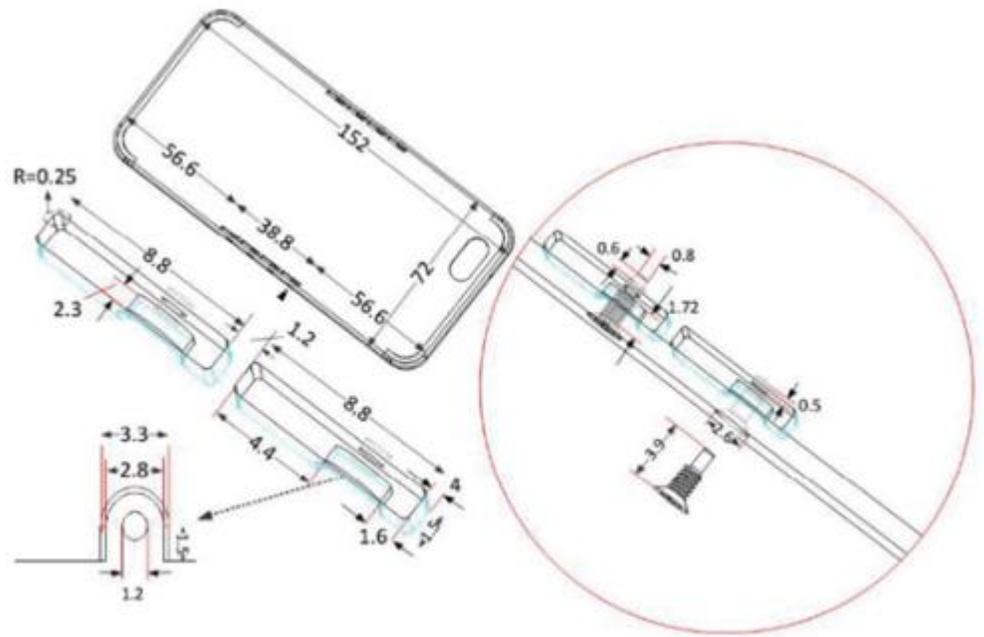
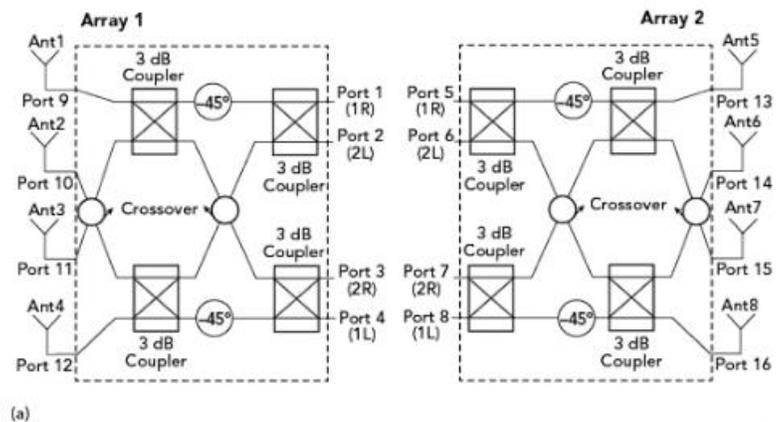


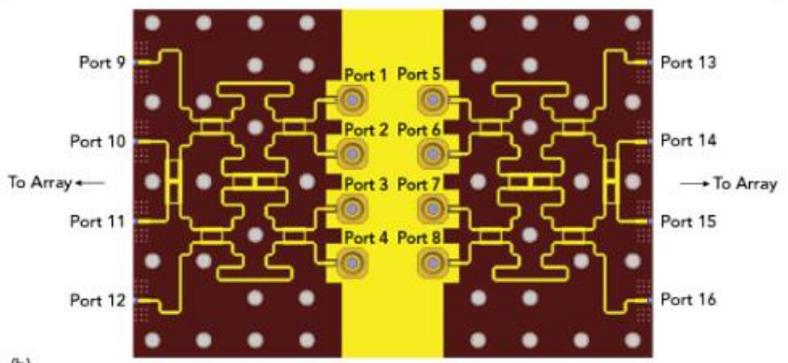
Figure 3 Antenna detail (dimensions in mm).

The block diagram and layout of the two 4x4 BMFNs are shown in **Figure 4**. They are used to feed the two beam steering arrays because they provide the necessary bandwidth, beam steering capability and beamwidth. Each BMFN is comprised of four hybrid couplers, two crossovers and two pairs of phase shifters to achieve the required amplitude distribution and phase differences between the output ports. The feeding ports of the BMFNs are ports 1 through 8, and their corresponding outputs, which connect to all eight antenna elements, are ports 9 through 16.

The feeding ports and output phase differences are shown in **Table 1**. The BMFNs are fabricated on a 0.254 mm thick Rogers 5880 substrate, with  $\epsilon_r = 2.2$  and  $\tan\delta = 0.0009$ . Eight mini-SMP connectors are used for the measurements.



(a)



(b)

Figure 4 Two 4x4 Butler matrix feed network block diagram (a) and layout (b).

TABLE 1				
PHASE RELATIONSHIP BETWEEN FEEDING PORTS				
	Port 1/5	Port 2/6	Port 3/7	Port 4/8
Output Phase Difference (°)	-45	+135	-135	+45

The beam steering antenna arrays were simulated using HFSS Version 15, and the  $|S_{11}|$  of the fabricated prototype were measured using ground-signal-ground RF probes, prior to the assembly of the mini-SMP connectors. The measured  $|S_{11}|$  for ports 1 to 4, plotted versus frequency in **Figure 5**, shows a minimum 10 dB bandwidth of 2.8 GHz, from 26.2 to 29 GHz, which covers the 28 GHz FCC band of 27.5 to 28.35 GHz. For brevity, the results for ports 5 to 8 are not shown.

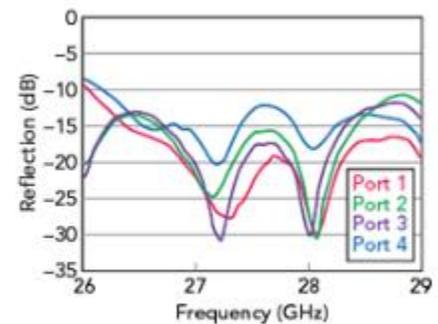


Figure 5 Measured  $|S_{11}|$  of the feeding ports.

Antenna gains and radiation patterns were measured in a mmWave compact range. At 28 GHz, the measured performance compared with the simulations are shown in **Figure 6** for the four cavity-backed slot antenna elements fed by ports 1, 2, 3 and 4, demonstrating peak gains of 10.1, 9, 9.4 and 9.8 dBi, respectively. Losses are attributed to the BMFN, with an approximate insertion loss of 1.5 dB, as well as the screw feeding structure and mini-SMP connector. With different port excitations, uniform amplitudes with different phase distributions were achieved at the output ports, enabling the array to radiate beams at angles of -22 degrees (port 3), -8 degrees (port 1), +8 degrees (port 4) and +22 degrees (port 2), a total of  $\pm 22$  degrees. The fabricated prototype is shown in **Figure 7**.

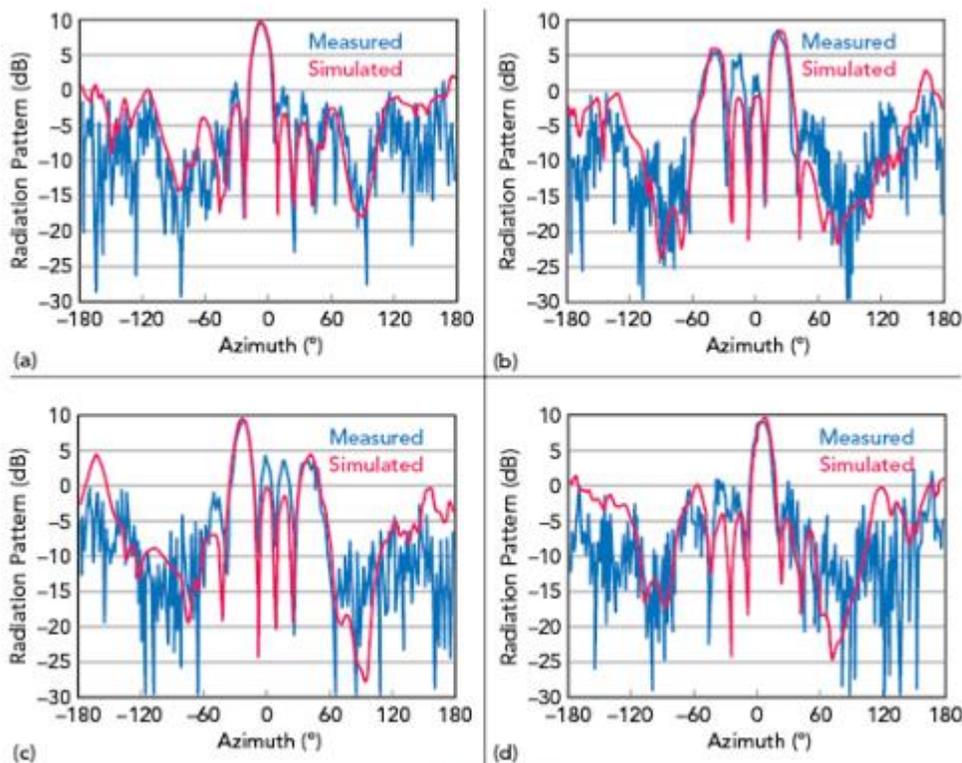


Figure 6 Simulated vs. measured radiation patterns at 28 GHz.

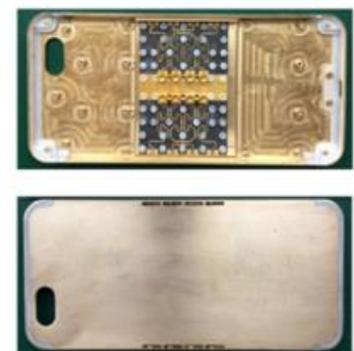


Figure 7 Fabricated prototype.

## CONCLUSION

A 28 GHz beam steering antenna array was successfully implemented in a metallic casing for cellular phones. As well as demonstrating good performance - return loss, gain and beam steering - the experimental results were validated by simulation. Owing to its performance, ease of integration, low fabrication cost and fitting into the restricted volume of a cellular phone, the design approach offers an attractive solution for 5G mmWave cellular phones.

## ACKNOWLEDGMENTS

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By Mickey Ristroph

On Thursday, Comcast's NBCUniversal becomes the fourth company in less than a year to unveil a video-streaming service to compete with Netflix. But NBCU is taking a very different approach to its service, Peacock, than the three earlier companies, Disney, Apple and WarnerMedia, did, making it more of a test case for an alternative approach to video streaming.

While other services are mostly free of commercials but cost subscribers \$5 to \$15 a month, Peacock will rely heavily on advertising but will be free to Comcast cable subscribers and possibly other people. Secondly, Peacock will rely less on original shows and will fill its lineup with more reruns—in some cases shows that are available on other outlets—as well as news and sports. Netflix and Disney's Disney Plus both rely heavily on originals as a way of persuading people they have programs that you can't find elsewhere, and the services don't carry news or sports.



*NBCUniversal Chairman Steve Burke*

That strategy means Peacock is relying heavily on NBCU's existing networks for programming—so much so that tensions arose last year between Peacock's then-chief, Bonnie Hammer, and NBCU cable executives over Hammer's efforts to grab cable programs for the service. Hammer has now moved to a broader role at NBCU's television studios,

overseeing development of programming for NBC's own channels, Peacock and companies buying shows from NBCU.

Another major difference: NBCU simply isn't spending very much money on Peacock. It will lay out just \$2 billion on every aspect of the service—content, marketing and technology—in its first two years. Disney, in contrast, has said it will spend up to \$2.5 billion just on programming for Disney Plus in its first year. Netflix spends \$13 billion a year on programming.

The result is that Peacock looks to be a less ambitious venture than what Disney in particular is pursuing. Peacock appears designed as more of a supplemental offering for cable TV subscribers than a must-have destination that could entice people to cancel cable.

That approach reflects NBCU's aim to avoid losing lots of money on Peacock. NBCU Chairman Steve Burke has told people close to him that he doesn't see how Disney is going to make money from Disney Plus, according to a person who has spoken to Burke about this in recent months. Disney didn't respond to a request for comment.

But some analysts question whether NBCU can make Peacock successful without spending more money.

“Comcast is betwixt and between, and they haven’t really wanted to acknowledge that this going to require some real heavy lifting,” said Craig Moffett, an analyst with MoffettNathanson. “Disney may be the only player that has enough content that they can make this work on their own.”

NBCU declined to comment for this story.

### **Balancing Needs**

One way that NBCU’s Peacock parallels the streaming efforts of Disney and AT&T’s WarnerMedia is that all the companies have struggled to balance the needs of their traditional TV businesses, which still make plenty of profit, with those of the investment-hungry streaming service.

Disney CEO Bob Iger overtly prioritized Disney Plus over the company’s cable channels. NBCU, owned by cable giant Comcast, appears to be trying to balance the needs of cable and streaming more finely. The issue surfaced last year in the efforts of Hammer, a veteran entertainment executive who was given the reins of Peacock early in the year. Her previous job was running NBCU entertainment cable networks such as USA, Syfy and Bravo. One area she focused on to get projects for Peacock was what was kicking around at the channels she used to run.

In the summer of last year, Hammer met with NBCU’s cable executives to discuss which series they had that could go on the streaming service. Among the projects that surfaced from that review was an adaptation of Aldous Huxley’s novel “Brave New World” that NBCU had planned to run on Syfy and later USA. Hammer decided to put it on Peacock first and then maybe on USA or Syfy.

Also going to Peacock is the show “One of Us Is Lying,” based on the popular young-adult book, which was previously developed as a possible show for the E channel. And Bravo had explored doing a reboot of “Queer as Folk,” which instead is going to Peacock.

Hammer and her team also debated whether Peacock could get exclusive access to some of NBCU’s sports programming—such as the Olympic Games—which has historically run on NBC’s broadcast network and some of its cable channels.

Taking shows from NBCU cable channels raised concerns among NBCU cable executives such as Chris McCumber, entertainment networks president. While he and other NBCU executives were supportive of Peacock, McCumber worried about how moving programming to Peacock would affect the cable channels.

Putting the Olympic Games on Peacock posed probably the biggest threat to NBCU’s traditional channels, as it would have meant people didn’t need cable to watch the Olympics. In the end, while Peacock is expected to stream live news broadcasts—such as from its NBC News Now streaming service—its sports programming will be more limited and isn’t expected to include any major live Olympics programming, according to people familiar with the situation.

Hammer’s efforts also touched on another sensitive issue: shows NBCU was developing for sale to outside networks. For example, members of her team asked executives to show Peacock projects designed for Jeffrey Katzenberg’s Quibi service before they were pitched, said two people familiar with the situation. In the end, Peacock passed on the projects. Quibi ended up buying programs from NBCU, such as a daily celebrity news show.

It’s unclear how much the Peacock launch will affect NBCU’s licensing business. Like most other big entertainment companies, NBCU has a sizable business selling shows to TV networks and streaming services owned by other companies. There’s little sign that NBCU is backing away from that business, whereas Disney, for instance, has pulled back so it can focus its production resources on its own streaming services.

Underlying the internal debates about Peacock programming is the fact that NBCU executives' compensation is based on the profitability of their networks or their divisions. Disney dealt with that issue by changing its compensation structure to give people an incentive to make its streaming service succeed. NBCU has not done so. When executives asked Burke how the company could motivate staffers to support Peacock, he said NBCU would take into account people's contributions to Peacock when determining bonuses, said one person familiar with those discussions.

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*'Comcast is betwixt and between, and they haven't really wanted to acknowledge that this going to require some real heavy lifting.'*

Comcast last fall abruptly moved Hammer into a new role at its studio. Her number two, Bill McGoldrick, stayed in his role, overseeing programming for both Peacock and NBCU's cable channels. It's not clear how the rearrangement will affect programming choices NBCU has to make between Peacock and the channels.

One former NBCU executive noted that Hammer, in her new role developing programming for NBCU's channels and Peacock, is better positioned to sign talent deals that will benefit the streaming service. Last week, for instance, NBCU announced a deal with comedy writer Seth

MacFarlane, who will develop shows across its portfolio of outlets.

#### Rerun Heavy

Overall, Peacock will have 15,000 hours of content on the service, NBCU has said. Original shows will include reboots of older NBC shows such as "Saved by the Bell" and "Punky Brewster." But much of it will be reruns of popular shows that first aired on NBC, such as "30 Rock," "The Office" and "Cheers."

Some will be exclusive to Peacock, such as "The Office" and "Parks and Recreation." But others are not owned by NBCU and will be available elsewhere. ViacomCBS' Paramount, which owns shows such as "Cheers" and its spinoff, "Frasier," has licensed reruns to those shows to Peacock but also can run them on its own streaming service, CBS All Access, according to a person familiar with the situation.

NBCU is also in talks to license streaming rights to "Law & Order" and its various spinoffs made by producer Dick Wolf, all of which ran on NBC originally. Whether these reruns would be exclusive to Peacock remains unclear. Peacock is also expected to run movies from NBCU'S Universal Pictures film studio exclusively once an agreement Universal has with WarnerMedia's HBO expires next year.

Similarly, while Peacock will be able to stream NBC shows, Comcast has licensed most of those programs to also run on Disney's Hulu through 2023, a deal struck as part of Comcast's deal to sell its stake in Hulu. NBCU can make some of these shows exclusive to Peacock by late 2022.

#### Advertising Priority

Hammer's move to a new role appears to stem from Comcast's realization that it needed an executive with a broader range of experience to run Peacock.

Her replacement at Peacock is a longtime Comcast executive, Matt Strauss, who is best known for his work on Comcast's X1 video service. Well versed on content acquisition and distribution, Strauss isn't expected to make any big decisions on original programming. He has demurred when cable executives have asked him if he wanted to see scripts for projects, said one person familiar with the situation.

Instead he is focused on making sure that the launch goes well and that the 500-plus staffers working on Peacock are all on the same page.

He has built a veteran team for dealing with both cable and satellite operators. That signals his focus on broadening Peacock’s distribution, which is important given the focus on getting a big audience to maximize advertising revenue.

Comcast doesn’t expect Peacock to make money immediately. It told investors it expects the service to break even in five years’ time—the same time frame Disney has outlined for Disney Plus. The difference is the amount of money Comcast is willing to lose. As Comcast chief financial officer Mike Cavanagh told investors recently, Peacock will have a “lower cumulative loss or investment than what you otherwise might see in other places.”

Cavanagh also made it clear that NBCU won’t stick with Peacock for years if it doesn’t show signs of turning a profit. “We are not going to walk away quickly, but we’re not going to...commit ourselves to do things for a decade when we might have evidence in a shorter period of time that it falls one way or the other.”

Investors will be closely watching Peacock’s performance as a harbinger of streaming’s potential profitability. Netflix’s endless cash burn has increasingly raised questions among investors. Wall Street has so far rewarded Disney’s streaming expansion by sending up its stock price. For other companies, the jury is still out—particularly given the costs.

“I would be skeptical that anybody except Disney can achieve the same level of global popularity that Netflix has,” said Chris Marangi, co-chief investment officer at Gabelli Funds. “But the question is, at what cost have they done that?”

By Brian Heater

Companies keep trying to make glassholes happen. Understandably. After the smartphone and the wrist, the face is the next local battlefield for computational space, if decades of science fiction movies have taught us anything. But we've seen the Google Glass, the Snapchat Spectacles, The Magic Leap, the whatever that thing that Samsung just semi-announced was.

Contact lenses have been mentioned in that same conversation for some time, as well, but technical limitations have placed the bar much higher than a heads-up display standard pair of spectacles. California-based Mojo Vision has been working on the breakthrough for a number of years now, and has a lofty sum to show for it, with \$108 million in funding, including a \$58 million Series B closed back in March.

The technology is compelling, certainly. I met with the team in a hotel suite at CES last week and got a walkthrough of some of the things they've been working on. While executives say they've been dogfooding the technology for some time now, the demos were still pretty far removed from an eventual in-eye augmented reality contact lens.

Rather, two separate demos essentially involved holding a lens or device close to my eye in order to get a feel for what an eventual product would look like. The reason was two-fold. First, most of the work is still being done off-device at the moment, while Mojo works to perfect a system that can exist within the confines of a contact while only needing to be charged once in a 25-hour cycle. Second, the issue of trying on a pair of contacts during a brief CES meeting.

I will say that I was impressed by the heads-up display capabilities. In the most basic demo, monochrome text resembling a digital clock is overlaid on images. Here, miles per hour are shown over videos of people running. The illusion has some depth to it, with the numbers appearing as though they're a foot or so out.

In another demo, I donned an HTC Vive. Here I'm shown live video of the room around me (XR, if you will), with notifications. The system tracks eye movements, so you can focus on a tab to expand it for more information. It's a far more graphical interface than the other example, with full calendars, weather forecasts and the like. You can easily envision how the addition of a broader color palette could give rise to some fairly complex AR imagery.

Mojo is using CES to announce its intentions to start life as a medical device. In fact, the FDA awarded the startup a Breakthrough Device Designation, meaning the technology will get special review priority from the government body. That's coupled with a partnership with Bay Area-based Vista Center for the Blind and Visually Impaired.

That ought to give a good idea of Mojo's go to market plans. Before selling itself as an AR-for-everyone device, the company is smartly going after visual impairments. It should occupy similar space as many of the "hearable" companies that have applied for medical device status to offer hearing-enhancing Bluetooth earbuds. Working with the FDA should go a ways toward helping fast-track the technology into optometrist offices.

The idea is to have them prescribed in a similar fashion as contact lenses, while added features like night vision will both aid people with visual impairments and potentially make those with better vision essentially bionic. You'll go to a doctor, get prescribed, the contact lenses will be mailed to you and should last about the length of a normal pair. Obviously they'll be pricier, of course, and questions about how much insurance companies will shell out still remain.

In their final state, the devices should last a full day, recharging in a cleaning case in a manner not dissimilar from AirPods (though those, sadly, don't also clean the product). The lenses will have a small radio on-board to

communicate with a device that hangs around the neck and relays information to and from a smartphone. I asked whether the plan was to eventually phase out the neck device, to which the company answered that, no, the plan was to phase out the smartphone. Fair play.

I also asked whether the company was working with a neurologist in addition to its existing medical staff. After 10 years of smartphone ubiquity, it seems we're only starting to get clear data on how those devices impact things like sleep and mental well-being. I have to imagine that's only going to be exacerbated by the feeling of having those notifications more or less beaming directly into your brain.

Did I mention that you can still see the display when your eyes are closed. Talk about a (pardon my French) mind fuck. There will surely be ways to silence or disable these things, but as someone who regularly falls asleep with his smartphone in-hand, I admit that I'm pretty weak when it comes to the issue of digital dependence. This feels like injecting that stuff directly into my veins, and I'm here for it, until I'm not.

We still have time. Mojo's still working on the final product. And then it will need medical approval. Hopefully that's enough time to more concretely answer some of these burning questions, but given how things like screen time have played out, I have some doubts on that front.

Stay tuned on all of the above. We'll be following this one closely.

By Kevin McLaughlin

## Carbon Footprint

Years by which the companies met or plan to meet the stated environmental goals

	100% RENEWABLE ENERGY	CARBON NEUTRAL	CARBON NEGATIVE
 Microsoft	2025	2012	2030
	2018	No public target	No public target
	2017	2007	No public target
	2030	2040	No public target
	2020	No public target	No public target

Source: The companies

Microsoft on Thursday unveiled a sweeping, 30-year plan to remove from the atmosphere all the carbon it has ever emitted, effectively eliminating its global carbon footprint. The plan appears likely to raise the stakes for other big tech companies that haven't set goals anywhere near as ambitious.

By 2025, Microsoft says, it will shift to using only renewable energy to power its facilities around the world. By 2030, Microsoft intends to be carbon negative, meaning that it will remove more carbon than it emits, Microsoft president Brad Smith said in a blog post outlining the strategy. None of the other big tech companies has set a target for becoming carbon negative. (See the above chart.)

Microsoft, like many other big companies, is facing increasing pressure from customers, governments, employees and interest groups to do more to fight the rise in global temperatures. Tech majors including Amazon, Apple, Alphabet and Facebook are all stepping up their efforts to lower their carbon emissions and use more renewable energy. Sustainability is also increasingly important to investors, who see financial downsides, including higher insurance costs and supply chain disruption, for companies that ignore climate risk.

Microsoft has previously said that its operations have been carbon neutral since 2012. Now, Smith said, Microsoft plans to cut its carbon emissions by more than half by 2030. That goal covers the emissions Microsoft puts out directly by operating its data centers and office facilities, as well as the emissions of its suppliers. Smith said that by 2050, after 20 years of being carbon negative, Microsoft expects to have removed from the atmosphere all of the carbon its operations have generated since its founding in 1975.

Microsoft's plan also emphasizes attaining what it calls carbon "net zero," which it said is a more aggressive and environmentally friendly milestone than the more common carbon neutral metric. Companies can reach carbon neutral status by buying carbon offsets, taking other financial steps or avoiding emissions. But according to Microsoft, to get to net zero, companies have to remove as much carbon from the atmosphere as they generate.

Of other big tech companies, Alphabet and Apple have been working toward similar goals, but none has gone as far. Apple, for instance, hasn't set a timeline for becoming carbon neutral.

On its website, Apple says it has reduced its carbon footprint by 35% since 2015. In April 2018, Apple announced that renewable energy was powering all of its global data centers and office facilities. Apple declined to provide an executive to talk on the record about its environmental policies.

Alphabet says it reached carbon neutrality in 2007. In 2017, Alphabet said it had reached its goal of running all of its global operations, including data centers and offices, on renewable energy. But Alphabet hasn't set a public target for being carbon negative. An Alphabet spokesperson didn't have a comment.

Amazon is lagging far behind in achieving these goals. Before last year, Amazon did not have a comprehensive plan for reducing the carbon footprint of its vast e-commerce business. That changed last September when CEO Jeff Bezos, faced with growing pressure from employees to address the issue, announced a broad-reaching program in which Amazon would aim to reach carbon net zero by 2040. Amazon also plans to be using 100% renewable energy in its operations by 2030.

Amazon spokespeople didn't respond to requests for comment.

Meanwhile, Facebook also hasn't set a target for becoming carbon neutral. On its website, the social network company says it has been increasing its use of renewable energy since 2013 and hit the 75% mark in 2018. Facebook plans to reach its target of running 100% of its operations using renewable energy this year.

"We have a goal of lowering our carbon emissions by 75% in 2020 from 2017 levels. In 2018, we achieved a 44% decrease and will announce our 2019 number later this year," said a Facebook spokesperson in an email.

### **Neutral Is Not Enough**

To remove carbon, Microsoft said it would plant new forests and replant depleted forests. It also said it would use a variety of other technologies such as putting carbon into the soil, capturing carbon from plant energy sources, and using direct air capture machines which suck in air and pull out carbon for storage.

"Like most carbon-neutral companies, Microsoft has achieved carbon neutrality primarily by investing in offsets that...avoid emissions instead of removing carbon that has already been emitted," Smith said in the blog post. "That's why we're shifting our focus. In short, neutral is not enough to address the world's needs."

It's often not feasible for technology companies to depend wholly on electricity generated by wind farms or solar panels to run their businesses, due in part to the massive power needs of the data centers and servers they operate. As a result, many companies have been purchasing renewable energy credits to offset their use of conventionally generated electricity, said Jennifer Cooke, an analyst at IDC focused on renewable energy.

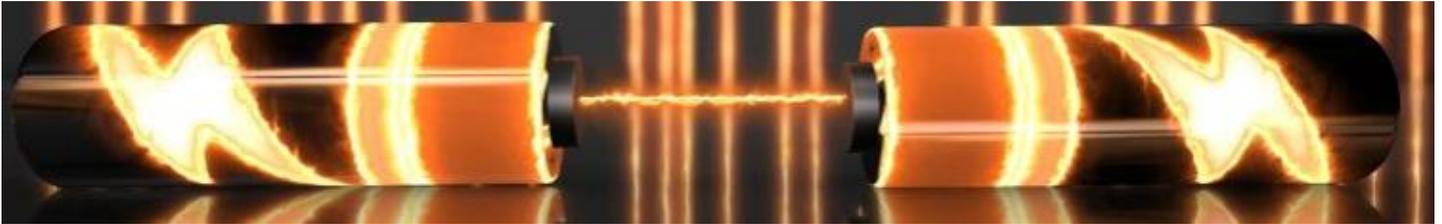
For technology companies, these efforts are an effective way to shape a favorable public perception, according to Cooke. "There are so many choices of companies to do business with, and people want to buy from companies that have sustainability goals that are in line with their own beliefs," she said.

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## World's Most Efficient Lithium-Sulfur Battery Developed – Powers Smartphone for 5 Days

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By Monash University



- Monash University researchers have developed the world's most efficient lithium-sulfur battery, capable of powering a smartphone for five continuous days.
- Prototype cells have been developed in Germany. Further testing in cars and solar grids to take place in Australia in 2020.
- Researchers have a filed patent on the manufacturing process, and will capture a large share of Australia's lithium chain.

Imagine having access to a battery, which has the potential to power your phone for five continuous days, or enable an electric vehicle to drive more than 1000km without needing to “refuel.”

Monash University researchers are on the brink of commercializing the world's most efficient lithium-sulfur (Li-S) battery, which could outperform current market leaders by more than four times, and power Australia and other global markets well into the future.

Dr. Mahdokht Shaibani from Monash University's Department of Mechanical and Aerospace Engineering led an international research team that developed an ultra-high capacity Li-S battery that has better performance and less environmental impact than current lithium-ion products.

The researchers have an approved filed patent (PCT/AU 2019/051239) for their manufacturing process, and prototype cells have been successfully fabricated by German R&D partners Fraunhofer Institute for Material and Beam Technology.



Associate Professor Matthew Hill,  
Dr. Mahdokht Shaibani and  
Professor Mainak Majumder.  
Credit: Monash University

Some of the world's largest manufacturers of lithium batteries in China and Europe have expressed interest in upscaling production, with further testing to take place in Australia in early 2020.

**The study** was published in *Science Advances* today

(Saturday, January 4, 2020) — the first research on Li-S batteries to feature in this prestigious international publication.

Professor Mainak Majumder said this development was a breakthrough for Australian industry and could transform the way phones, cars, computers, and solar grids are manufactured in the future.

“Successful fabrication and implementation of Li-S batteries in cars and grids will capture a more significant part of the estimated \$213 billion value chain of Australian lithium, and will revolutionize the Australian vehicle market and provide all Australians with a cleaner and more reliable energy market,” Professor Majumder said.

“Our research team has received more than \$2.5 million in funding from government and international industry partners to trial this battery technology in cars and grids from this year, which we’re most excited about.”

Using the same materials in standard lithium-ion batteries, researchers reconfigured the design of sulfur cathodes so they could accommodate higher stress loads without a drop in overall capacity or performance.

Inspired by unique bridging architecture first recorded in processing detergent powders in the 1970s, the team engineered a method that created bonds between particles to accommodate stress and deliver a level of stability not seen in any battery to date.

Attractive performance, along with lower manufacturing costs, abundant supply of material, ease of processing and reduced environmental footprint make this new battery design attractive for future real-world applications, according to Associate Professor Matthew Hill.

“This approach not only favors high-performance metrics and long cycle life, but is also simple and extremely low-cost to manufacture, using water-based processes, and can lead to significant reductions in environmentally hazardous waste,” Associate Professor Hill said.

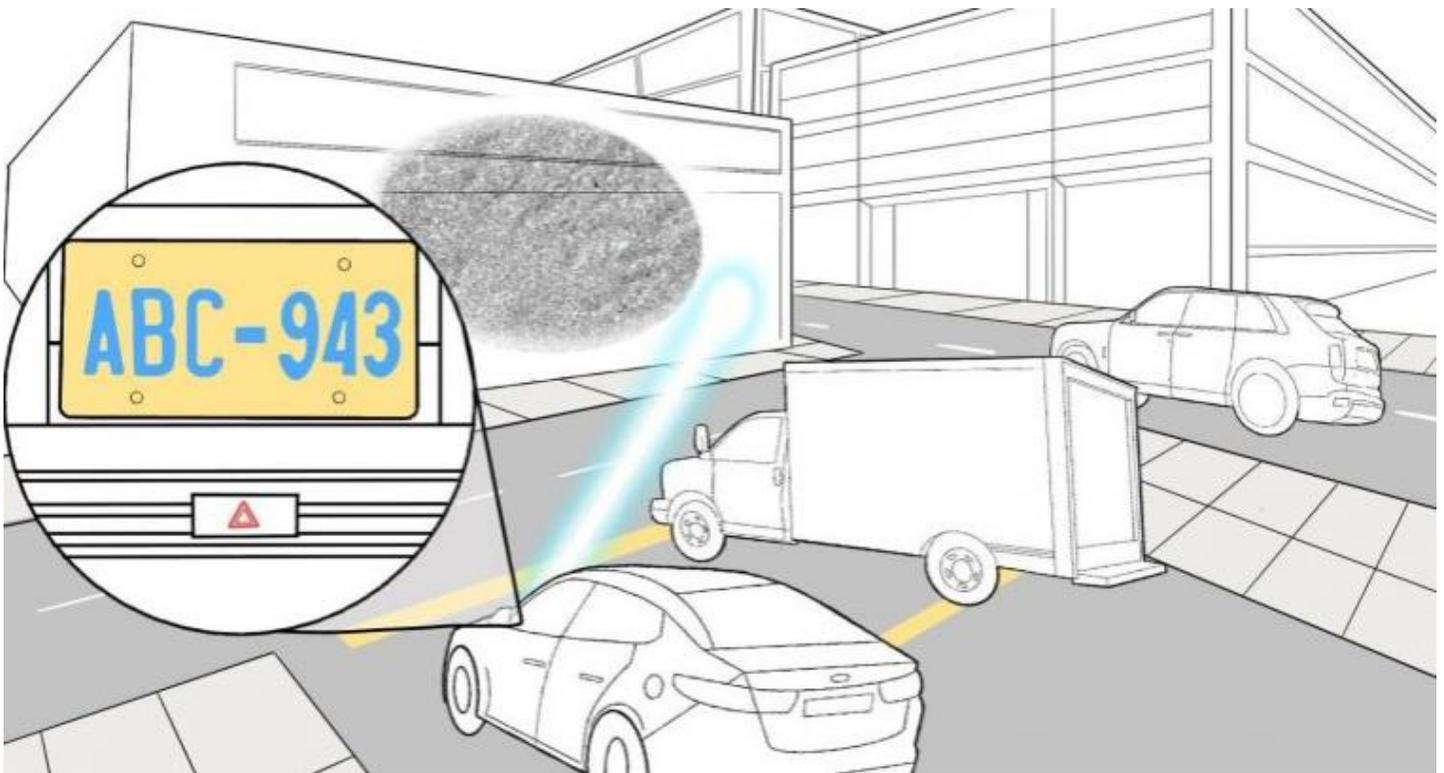
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Reference: “Expansion-tolerant architectures for stable cycling of ultrahigh-loading sulfur cathodes in lithium-sulfur batteries” by Mahdokht Shaibani, Meysam Sharifzadeh Mirshekarloo, Ruhani Singh, Christopher D. Easton, M. C. Dilusha Cooray, Nicolas Eshraghi, Thomas Abendroth, Susanne Dörfler, Holger Althues, Stefan Kaskel, Anthony F. Hollenkamp, Matthew R. Hill and Mainak Majumder, 4 January 2020, *Science Advances*.

DOI: [10.1126/sciadv.aay2757](https://doi.org/10.1126/sciadv.aay2757)

The research team comprises: Dr Mahdokht Shaibani, Dr Meysam Sharifzadeh Mirshekarloo, Dr M.C. Dilusha Cooray and Professor Mainak Majumder (Monash University); Dr Ruhani Singh, Dr Christopher Easton, Dr Anthony Hollenkamp (CSIRO) and Associate Professor Matthew Hill (CSIRO and Monash University); Nicolas Eshraghi (University of Liege); Dr Thomas Abendroth, Dr Susanne Dorfler, Dr Holger Althues and Professor Stefan Kaskel (Fraunhofer Institute for Material and Beam Technology).

By The Optical Society



Researchers used deep learning to create a new laser-based system that can image around corners in real time. The systems might one day let self-driving cars ‘look’ around parked cars or busy intersections to not only see cars but also read license plates. Credit: Felix Heide, Princeton University

**Detailed, fast imaging of hidden objects could help self-driving cars detect hazards.**

Researchers have harnessed the power of a type of artificial intelligence known as deep learning to create a new laser-based system that can image around corners in real time. With further development, the system might let self-driving cars “look” around parked cars or busy intersections to see hazards or pedestrians. It could also be installed on satellites and spacecraft for tasks such as capturing images inside a cave on an asteroid.

“Compared to other approaches, our non-line-of-sight imaging system provides uniquely high resolutions and imaging speeds,” said research team leader Christopher A. Metzler from Stanford University and Rice University. “These attributes enable applications that wouldn’t otherwise be possible, such as reading the license plate of a hidden car as it is driving or reading a badge worn by someone walking on the other side of a corner.”

In *Optica*, The Optical Society’s journal for high-impact research, Metzler and colleagues from Princeton University, Southern Methodist University, and Rice University report that the new system can distinguish submillimeter details of a hidden object from 1 meter away. The system is designed to image small objects at very high resolutions but can be combined with other imaging systems that produce low-resolution room-sized reconstructions.

“Non-line-of-sight imaging has important applications in medical imaging, navigation, robotics and defense,” said co-author Felix Heide from Princeton University. “Our work takes a step toward enabling its use in a variety of such applications.”

### **Solving an optics problem with deep learning**

The new imaging system uses a commercially available camera sensor and a powerful, but otherwise standard, laser source that is similar to the one found in a laser pointer. The laser beam bounces off a visible wall onto the hidden object and then back onto the wall, creating an interference pattern known as a speckle pattern that encodes the shape of the hidden object.

Reconstructing the hidden object from the speckle pattern requires solving a challenging computational problem. Short exposure times are necessary for real-time imaging but produce too much noise for existing algorithms to work. To solve this problem, the researchers turned to deep learning.

“Compared to other approaches for non-line-of-sight imaging, our deep learning algorithm is far more robust to noise and thus can operate with much shorter exposure times,” said co-author Prasanna Rangarajan from Southern Methodist University. “By accurately characterizing the noise, we were able to synthesize data to train the algorithm to solve the reconstruction problem using deep learning without having to capture costly experimental training data.”

### **Seeing around corners**

The researchers tested the new technique by reconstructing images of 1-centimeter-tall letters and numbers hidden behind a corner using an imaging setup about 1 meter from the wall. Using an exposure length of a quarter of a second, the approach produced reconstructions with a resolution of 300 microns.

The research is part of DARPA’s Revolutionary Enhancement of Visibility by Exploiting Active Light-fields (REVEAL) program, which is developing a variety of different techniques to image hidden objects around corners. The researchers are now working to make the system practical for more applications by extending the field of view so that it can reconstruct larger objects.

By Junko Yoshida

**What I derived from my tour of CES 2020. Dealing with big data, vision vs. lidar, what autonomy really means, and much, much more.**

After miles of roaming the show floor, countless press briefings and one-on-one interviews, what did we learn at the CES 2020?

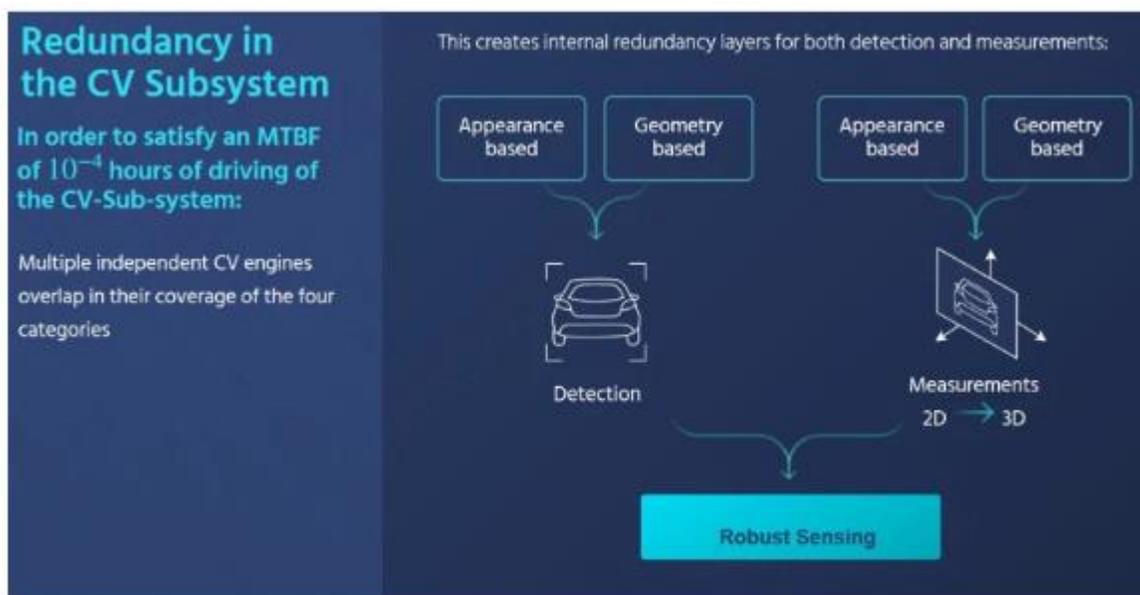
Anyone who survived the last week's ordeal in Las Vegas almost involuntarily comes away with a personal "takeaway" list. Below are the main perceptions I derived from my tour of CES 2020.

[Separately I recorded my interviews with executives from leading automotive semiconductor companies and aired them on our radio show, CES 2020, Day 3: IC Vendors Talk Self-Driving. Please give it a listen.]

### 1. Camera-only AVs can create 'internal redundancy' - Forget radars and lidars?

Experts in the automated vehicle (AV) industry maintain that redundancy — essential to the safety of AVs — comes from the use of multiple sensory modalities (i.e. vision, radar, lidar), and data fusion.

At an Intel/Mobileye press briefing at CES last week, Amnon Shashua, president and CEO of Mobileye, defied conventional wisdom. He said that by leveraging AI advancements, Mobileye now runs different neural network algorithms on multiple independent computer vision engines. This, he said, creates "internal redundancies."



Mobileye is working on "Full-Stack Camera-only Autonomous Vehicle"  
(Source: Intel/Mobileye)

For example, Mobileye says it applies as many as six different algorithms to the camera-only subsystem for object detection. Separately, it runs four different algorithms to add depth to 2D images, which the company claims can

effectively create 3D images without using lidars. Some of the new neural networks used by Mobileye include “Parallax Net” capable of providing accurate structure understanding, “Visual Lidar” (Vidar) offering DNN-based multi-view stereo, and “Range Net” for metric physical range estimation.

Mobileye, however, isn’t suggesting that the automotive industry do away with radars or lidars. OEMs can use a combination of lidars and radars, for example, as a separate stream, if so desired, says Shashua.

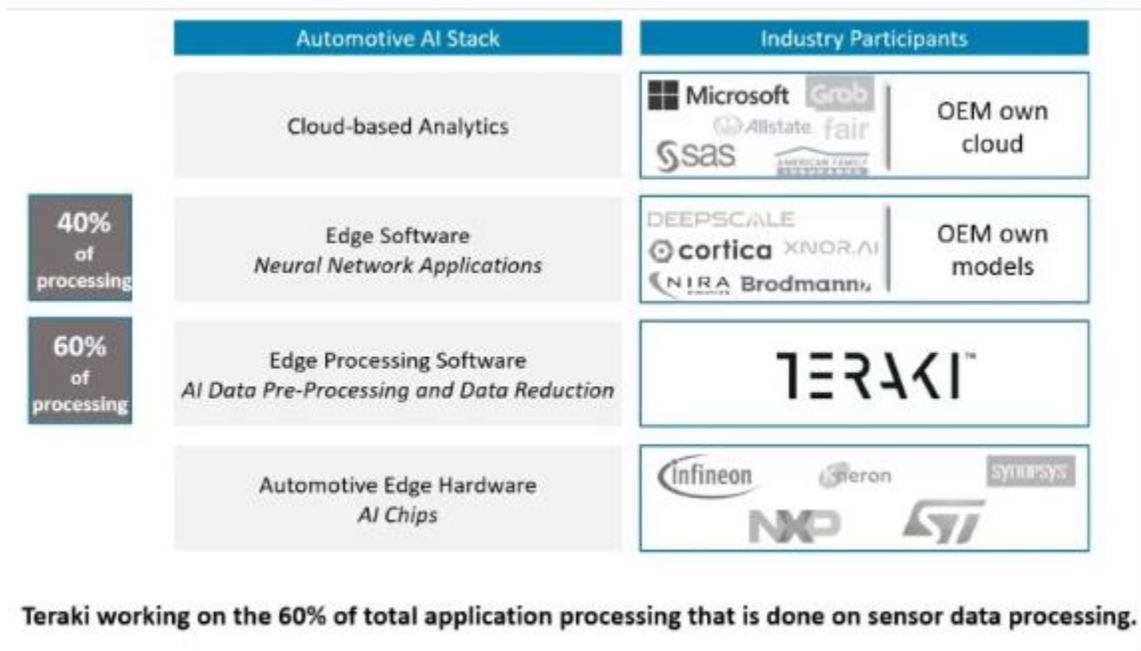
“It will be up to their customers,” said Phil Magney, founder and principal of VSI Labs. But what’s new here, Magney said, is, “the evolution of AI that can now add a certain level of redundancies to camera-only sub-systems.”

**2. Filter ‘big data’** - Big data is what drives connected devices. No question. But even more important is how to extract quality information out of big data. That’s where everyone struggles.

Take highly automated vehicles, for example. A processing unit powerful enough to digest incoming sensory data – whose volume gets bigger every day – won’t be cheap. A big CPU/GPU tends to dissipate too much heat. And sending big data to the cloud for AI training gets expensive. Add to this the mounting cost of annotating big data.

One way to buck the trend is to filter the data at the edge.

Teraki is a good example. The Berlin, Germany-based company claims it has developed software technology that can “adaptively resize and filter data, for more accurate object detection and machine learning.” Lidars generate “point clouds” — a collection of points that represent a 3D shape or feature, and they come with an enormous data load. What’s needed, said Teraki CEO Daniel Richart, is software that extracts information — “fast enough, at the quality they need” — before the data goes a central sensory data fusion unit inside an embedded system for transmission to the cloud.



*Where Teraki sits in the ecosystem (Source: Teraki)*

Paris, France-based Prophesee is another case. Its event-driven image sensors can directly address the issue of latency. Think of automatic emergency braking (AEB). Without waiting for an ADAS-equipped vehicle to finish fusing sensory data and issue a safety warning, the event-based camera can spot a road anomaly without latency. In

comparison, frame-based images fused with radar data often miss the object on the road, because automakers do not want false positives to confuse drivers, explained Luca Verre, Prophesee CEO.

**3. AI chips on 40nm to be fabricated in Japan** - CES is not exactly a venue where AI chip startups set up booths for demos. Nonetheless, AI chip company executives were on the prowl. AI hardware vendors such as Blaize and Gyrfalcon were present in technical posters at their partners' booths.

EE Times, however, caught up with Mythic co-founder and CEO Mike Henry in a press room. Mythic's accelerators, based on a compute-in-memory approach, will be fabricated in Japan, by Mie Fujitsu Semiconductor.

With technologies that range from ultra-low-power and non-volatile memory to RF, Mie Fujitsu, now wholly owned by UMC, offers foundry services based on 300mm wafer production facilities. Mythic will shortly start sampling its first AI accelerator chip — integrated with a PCI express interface to connect to the host — together with its SDK, according to Henry.

In the AI race, on one end of the spectrum, companies such as Nvidia have pioneered a large AI model equipped with faster acceleration, lower latency and higher resolution. On the other end of the spectrum, chips are running a tiny machine-learning model, which, however, could suffer a huge hit on accuracy, Henry explained. "The industry is currently stuck."

Mythic hopes that by splitting the difference it will occupy a sweet spot. It is developing in-memory AI acceleration chips powerful enough to handle HD video at 30 frames per second, while achieving low latency and low cost. System vendors need not pay for the memory bandwidth.

For what sort of applications will such an AI acceleration chip be used?

"This is for high quality products," explained Henry. AI acceleration can enhance image quality, even in low light. It can even detect and read license plates. In a parking garage, it could augment security. In short, AI can take over a lot of challenging high-quality video-capturing and processing tasks that traditional cameras can't pull off without inventing new hardware.

The key to Mythic's compute in memory approach is a Flash memory array combined with ADCs and DACs, turned into a matrix multiply engine. On the Mythic chip Henry is holding in the picture above, 10,000 ADCs are crammed inside.

**4. Selling into the future** - Clearly, the initial euphoria of consumer IoT devices is over.

Most consumers think nothing of replacing smartphones or wearable devices in less than a year. In contrast, connected devices for the industrial market are a long game.

That applies equally to highly connected vehicles and Industrial IoT. As Gideon Wertheizer, CEO of CEVA, explained, many building blocks used in today's highly automated vehicles (or industrial IoT devices) are not so different from what the industry has already developed. "The difference is whether you have the patience to stay in that [long-haul] business."

Patience is one. Commitment is another.

Silicon Labs' CEO Tyson Tuttle told us that, as IoT continues to look for design wins in the industrial market, the chip supplier's job is never done at time of sale. He said, "We are selling our chips into the future." More specifically, the success of the industrial IoT business is incumbent on chip suppliers' commitment to support new software, protocol updates and applications. "All that over the next 10 to 15 years."

## 5. Let big data companies see the forest but not trees

In the era of big data, if you are interested in the protection of your private data or increasingly concerned about future AI applications, look to Europe for help.

Unlike U.S. regulatory agencies who are hesitant to challenge big tech corporations' "innovations," European regulators have squarely committed protecting their citizens. Privacy and AI are their top agenda items.

The EU's General Data Protection Regulation (GDPR) is already setting the tone not just for Europe but for the worldwide market. Global companies engaged in aggregation and data analysis are mindful that their business practices do not violate the GDPR.

At CES last week, we came across a Taiwan-based startup called DeCloak. The company's founders succinctly described their technology as "letting big data companies see the forest without seeing any trees."

In the burgeoning confluence of surveillance and social media, the idea of "de-cloaking" might have never occurred to Silicon Valley startups.

DeCloak has designed a privacy processing unit (PPU) on a 1x1mm chip. The PPU includes a true random number generator. Installed in a dongle connected to a smartphone, for example, the PPU would block any private data that would otherwise migrate automatically to the cloud.

DeCloak believes that de-identification is vital for medical data. Although data collectors often say they are anonymizing data, it's unclear how much they are doing. Using the PPU, a patient can de-identify himself, to comfortably participate in the sort of medical research that depends on big data, according to DeCloak.

## 6. AVs with chutzpah

Mobileye showed at its press briefing a video clip shot while its autonomous vehicle was driving in Jerusalem.

Forget Hitchcock. This was one of the most gripping videos we've seen in a long time.



Mobileye CEO Amnon Shashua showed a two-minute clip of the Autonomous Vehicle coping with traffic impediments — including vehicles randomly parked on the street — and navigating oncoming traffic. The AV, trying to maintain a safe distance, gets boxed in but finds its way out. As it apparently intends to make a left turn in a busy intersection, the AV suddenly faces a tandem bus turning and cutting across its path from the right.

The huge bus totally occludes the AV's view while another vehicle looms on the left. To make it worse, pedestrians are randomly crossing the road as the AV tries to escape the jam with an unprotected left turn into heavy traffic.

Throughout the video, Mobileye's AV demonstrates a certain level of assertiveness — perhaps even chutzpah. When it finally reaches the intersection, the AV is confronted by yet another vehicle on its left. But the AV negotiates the

unwieldy traffic, asserts itself and finishes the left turn. The AV got a thunderous hand from the press briefing crowd as they shared a collective sigh of relief.

How often do you get that kind of reaction from the jaded members of the media?

Just to prove that Mobileye did not conveniently show only the good part, the company released a separate video clip — 22 minutes long. This version shows the AV going through the same intersection but with less drama.

### 7. Why are we doing AV?

CES 2020 effectively ended a hype cycle and unrealistic expectations for the imminent arrival of fully autonomous vehicles. Robo-taxis? Maybe in a few years.

As for consumer AVs, probably not until 2030, according to Peter Schiefer, Infineon’s division president responsible for automotive.

Automotive chip companies, traditionally known for conservative views on highly automated vehicles, have gotten their voice back. In contrast, Nvidia chose not to hold a press conference this year. Without Nvidia CEO Jensen Huang to quote at CES, the media had less copy to write about the remarkable progress of AI, big SoCs integrated with GPU cores with whopping teraflops and more design wins in AV prototypes.

Instead, Sameer Wasson, vice president and general manager of TI’s processor business unit, took a more reflective approach. Talking about AVs he said, “We need to ask ourselves why we are doing this.”

Uber might be doing AV to replace drivers. Semiconductor companies with big processors are certainly looking for an opportunity to tackle a new computing architecture for the sake of pushing the AI envelope.

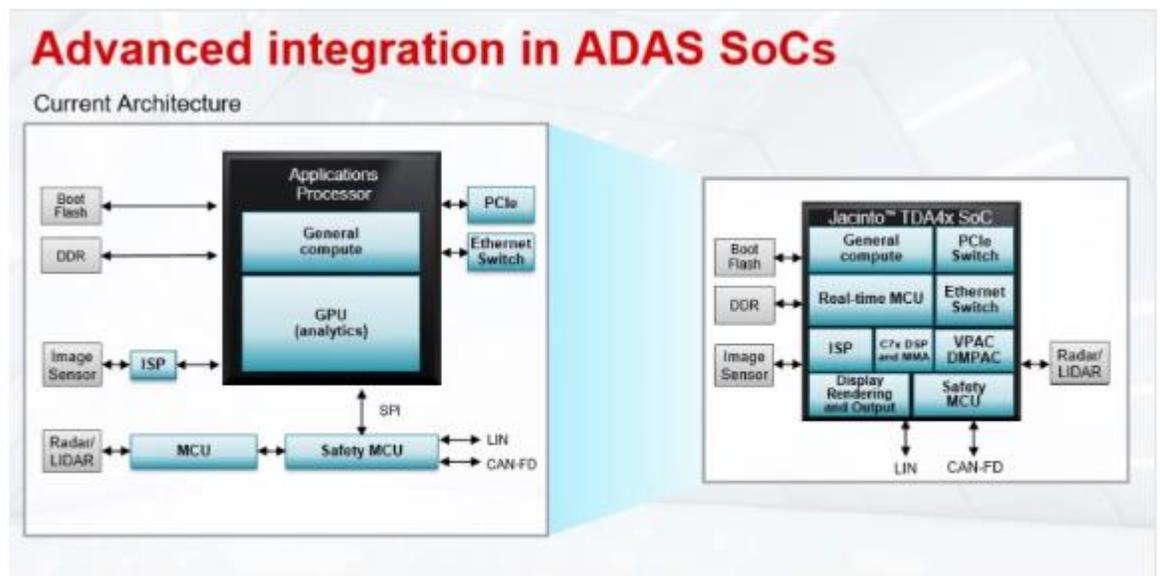
But for TI, the answer is simple: to develop practical cars enabled by more advanced safety functions.

Wasson said, “Our mission is 1) to make advanced automated features as accessible as possible to everyone, 2) to learn from the system (what automakers need) and 3) to effectively manage a whole product cycle across product lines with a scalable solution — more than 15 years.”

TI rolled out at the CES ADAS and gateway processors built on TI’s latest Jacinto platform and designed to enable mass-market ADAS vehicles.

### 8. Can cars tell us their intent? -

Developers running prototype robotaxis are eager to convince consumers that AVs are safe. Intel/Mobileye



TI’s new ADAS processor TDA4VM is not only highly integrated but also capable of fusing a variety of sensory data. (Source: TI)

discussed that its robocar provides a display to show what the AV is seeing. It allows riders to play back a few seconds of video to let them see why the AV did what it did.

Qualcomm, meanwhile, brought its AV to Las Vegas, giving the media and its clients a chance to ride.

Jim McGregor, principal analyst at Tirias Research, who took the ride, told us, “The ride was on a highway in Vegas. The car did well at merging, navigation and even avoiding an aggressive Camaro that cut us off and almost spun out. Overall, it was a comfortable ride, and the system appeared to operate very well,” he said.

One new Qualcomm feature enables the AV to vocally announce to passengers its intent — that it is trying to merge to the right, for example. We know it will be a long time before AI can explain itself (why it arrived at a certain decision) to humans. But it’s possible now, and a good idea, for an AV to let the passengers know what it plans to do next.

**9. Qualcomm-NXP: Life after the M&A was called off** - It’s been 18 months since Qualcomm’s proposed acquisition of NXP Semiconductors fell through. Several chip company execs last week remarked at CES how little the unconsummated acquisition deal has affected either company.

Qualcomm soldiered on to expand its automotive business — without NXP.

NXP sans Qualcomm, meanwhile, has been beefing up its connectivity portfolio. Last year, NXP acquired Marvell’s WiFi and Bluetooth connectivity assets. NXP is also pushing ultra-wide band (UWB) as a much more precise location technology.

Still, NXP is missing cellular technologies. The company doesn’t have big AI solutions, either.

Is Qualcomm’s aggressive foray into the automated vehicle platform worrisome to NXP? Not really, according to Lars Reger, NXP CTO. “We will gladly let Nvidia, Qualcomm, Kalray and others fight for the big AI space.”



*NXP CTO Lars Reger in the company’s tent at CES 2020 in Las Vegas. (Photo: Mitch Tobias / michtobias.com)*

After all, the market for fully autonomous vehicles will remain relatively small. Further, the competition among these powerful AI chips is expected to get even more brutal because everyone wants to use 7nm or 5nm finer process node technology, which isn't cheap.

“NXP’s focus will be on the rest of the automotive platform,” said Reger, with solutions ranging from safety, security and gateways to domain controllers and edge nodes/sensors.

#### **10. It takes a village...**

Anyone serious about the future of connectivity and shared mobility, with fully autonomous vehicles roaming the streets, must begin planning a brand-new “smart” village.

Toyota did a complete 180 before a tech audience expecting Toyota’s new AI-driven vehicles. Almost completely absent from Toyota CEO Akio Toyoda’s presentation was any mention of automobiles.

Instead, Toyoda showed artist’s renderings of a futuristic “Woven City” of 2,000 residents, nestled in the shadow of Mount Fuji.

Toyota literally leapfrogged the dream of fully autonomous vehicles and transformed it onto AI-driven smart-city concepts. Toyota’s vision includes: high-rise “blocks” surrounded by greenery, each roofed with photovoltaic tiles to convert sunlight to energy, while underground, there will be a hydrogen power plant to provide additional energy. Robots will be everywhere, “sensor-based AI detects the household’s needs before any human notices, stocking the fridge, adjusting the heat, collecting the trash, monitoring the baby, housebreaking the puppy, and polishing the doorknobs,” reported EE Times.

Autonomous vehicles turned into food trucks, delivery vehicles and shared shuttle are only parts of the story of the smart village.

Asked if this sounds too crazy, Alexander Hitzinger, CEO of VW Autonomy GmbH, said, “Not at all. That’s where the future of mobility is.” In other words, “mobility” isn’t just about going from point A to point B. It’s about the entire environment in which AVs will operate.