WHAT WERE THE BRIGHT IDEAS THAT VISIONARIES SHOULD HAVE LEARNED FROM CES 2019?

idea

14

1-MINUTE READS

ABIresearch
for visionaries

CES

Letter From Our VP of Verticals/End Markets

Dear visionaries,

With 180,000 visitors and more than 4,500 exhibitors, CES 2019 maintained the momentum from previous years at the intersection between consumer verticals (automotive, smart home, entertainment, and healthcare/wellness) and underlying technologies, such as computing and short-range wireless semiconductors and connectivity, AI (Artificial Intelligence), AR (Augmented Reality), robotics, and video. However, new and adjacent areas, including smart cities, retail, blockchain, and financial services, remained largely marginal. At the same time, focus was somewhat shifting from long-term visionary, transformational, and disruptive innovations to shorter-term incremental enhancements as well as using new technologies to improve existing products, services, and solutions.

This was very apparent in automotive with both **NVIDIA** and **Intel's** Mobileye putting renewed focus on ADAS and level 2+ automation, which are awaiting longer-term level 4/5 driverless cars. At the same time, AI-enabled voice assistants (Alexa Auto), AR (**Waymo**) and Virtual Reality (**Nissan's** invisible-to-visible (I2V) tech) were highlighted as major automotive user interface innovations. **Amazon** voiced its ambition to turn Alexa into the unifying user interface across verticals, with rival **Google** Assistant spreading its message across Las Vegas. **Samsung's** Bixby very much remains a distant third.

Flexible screens were a major highlight at CES, not just for smartphones but also for televisions (roll-up OLED screens from **LG**). **Luxoft's** partnership with LG to bring webOS to automotive infotainment represents another example of cross-vertical deployment of horizontal technologies.

While IoT, connectivity, and 5G in particular remained largely out of the limelight despite eye-catching keynotes from **Qualcomm**, **Verizon** and **AT&T** (confirming the enthusiasm for 5G outside the telco space remains lukewarm), AI was ubiquitous, as an enabler for both short incremental and long-term transformational innovations. New use cases were abundant. NVIDIA made a big deal out of the role of AI to enhance graphics performance and image quality (DLSS neural network supported on new RTX graphics card).

Automotive electrification and charging technologies were highlighted in many forms, from eVTOLs (electric vertical takeoff and landing from **Bell**) to air taxis, two-wheel vehicles, drones, robots, wireless charging, Vehicle-to-Grid (V2G), AI, fuel cells, and wireless power over distance. More generally, the use of technologies to enable resilience and sustainability resonated across the show.

Presence of digital health and wellness vendors was on the rise with a 25% increase in the number of exhibitors. Brain wave sensing is one of the noteworthy innovations enabling meditation tools (Muse headband EEG device from **InteraXon**).

CES is slowly reinventing itself. While the largest global tech event is still very much defined by consumer hardware, it is now branching out into new verticals and new (invisible) technologies like AI and voice assistants. It is becoming more global with almost one-third of the exhibitors coming from China. It is also giving a bigger voice to startups. CES is clearly jumping on the bandwagon of telling the digital transformation story of verticals and consumer experiences — a story ABI Research is very familiar with. ABI Research has focused on the compelling technology findings from CES 2019 into this whitepaper — a total of 14 1-minute reads.

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5G AND MOBILE NETWORK INFRASTRUCTURE

- While often touted as limitless, 5G will not be able to address all IoT (Internet of Things) connectivity needs. Satellite and LPWA (Low-Power Wide-Area) solutions are necessary to fill in the connectivity gaps 5G will leave behind and previous generations of cellular technology. **Astrocast** is planning to launch 64 nanosatellites to provide low-cost satellite coverage to the 90% of the earth not covered by terrestrial networks, focusing on transportation, energy, and agriculture. **Globalstar** provides remote asset-tracking satellite-connected solutions through its SmartOne product line. Additionally, 85 cellular LPWA networks have been deployed so far worldwide to provide end users with low-cost and low-power solutions with technologies such as NB-IoT and LTE-M set for significant growth at a 141% CAGR (compound annual growth rate) during the next five years.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- Voice assistants saw an enormous marketing push by the likes of **Google**, **Amazon**, **Samsung**, and **LG** at CES. Many consumers still view devices, such as Amazon's Echo and Dot, as novelty gadgets, and they aren't using their voice assistants to interface with nearly as many consumer devices as the vendors of these systems would like. CES was clearly an attempt to demonstrate the number of other devices that will now be compatible with a voice assistant, and how consumers can leverage voice in more meaningful ways than selecting songs on **Spotify**, but time will tell as to whether this will translate into meaningful changes of consumer behavior.

- Software companies express concerns about custom AI silicon solutions. Companies building and designing custom AI hardware are exposed to significant risk in terms of the changing nature of techniques and approaches used in AI software. Building optimized silicon solutions around AI algorithmic techniques that are popular today is very risky because these approaches could change dramatically between now and when many solutions are finalized and move into full commercialization. Any changes to AI software could have a dramatic impact on the effectiveness of bespoke silicon architectures and could make these efforts by startups redundant.

- **NVIDIA** has an unassailable lead in terms of AI training and associated training algorithms. NVIDIA has invested heavily in building out its software libraries to make many different Convolutional Neural Network training processes possible. Challengers will have a mountain to climb in terms of both competitively replicating NVIDIA CudaNN software and convincing developers they need to learn new platforms.

AUGMENTED AND VIRTUAL REALITY

- Hardware Evolution, No Revolution: While there were plenty of hardware offerings on display across the show, none were a revolutionary entry compared to what is already available. Some advances in form factor and display, as in the AR glasses from **nReal**, were more noticeable than some of the more iterative field of view and resolution improvements on the VR side as a whole. Standalone VR devices were common; the Oculus Quest and the newly announced **HTC** Vive Focus were present. **Vive** also added eye tracking to its Vive Pro offering, which is a positive indicator of future input method improvement, something sorely needed in both AR and VR.

- 5G Tie-ins Grow Stronger: **Qualcomm** was on the show floor with a VR demo running over 5G. Cloud AR/VR has been discussed in great detail during the past few years, but it is important to see performance and potential firsthand. Obviously, real-world examples are still a way off, but early demos at CES, ultimately shifting to realistic implementations, along with support from operators, will expand the potential footprint. Cloud AR/VR allows devices to forego onboard processing or tethered requirements in favor of offloaded processing, shrinking form factor and allowing for more user-friendly devices.

- Partnerships Abound: Partnerships were plentiful across hardware, software, manufacturing, and more. Whether it be operators and silicon vendors, or fitness brands and VR headsets, AR and VR was a cornerstone of some major partnerships as companies begin to realize the value in AR and VR experiences. Hardware advancements like HTC's first party eye tracking offer another input method and data point for potential partners to leverage, and the increase in user-friendly standalone headsets lessens the burden on a potential partner in working with VR.

BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGIES

- There was more discussion of Blockchain technology at CES in presentations and moderated panels than displayed as the leading technology in products and services by established companies and startups. However, Blockchain was listed as a key technology for some company products and services. One company of note is **Populstay,** which is trying to reinvigorate the home sharing market by using Blockchain in two ways. First, to lower booking and payment administration costs using Blockchain and smart contracts. The second way is the management of customer preferences for IoT device usage and settings in smart locks, Wi-Fi, TV, Siri, Alexa, and others. Overall, Populstay is removing overhead for activities that can be done more efficiently when executed on smart devices and using Blockchain technology.

- **Luxoft** showcased how Blockchain can be used in smart mobility contexts, facilitating carsharing and peer-to-peer lending based on automated payments through smart contracts and self-sovereign, decentralized identity linking banks, dealerships, and consumers while maintaining security and privacy. Luxoft's blockchain partners include **Sovrin** and **Corda**.

DIGITAL SECURITY

- Within the consumer IoT, privacy and security are huge concerns that are largely being unaddressed. As a result, consumers are starting to re-evaluate their expectations around what they want their technology to do and the limitations they expect it to have. There is eroding trust when it comes to these types of connected solutions with many consumers realizing that these products are often predicated on a false notion of manufactured necessity and as such any risks associated with using them are simply not worth taking. While companies such as **BlackRidge Technology** are addressing security by enabling identity at the edge to authenticate devices before establishing connections, security often seemed like an afterthought in most connected products and solutions on display. In a panel discussion, one cybersecurity expert even warned that "we are on the cusp of a global cyber pandemic" that will result in tremendous economic damage if device manufacturers and solution providers don't adequately address these challenges.

INDUSTRIAL, COLLABORATIVE AND COMMERCIAL ROBOTICS

- This year's CES was another that yet again didn't see the launch of a killer consumer robotics platform. Significant incremental improvements were demonstrated by a number of companies at the show particularly in terms of leveraging AI voice assistants and cameras to improve robotics systems. But fundamentally the only robot that addressed a new application we haven't seen before was **Foldimate**, the laundry-folding robot. Consumers will have to wait another year for true innovation in the robotics category or a product that could have genuine mass market appeal in the consumer segment.

- Social robotics companies use AI to develop highly personalized robotics systems. Robots like EliQ developed by **Intuition Robotics** and **Kiki** take advantage of AI for perception but also use AI reinforcement learning techniques for their decision-making system in terms of how they choose to react to different individuals in a personalized manner appropriate to individual users.

- Consumer robotics companies are recognizing the importance of data privacy embedding all the processing needed for their systems on their robots and avoiding connected systems. This means their robots can avoid having to send any data to the cloud or providing hackers with an attack surface. Given that many consumer robots can now collect significant amounts of data about their owners with the image and voice recognition systems, it is excellent to see that companies are recognizing the importance of privacy and security.

M2M (MACHINE-TO-MACHINE), IoT (INTERNET OF THINGS) AND IoE (INTERNET OF EVERYTHING)

- IoT was everywhere at CES when defined by "things" getting connected and becoming smart; smart home technology had the largest number of products present. However, features and services among many IoT products displayed at CES were communicated by merging two or more product themes. For instance, pet monitoring and healthcare are two examples. **Toletta**, **Pepe**, and **Avec** were all offering smart pet houses that either provided a soothing environment for pet sleep and drying after baths or monitored pet weight and urine analysis for medical monitoring. Another example is the connected gym and environmental sustainability. **SportsArt's** Verde offers the electricity generating treadmill that converts human power into utility grade electricity. A third was healthcare, clothing, and smart living. **Dr. Scholl's** was offering customized insoles designed and manufactured using a smartphone app. **Soma** Innofit demonstrated its bra fitting technology cutting down the time women need to find the perfect fit bra. Finally, **Willow** showed the wearable breast pump that allows mothers to pump breast milk using a pump designed into a breast size cup.

- IoT was one of the main digital transformation enablers at CES 2019, present in everything from smart cities and autonomous vehicles to retail and the smart home. Its ongoing convergence with 5G and AI will create substantial cross-vertical opportunities for visionaries to create significantly improved end-user experiences leveraging IoT's vast sensor networks, 5G's low latency, and AI's analytics algorithms. IoT, 5G, and AI were the pillars behind many leading companies' CES strategies, with **Samsung** promising a vision of truly connected living with its "intelligence of things" and **Qualcomm** loftily proclaiming, "This is the

age where everything connects to everything else." The question for IoT visionaries moving forward in 2019 and beyond is not "how do I create value?" with these enablers but rather "how do I capture it?" Visionaries must create new consumer and enterprise business models that enable new pathways to capture this value by providing not just data monitoring, but also event and incident response solutions.

SMART CITIES AND SMART SPACES

- Despite dedicated exhibition space and talking tracks, Smart Cities remains a more marginal part of the coverage at CES. It was also somewhat hijacked and/or dominated by the smart mobility and automotive vertical. Talk tracks and focus areas included sustainability, resilience, and public safety. CES remains firmly rooted in consumer hardware and struggles to expand into more conceptual markets like Smart Cities.

- **INRIX** announced a partnership with the **Regional Transportation Commission of Southern Nevada** using its AV Road Rules framework to digitize, validate, and manage local traffic rules and restrictions, such as speed limits, crosswalks, school zones, and stop signs in busy areas for HAV (highly automated vehicle) testing and deployment. INRIX also announced joining the PAVE (**Partners for Automated Vehicle Education**) coalition solely aimed at informing and educating the public and policymakers on the impact of HAVs on future mobility. Other PAVE members include **AAA**, **Audi of America**, **Daimler**, **Intel**, **National Safety Council**, **NVIDIA**, **SAE International**, **Toyota**, **Volkswagen**, and **Waymo**.

SMART HOME

- This year saw some notable new exhibitors emphasizing the growing global reach and value of Smart Home services. Most notable were two from China: **JD.com** and **Tuya**. Both underpin the potential for China to offer Smart Home development and infrastructure support, not just OEM manufacturing. JD with its supply chain operations already is where **Amazon's** new Key service wants to be, but with a greater interest in in-home sensing over securing deliveries. For its part, Tuya unveiled its already impressive reach outside China. It delivers IoT connectivity and management to Smart Home OEMs and supports 30,000+ existing products, 10,000 OEM customers, and 100 million deployed devices. It also underpins the **Energizer** and **Monster** brands move into the Smart Home market announced at the show.

- **Comcast** announced its first service to leverage the Smart Home support embedded in its broadband routers that launched at CES 2018. This year Comcast launched a network security monthly subscription fee service to extend monitoring and protection to Smart Home end-points within the home network. The move is not just ahead of the Smart Home market and its support for greater device security but a step toward Smart Home as an enabler of new services and associated revenues.

- Meshing Smart Home services and capabilities with elderly monitoring has long been outside the immediate focus of Smart Home service providers. CES 2019 showed this is starting to change. **Alarm. com** announced an elderly monitoring device and related platform services for its Smart Home customers to offer. The move comes as Smart Home vendors increasingly look to the appeal of elderly monitoring as a potential market that dovetails well with their existing capabilities.

SMART MANUFACTURING PLATFORMS (INDUSTRIAL SOLUTION)

- The democratization of manufacturing services was on display at CES and most noted by the services of two companies: **Surcle** and **Fictiv**. Surcle offers crowdsourced engineering design services. Through its platform, companies can create competitions for design of products and solutions that are engaged by Surcle's network of nearly 10,000 engineers, inventors, and specialists. What makes Surcle interesting is that the challenges for product designs are increasingly for smart products, which should not be a surprise as many enterprises do not have all the internal skills to build digitized, sensorized, and connected products. Fictiv is an on-demand engineering platform designed to make it easy to quickly get products manufactured. By uploading 2D and 3D CAD files, Fictiv will match product manufacturing requirements with its network of manufacturing service suppliers covering CNC machining, injection molding, finishing, and other post-processing services. The online communications enabled by the platform also allow manufacturers to provide feedback on the design to improve manufacturability.

SMART MOBILITY AND AUTOMOTIVE

- Semi-Autonomous and Active Safety: CES 2019 saw a flurry of driverless prototypes being showcased, alongside ambitious strategies to develop platforms supporting a number of Smart Mobility use cases. The launch of the **Waymo** One service in late 2018 brought home the reality that even as driverless vehicles begin hitting the road during the next few years, it will take time for these early implementations to become ubiquitous and profitable. OEMs and their suppliers are therefore keen to monetize the assets that they have developed to support fully driverless operation by supporting applications that have greater potential in the short term:

  - Active Safety: The **Toyota** Guardian system demonstrates how driverless technologies can be repurposed to enable robust active safety with capabilities above and beyond contemporary ADAS.

  - "Level2+": The NVIDIA Autopilot system leverages hardware, software, and HMI elements from the DRIVE AV and DRIVE IX stacks to enable a robust semi-autonomous driving system, with scope for OTA (over-the-air) updates to add new functionality over time.

- Intelligent Assistants: While the market opportunity for widespread driverless services has been pushed back, the industry is looking to connected infotainment innovations to drive new car sales in a difficult market and to generate ongoing revenue streams. **Amazon's** aggressive move into the vehicle continues at pace, with multiple integrations of Alexa Auto demonstrated at CES. In tandem with the use of intelligent prompts, automakers are finally developing connected infotainment beyond simple smartphone mimicry, with application-based approaches being displaced by a navigation-centered experience augmented with natural language interfaces and prompts enriched with location context.

- Connected Infotainment Marketplaces: Infotainment and navigation players, such as **HARMAN**, **Telenav** and **HERE**, are supporting OEMs in their ambitions to transform the connected infotainment system into a focal point for revenue-generating touchpoints. These new offerings are taking advantage of the HMI (Human Machine Interface) developments listed above to enable consumers to make transactions safely, and often in response to prompts driven by their location context. In the case of HERE NavOD, a

new approach based on software clients is enabling OEMs to deliver access to new, monetizable navigation services.

SMARTPHONES, MOBILE BROADBAND AND WEARABLES

- As in past years of CES, smartphone brands used the event to showcase new upgrades and innovations. The most interesting innovation was the foldable smartphone. **Royole** FlexPai had an actual product to show but **Samsung**, **LG**, and **Huawei** all state they will be launching smartphones with this technology. But with smartphone sales peaking, smartphone services are the growth market, and **Google** was making the most noise in this area at CES with the upgrades to its Google Assistant voice app. These upgrades include checking into flights, booking hotel rooms, updating notes and lists, expanded messaging to **Facebook** Messenger, WhatsApp, Viber, Telegram, Android Messages, Hangouts, and SMS, as well as improved voice command interpretation in noisy environments. In addition, Google Assistant is now available in Google Maps, enabling these same functions in addition to voice navigation functions. The bigger picture being facilitated by Google Assistant, but also in **Amazon's** Alexa and **Apple's** Siri, is that voice AI will become a feature in more and more devices and things. While this will not kill the smartphone, it certainly takes away one of the smartphone's key differentiators as well as change customer relationships with their "stuff" and the offering brands.

VIDEO AND CLOUD SERVICES

- AI/ML (Machine Learning) on the minds and in solutions of video companies at CES 2019: Companies like **AWS/Amazon** have been pushing AI for the video space, but many insiders have openly wondered how AI would impact the industry more broadly. CES 2019 started the year off with a strong push toward answering those questions. Companies like **Nagra**, **TiVo**, and **Conviva** showed how AI will help companies reduce churn, increase revenue opportunities, and manage and improve service performance, while **Gracenote/Nielson** showcased significantly deeper metadata taxonomy to help feed ML datasets. Security is also seeing an infusion of AI, with **Irdeto** and **Synamedia** (respectively) showing how AI is improving the processes and workflows to combat piracy (and secure content) and helping to prevent password sharing. On the device side, TV manufactures (and silicon providers) showcased how AI can help improve picture quality and upscaling, an essential ingredient for 8K TVs with no native content to play. It is still early days, but AI and ML bring new levels of upgradeability and adaptation to products and solutions that were previously more static.

- CES 2019 still looking for the next big thing in displays/TVs: With 4K TV prices at mainstream levels, the display/TV industry is already looking for differentiation and new technologies to help boost margins and introduce some excitement and intrigue back into the pipeline. **AU Optronics**, **Hisense**, **Panasonic**, **Samsung Electronics** (not yet Samsung Display, but reportedly coming onboard), and **TCL Electronics** highlighted the push into 8K by forming the **8K Association** (8KA). TV manufacturers also showcased their new 8K TV sets along with rollable displays (**LG**), laser projection (Hisense in particular, but others as well), more certifications (IMAX Enhanced was announced in September 2018 but new support was unveiled

including streaming services, content providers, and devices/displays) and related to the other integration trend of AI/ML.

▪ Streaming (and storage) of content marches forward, but hints of maturity sprinkled around at CES 2019: Questions were raised at CES if OTT (over-the-top) Video is still indeed OTT — or perhaps it is all now simply "TV." On the one hand, streaming video is expected to continue growing to new heights, even in an odd-calendar year (no major events like Olympics or World Cup) so it appears it is still far from maturity, but companies are starting to shift strategies that better address some needs that arise in a mature market. It's no longer just about launching services, reaching scale and bringing flexibility, although these things are still vitally important. The rise of AI and thoughts to new or alternative business models are prime examples where companies and thought leadership are starting to focus on customer retention and capturing consumer surplus — shifting the focus from pure viewership growth to revenue expansion and profitability. CES 2019 also highlighted how pervasive video will become as new technologies like XR, 5G, autonomous vehicles, etc., come into play.

WI-FI, BLUETOOTH AND WIRELESS CONNECTIVITY

▪ Wi-Fi 6 ready ecosystem gains further traction: CES 2019 saw further traction in the emergence of Wi-Fi 6 (802.11ax) capable chipsets and devices. **MediaTek** announced its new Wi-Fi 6 and Bluetooth combo chip portfolio for home and enterprise APs (access points), routers, gateways ,and repeaters supporting 2x2 and 4x4 MIMO. **Cypress Semiconductor** announced a 2x2 combo Wi-Fi 6 and Bluetooth solution targeting automotive infotainment applications. **Celeno** launched its new CL8000 Wi-Fi 6 chip with ElasticMIMO support that enables APs to dynamically adapt to ensure the best user experience on 2.4GHz, 5GHz, and upcoming 6GHz bands, while **Intel** and **Qualcomm** demonstrated their existing Wi-Fi 6 solutions. On the device side, new Wi-Fi announcements and demonstrations from **TP-Link**, **Netgear**, **ASUS**, **ARRIS**, **EnGenius**, **HP**, among others, further demonstrated the growing traction and expectation of Wi-Fi 6 growth in the 2H 2019 and throughout 2020.

▪ Mesh, distributed Wi-Fi, and value-added services: CES 2019 also saw further traction in the Wi-Fi mesh networking space, with Wi-Fi 6 increasingly being leveraged as part of these solutions. ARRIS unveiled its SURFboard mAX Pro, a tri-band residential Wi-Fi 6 mesh networking solution. TP-Link announced its first Wi-Fi 6 mesh networking solution, the Deco X10, available in Q3, while Netgear announced that its next-generation Orbi mesh networking product line will support Wi-Fi 6 later this year. Qualcomm had a stand dedicated to its mesh networking products from the likes of EnGenius, **Google** and Netgear, highlighting continued growth in this space. In addition, with devices like Netgear's Orbi and the ASUS Lyra voice, the value proposition of mesh solutions is also increasing through integration with smart speaker functionality and voice control platforms like Alexa. Alongside this, a number of chipset vendors, such as **Quantenna** and Qualcomm, are beginning to support additional functionalities and value-added services, such as Wi-Fi motion detection to provide intrusion detection, elderly monitoring, and presence detection for Smart Home automation use cases like smart lighting. In addition, flexible or adaptive MIMO (Multiple Input Multiple Output) configurations are becoming increasingly important differentiators in mesh platforms to ensure the best performance throughout the home is maintained at all times.

- The emergence of wireless power over distance: Perhaps one of the more exciting and transformative technologies on display were a number of wireless power-over-distance demonstrations from the likes of **Ossia**. Ossia's Cota Real Wireless Power solution does not require plugs, pads, or line of sight, but is delivered OTA (over the air) and at a distance utilizing the same antenna as Wi-Fi and Bluetooth, enabling small form factors without the need for additional costly coils, antennas, or ultrasound transceivers. An embedded receiver on a device sends a beacon to the Ossia transmitter, which then sends power back via the same path. By completing this process 100 times a second, Ossia was able to demonstrate how its technology can power multiple devices simultaneously, power moving devices, does not require line of sight, and can safely send power over distance. At CES 2019, Ossia demonstrated its new 5.8GHz wireless power system at the show, expanding and improving on its existing 2.4GHz solution, in addition to announcing a partnership with **Spigen** to develop a wireless powered phone case, though this is unlikely to hit retail before 2020. Ossia also has announced recent partnerships for IoT asset tracking solutions with **Xirgo Technologies**, in addition to **Walmart** for potential applications in barcode scanners, electronic shelf labels, cameras, beacons, and other devices. In the long term, embedded wireless power could have enormous implications for wireless devices, enabling them to be deployed more flexibility, in smaller form factors, and providing greater scalability across a wide range of device types.

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