BRYAN, GARNIER & CO

# CES 2018

## ARTIFICIAL INTELLIGENCE TAKES CONTROL

# Contents



We attended the latest Consumer Electronics Show (CES) in Las Vegas to get a better view of the megatrends affecting the automotive and semiconductor industries, and to see the latest solutions from tech start-ups. In this report, we review the most important innovations in these two tech sectors.

CES 2018 was a record-breaker, especially for the auto and components sectors: This year, over 3,900 exhibitors showcased world-changing technologies. CES is now clearly seen by the auto industry as the best place to unveil and promote innovation as well as new products. Interestingly, the number of auto suppliers attending the fair was up significantly compared with 2017 while the number of carmakers remained stable. This confirms our view that the most high-tech suppliers will tend to gain further share in the entire vehicle value chain, to the detriment of their end customers (carmakers) who are losing market share in the value of the car. Most innovation comes from tech suppliers rather than automakers.

The cockpit of the future: While self-driving technologies and electric cars were the focus of attention at last year's CES, most of 2018's auto and parts innovations were focused on the "cockpit of the future" and infotainment solutions to entertain the "driver" during self-driven trips. The race to develop the best ADAS hardware solutions (e.g. radar and Lidar) was also clearly visible. We assume at some point that only two or three players will remain in Lidar tech.

AI on everyone's lips: For semiconductors, the main topic at the 2018 show was undoubtedly artificial intelligence. We saw numerous initiatives from major players, ranging from Intel to STMicroelectronics, which unveiled its new artificial neural network SoC in 28nm FD-SOI, dedicated to computer vision applications. However, we also saw many start-ups showcasing new AI technologies, from a lightweight voice control assistant to a surprisingly powerful "Brain Processing Unit" from Horizon Robotics that is scaring semiconductor giants. While the larger players flex their muscles, some start-ups really appear to have found the right way first – this is why we believe AI will be a major M&A theme this year. Overall, the current focus on AI tends to be driven by tangible customer applications, which in turn leads us to believe that it has potential to be the next big growth driver


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# Part 1. Automotive: a record-breaking CES, still strongly focused on self-driving technologies

CES is indisputably the place for mature and large companies to unveil new innovative products or for disruptive tech start-ups to promote themselves. This year was a record for CES, with more than 3,900 exhibitors showcasing world-changing technologies that spanned more than 2.75 million net square feet of exhibition space across Las Vegas. 2018 was the largest show floor in CES's 51-year history.

As expected, the automotive sector was well-represented at the international fair. The auto industry now sees the show as the best place to unveil and promote innovation and new products – even if products are not always only based on electronic innovation and even though visitor numbers remain six times lower than at a motor show (this is still the case in 2018 despite a rise in the number of attendees).

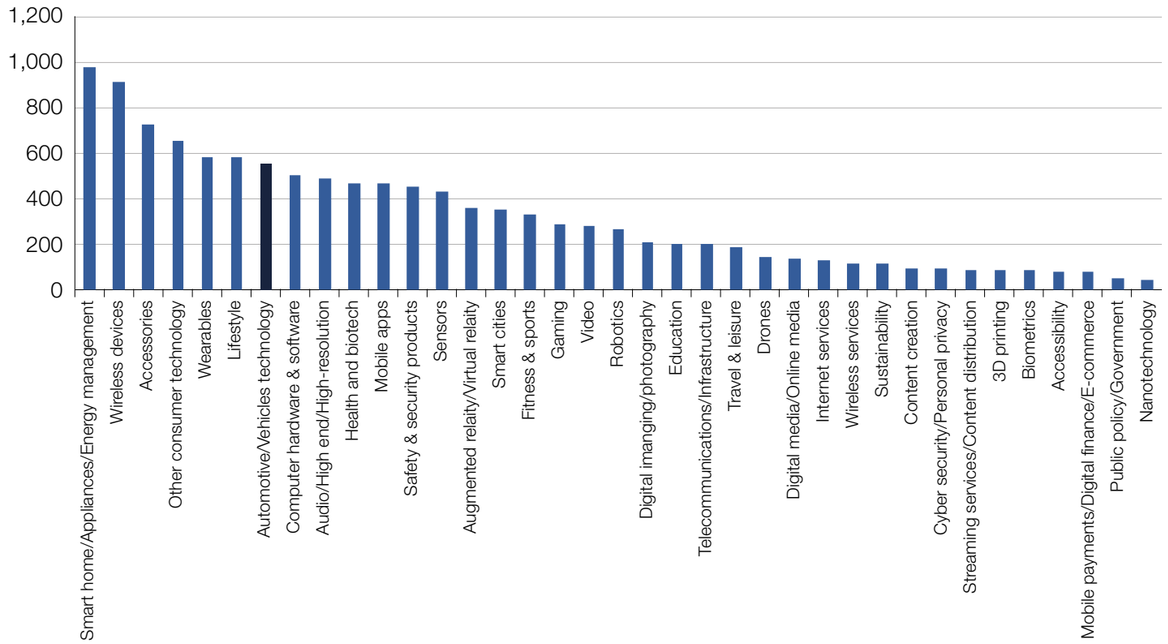
As with CES 2017, despite "Self-Driving Technology" having only one "marketplace" out of 23 different marketplaces dedicated to the automotive business (as we can see in Fig. 1), the number of auto and parts-related companies officially present at CES surged from <500 compared with last year to 556. This clearly indicates the growing importance of the "Self-Driving Technology" marketplace: this year it ranked seventh versus ninth in 2017.

Interestingly, the number of automakers at CES did not really increase compared with last year given that VW, Audi and GM were not present at this edition. Newcomers specialized in electric vehicles, such as Chinese start-up Byton, were however present for the first time, confirming the shift towards electric vehicles (EVs) imposed by European authorities while the Chinese government is reshuffling the cards to the benefit of young tech companies.

The number of traditional automotive suppliers was nevertheless significantly higher than last year, with Faurecia, Aptiv and Gentex notable in joining traditional suppliers such as Continental, Mobileye, Bosch and Denso.

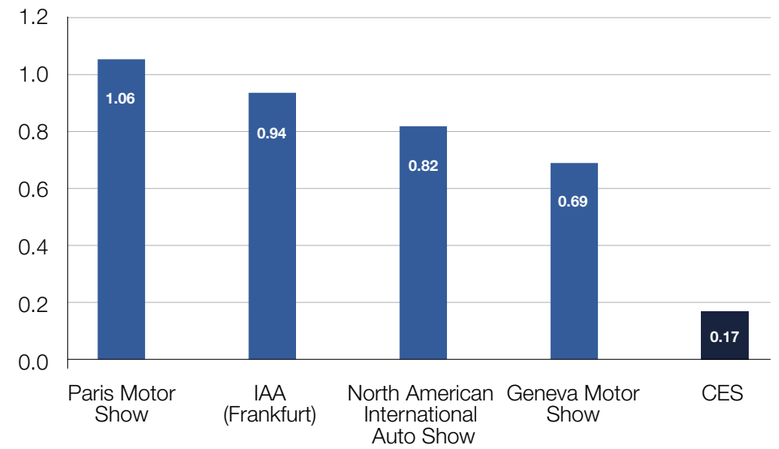
Combined with the stable number of automakers at CES this year, this increase in suppliers attending confirmed our view that the most high-tech suppliers will tend to continue gaining share in the entire vehicle value chain, to the detriment of their final customers (carmakers) who are losing market share in the value of the car. Given that innovation/development of new innovative products remains the main driver behind a group's presence at the CES, the higher presence of automotive suppliers every year confirms our thoughts that innovation is now in the hands of automotive suppliers and no longer in the hands of carmakers. We assume more and more automotive suppliers will try to attend CES over the coming years alongside non-traditional auto start-ups promoting their self-driving electric vehicle prototypes.

**FIG. 1: NUMBER OF COMPANIES PER "MARKETPLACE" AT CES 2018**



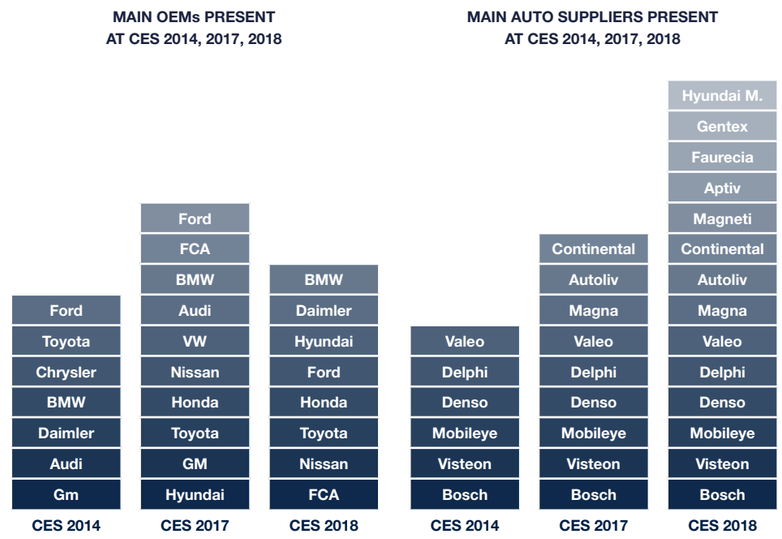

Source: CES; Bryan, Garnier & Co

**FIG. 2: CES VESRUS OTHER TRADITIONAL AUTO SHOWS (NUMBER OF VISITORS IN MILLIONS)**




Source: CES; Bryan, Garnier & Co

**FIG. 3: CES AUTO AND PARTS ATTENDEES**




Source: CES; Bryan, Garnier & Co

Last year, we identified electric vehicles, connected vehicles and self-driving cars as the three megatrends present at the CES, with major announcements made by automakers and auto suppliers during the four days of the show.

However, this year's edition of the CES focused more on connected vehicles and self-driving cars and less on electric vehicles. Later, we discuss the most important takeaways from the main announcements in these fields. Figures 4 and 5 show a summary of the key 2018 automotive announcements:

**FIG. 4: MAIN ANNOUNCEMENTS IN THE AUTOMOTIVE FIELD AT CES 2018 – PART 1**

| COMPANY NAME | NEWSFLOW |
|---|---|
| AEYE | Aeye unveils the AE100 robotic perception system for autonomous vehicle |
| APTIV | Aptiv to continue testing robotaxi fleet in Vegas long after CES |
| ARCIMOTO | Arcimoto unveils its affordable pure electric "Fun Utility Vehicle" |
| BYTON | Chinese-backed electric car startup Byton vows CES with model 40% cheaper than a Tesla |
| BOSCH | Bosch advances its ancillary mobility technologies, both of which help to maximize the inherent advantages of electric vehicles. |
| CONTINENTAL | Continental unveiled two new battery charging systems |
| CINEMO | Cinemo unveils its latest embedded innovations for automotive. The group also signed a partnership on enhanced In-Vehicle Infotainment with Elektrobit. |
| CYPRESS | Cypress introduces a new capacitive touchscreen controller for next-generation infotainnment systems |
| FAURECIA | Faurecia officially confirms its collaboration with Amazon to develop the connected cockpit |
| FORD \|POSTMATES | Ford taps Postmates for edge in self-driving delivery race |
| FORD \|QUALCOMM | Qualcomm, Ford Partner On C-V2x Global Initiative |
| GOOGLE | Google brings voice assistant to speaker screens and more cars |
| HYUNDAI | Hyundai Nexo hikes range of next fuel cell more than 30% |
| HYUNDAI \|CISCO | Cisco And Hyundai Motor Company Announce Production Of Next-Generation Hyperconnected Car |
| HYUNDAIS MOBIS | Hyundai Mobis unveils 1/the e-Corner Module, a modular platform designed for electric vehicles, and its 2/its smart parking system |
| INTEL | Intel Partners with BMW, Nissan, SAIC Motor, Volkswagen, Paramount Pictures, Ferrari North America to Showcase Power of Data at CES |
| INTEL \|MOBILEYE | Intel says Mobileye's autonomous driving tech to be used in two million vehicles - Mobileye will collect for the first time road data which will be aggregated in the cloud |
| KIA MOTORS | Kia hints at electric Niro, readies autonomous push |
| KOOLICAR | Koolicar wants to make autosharing easier thanks to Augmented Reality |
| NAVYA | Navya unveils AUTONOM CAB, the first fully autonomous taxi |

Source: CES; Company data; Bryan, Garnier & Co

**FIG. 5: MAIN ANNOUNCEMENTS IN THE AUTOMOTIVE FIELD AT CES 2018 – PART 2**

| COMPANY NAME | NEWSFLOW |
|---|---|
| NVIDIA | Nvidia partners with Uber, VW in self-driving technology |
| OSRAM | Osram spotlights LED and Laser Solutions in latest concept vehicle |
| PANASONIC | Panasonic upgrades infotainment to enable voice commands without cloud & unveils its smart cockpit dedicated to self-driving cars from Level 2 to Level 5 |
| PANASONIC | Panasonic indicated it has developed a scalable "ePowertrain" platform to develop small electric vehicles |
| QUALCOMM | Qualcomm to power connectivity for range of new partners including Honda and BYD |
| RENAULT-NISSAN-MITSUBISHI | Renault-Nissan-Mitsubishi launch $1 bln venture capital fund |
| RENESAS | Renesas unveils the next generation of its ADAS, automated driving and connected cockpit demonstration vehicles |
| SAMSUNG | Samsung Electronics unveils driverless car parts, infotainment platform |
| SLD Laser | SLD Laser (previously Soraa Laser) introduces LaserLight sources for automotive applications |
| TOMTOM \|BAIDU | TomTom HD Map & TomTom AutoStream to Power Baidu's Open Autonomous Driving Platform, Apollo |
| TOMTOM \|ZENUITY | TomTom & Zenuity Join Forces on End-To-End Autonomous Driving System Software |
| TOTOYA | Toyota to introduce Amazon Alexa in its vehicles |
| TOYOTA | Toyota unveils self-driving concept vehicle for rides, deliveries |
| VALEO | Valeo unveils 48V EV concept |
| VISTEON | Visteon Introduces DriveCore™ Autonomous Driving Platform to Accelerate Adoption of Self-Driving Technology |
| ZF | ZF's mobility payment platform hits German market in Q3 // ZF readies next-gen car computer for high level autonomous driving |

Source: CES; Company data; Bryan, Garnier & Co

Out of the 36 announcements we identified, interestingly only 9 were made by automakers.

# Main automotive trends at CES

This year's CES was again an occasion to announce numerous partnerships between automotive players and tech companies including software houses and semiconductor makers. Unlike in 2017, this year's show brought automotive parts suppliers such as Valeo, Faurecia, Bosch, Continental, Aptiv and ZF into the spotlight with two main focuses: artificial intelligence applied to automotive and customization of the driver experience, particularly through shaping a new cockpit.

Vehicle interiors drew particular attention this year. As outlined by Patrick Koller, CEO of French supplier Faurecia "Tomorrow this will be the key element for differentiation". As the driving experience will no longer be the main focus, entertainment, and customization of the in-car experience are becoming prominent.

Transformation of the driving experience into a riding experience was highlighted by three trends:

1. **sophisticated touch screens** and user interfaces providing audio, images, information, video games and more

2. **voice assistance powered by AI**

3. **a new vision of comfort on-board.** What we retained is that the connected vehicle's interior – with digital clusters, head-up displays (HUD) and in-vehicle infotainment systems – has the potential to deliver an immersive digital experience.

In the cockpits unveiled at CES, customers will no longer feel that they are a traditional car, but will find the comfort they can enjoy at home as well as a digital experience similar to smartphones.

## COCKPIT OF THE FUTURE / PERSONALIZATION OF THE COCKPIT

The cockpit is set to become the center of a whole new driving experience, with a strong focus on digital tools as well as increased comfort. As proof that the automotive sector has widened beyond traditional players, **Panasonic, Samsung** and new Chinese automaker **Byton** all unveiled "digital cockpits", with striking user experiences. In our view, competition in this field is likely to be strong given the arrival of tech newcomers with display expertise from smartphone, TV and tablet development. These players will be able to challenge traditional automotive interior suppliers such as **Valeo, Faurecia** or **Continental.**

Byton presented a concept car featuring a panoramic screen that can be used either for navigation or passenger entertainment. No key is needed to unlock the vehicle or access its digital devices as it uses a facial recognition system. Both Bosch and Faurecia collaborated with Byton to develop this vehicle, which is due to be delivered to the first customers by the end of 2019. Faurecia designed the car's cockpit.

Present at CES for the first time, Faurecia demonstrated its work in developing the cockpit of the future. Smart life on-board appeared as a strategic priority, with Faurecia's CEO stating that "the future vehicle interior will become a living room where everyone will be able to carry out their activities". In the new cockpit imagined by the company, we can safely lie down, watch videos or answer e-mails. The French supplier unveiled new seats designed in collaboration with ZF, incorporating a seatbelt and airbags protecting the passenger in any position, even when they are relaxing. The traditional dashboard has been totally reshaped to include a large digital display as it appears in the Byton cockpit, conceived by Faurecia.

Each passenger can enjoy some privacy, particularly when it comes to sound. Anyone can listen to their favourite song or have a phone conversation without disturbing other occupants. Finally, the Faurecia cockpit also features facial recognition, allowing the vehicle to suggest music or specific routes depending on the time of the day.

**Panasonic:** The Japanese electronic device maker showcased a new SUV that incorporates its latest dual display system and HUD, and three next-generation cockpit/cabin system concepts - depending on the car's autonomy level - to meet vehicle advances. "Smart design cockpit" is the cockpit for ADAS (Advanced Driver Assistance Systems) Level 2 that offers four multi-displays and enables either the driver or the passenger to select the content to be displayed on each screen. This system also provides gesture recognition as well as smart material. "Smart vision cockpit" (ADAS Level 3) incorporates a 360° panoramic view projected on the display when autonomous mode is activated and a large-screen HUD that shows local sightseeing information depending on the direction of the driver's sight. "Living Space Autonomous Cabin" (ADAS level 5) is a cabin concept designed in four styles: living room, business, relax and entertainment. Depending on the style, this space features digital sunshades, seat air conditioners, different types of lighting, image projections, a videoconference system and a multichannel surround system.

**FIG. 6: BYTON REVEALS USD45K SMART INTUITIVE VEHICLE AT CES**


Source: Byton; Bryan, Garnier & Co

**FIG. 7: FAURECIA "COCKPIT OF THE FUTURE" UNVEILED AT 2018 CES**


Source: Faurecia; Bryan, Garnier & Co

**Samsung/Harman:** In collaboration with Harman, the South Korean giant presented prototypes of large screens incorporated in the dashboard. Through a multi-display layout, the in-car user experience can be personalized for the driver and passenger via services such as portable and cloud profiles, augmented reality and more. The customized occupant experience enables drivers and passengers to feel like the car is their own even if it is not using their phone.

In addition to the focus on "digital cockpits", other exhibitors provided insights into a brand new in-car comfort experience. Reshaped seats, individualized and auto-regulated temperatures, diffusion of fragrances, smart coatings… through their concept cars, these companies have brought major changes to the passenger compartment, which has seen little development in recent years.

**Valeo:** The French automotive supplier exhibited its "Smart Cocoon", a vehicle full of sensors analyzing outside conditions as well as the car occupant's mood and reactions. Using thermal imaging technology, the system controls interior climate and adjusts it to each passenger's physical condition and sensitivity to temperature. Through facial recognition, it can also detect the driver's mood and spray water drops if the driver falls asleep, or release soothing fragrances in the event of stress.

**Melexis:** Although Melexis did not have a booth at CES, this semiconductor vendor has one of the most comprehensive portfolios in lighting. For several years now, the group has showcased products enabling LED control to change light color and intensity in the cabin interior depending on user choice and external events.

Many automakers use light for comfort and design but Melexis also highlights safety features such as the visual alert system, which could be required for Level 4 and Level 5 autonomous driving systems. This is an efficient and elegant way for the autonomous driving system to interact with the driver and request that they regain control of the car. Melexis also supplies Time of Flight components so automakers can reduce the number of physical buttons with touch-free control of infotainment systems and passenger detection.

**FIG. 8: PANASONIC HUD SMART DESIGN COCKPIT**

Source: Panasonic; Bryan, Garnier & Co


## ARTIFICIAL INTELLIGENCE IN THE CAR

Artificial intelligence (AI) was one of the key trends during CES and its application in future cars offers a wide range of new possibilities. All the companies that presented their vision of the future cockpit featured voice assistance as a key tool. This technology ensures increased safety by avoiding driver distraction when operating the car's systems and it allows easier use of all on-board technology.

As AI is set to play a critical role in cockpits, automakers and suppliers have two options: to collaborate with a tech company – most likely Amazon or Google – or to build their own system. Nissan and BMW are already working with Amazon to integrate its Alexa solution.They have been joined by Faurecia and Toyota, which took advantage of CES to announce partnerships with Amazon to include its vocal assistant in their cockpit. Google, the other prominent actor in this field, said in Las Vegas that it will rapidly incorporate Google Assistant into Android Auto to operate Google's applications, music and mailbox. However, using Amazon or Google's knowledge leaves traditional auto players without precious driver data, which could imply potential value loss when future mobility solutions (no need to own the car, car sharing…) become a reality. For this reason, companies like Mercedes and Bosch have decided to develop their own voice assistants.

**Bosch:** in Las Vegas, the German group showcased a smart cockpit technology that allows drivers to keep their eyes focused on the road. Artificial intelligence helps transform the human-machine interface (HMI) into a system that thinks ahead. It can feed valuable information about the driver, the surroundings, and the vehicle to anticipate and adjust displays and controls to any given driving situation. Artificial intelligence is present in the form of Bosch's vocal assistant "Casey" the first time the driver gets in. Natural language understanding (NLU) enables drivers to talk to Casey as they would with a passenger. Another strength of Casey is "her" ability to think ahead - she can learn to predict likely destinations depending on the time of the day – or if she is asked to switch on the radio, she knows the driver's preferences, such as listening to news programmes in the mornings and music in the evenings.

**Faurecia:** Like Toyota, just before CES the French group announced an agreement with Amazon to feature its voice assistant Alexa in future cockpits. CEO Patrick Koller explained Faurecia will collaborate with software consulting company Accenture to integrate Alexa into the company's smart cockpit.

# Important takeaways for automotive and parts groups covered by Bryan, Garnier & Co

## BMW

Most of the announcements and innovations from German premium automakers focused on virtual reality, either to enhance the retail experience by allowing potential buyers to view and interact with virtual models while being able to customize key elements of a vehicles, or to promote the brand through video games (collaboration with PlayStation on Gran Turismo Sport).

Virtual reality technology enabled BMW to virtually show off its new X2 crossover SUV, expected to go on sale in the first half of this year.

Apart from autocross test drives including the BMW i, BMW M and BMW X models during show hours, nothing else was organized and no other announcements made by the group.

## DAIMLER

Like BMW, Daimler and Mercedes-Benz did not unveil many innovations at CES. The number one premium automaker was nevertheless quite active in infotainment, like other companies, and went on to introduce its new Mercedes Benz User Experience (MBUX) infotainment system, based on artificial intelligence and an intuitive operating system. This system includes the high-resolution Widescreen Cockpit with touchscreen operation, navigation display with augmented reality technology plus intelligent voice control with natural speech recognition.

MBUX is now used in the entire new compact car generation from Mercedes-Benz and will enter series production in spring 2018 in the new A-Class.

The automaker also displayed the Concept EQA, smart vision EG fortwo and the Mercedes-AMG Project One in Las Vegas this year.

## CONTINENTAL

As well as attending CES as an automotive tech supplier, Continental also presented its 2017 preliminary figures to the financial community while unveiling its latest technologies through an investor day that focused on three key areas: safety and security, comfort and convenience, as well as sustainability and maintenance.

More specifically, Continental presented:

- an automatic wireless charging system that transfers charging power inductively, which means that drivers no longer have to grapple with a cable. This system is accompanied by a new Continental micro-navigation solution that allows the vehicle to be positioned precisely over the ground-based charging pad. The group also developed a charging technology called “AllCharge” that allows the car to use any charging point, whatever the charging rate, type of current or voltage level
- an automated trailering solution that helps drivers handle trailers
- Continental’s award-winning 3D Surface Touch Display, which helps reduce driver distraction during control actions
- new sensor technology with notably the HFL 3D Flash LiDAR and 5th generation camera, which is set to improve the performance of an automated vehicle sensor set

## FAURECIA

This was Faurecia’s first year at CES, reflecting its ambition to clearly position itself as a tech group rather than a traditional automotive supplier. At a large and clearly visible booth close to other major car parts suppliers, the French group unveiled its latest innovations in seating, interiors and displays.

The group presented:

- its own vision of the “Cockpit of the future”, based on different modules that allow a personalized environment and experience while driving or resting. The cockpit included the group’s latest innovative seating and interior technologies
- an innovative seat frame that will allow both drivers and front passengers to speak to each other more easily when the car is driving itself. Both front seats can move toward the center of the vehicle without affecting safety. This prototype was jointly developed by Faurecia conjointly with ZF
- a smart trim cover, equipped with sensors that provide the driver with a clear view on their real-time state of health (heart rate, stress level, fatigue level…)
- a new cockpit display equipped with latest Parrot technologies (NIS 8300 automotive entertainment system) and with two Amazon Alexa agents to separately identify the vehicle’s driver and passenger and route voice commands to the appropriate Alexa service. This prototype was developed by Faurecia together with Parrot and Accenture
- a real-time application that allows emissions control for car fleets in a bid to reduce air pollution in big cities

## VALEO

French automotive supplier Valeo took the wraps off a new 48V, all-battery electric vehicle prototype for the Chinese auto market, more specifically the entry-level electric vehicle segment. The low-voltage two-seater has a range of 100km and a top speed of 100 km/h, suited to urban usage. The group indicated this new model is 20% more economical than existing high-voltage solutions.

Through Navya (in which the group has a strategic stake), the car parts supplier also unveiled the Autonom Cab, a self-driving robo-taxi. The all-electric, driverless vehicle is fitted with seven Valeo SCALA laser scanners, the first and only mass-produced Lidar scanner on the market designed specifically for cars.

Valeo also showed a new system that allows the interior climate of a vehicle to be adjusted to each passenger’s physical condition and sensitivity to temperature, when and where they need it. The system can also detect the driver’s mood and release stimulating or soothing fragrances and ions in the event of tiredness or stress.

# Automotive innovations in the hands of start-ups?

## FRANCE WAS WELL REPRESENTED, AS ALWAYS

Unlike 2017 when there was no Business France/La French Tech booth dedicated to the automotive sector, this year's CES saw a "Vehicle Technology" booth with seven French auto tech start-ups near to French groups Valeo, Faurecia and Navya. We had an opportunity to speak directly to some of the personnel to get a better idea of the products and solutions on display. Most of the solutions were linked to connected and self-driving vehicle themes.

We were amazed by the number of French start-ups presenting at CES, putting France in the number two spot, just behind the US, with 275 entities attending the 2018 fair vs. 289 for the US, 60 for the Netherlands and 47 for China and for Italy.

However, we were negatively surprised by the limited number of theme booths uniting French start-ups by industry and/or potential market such as Smart Home, Automotive and TMT. As indicated in Fig. 9, the dedicated French "Vehicle Technology" booth was a first successful test from Business France/La French Tech, confirming that the automotive sector is a dominant market.

**FIG. 9: FRENCH AUTO TECH START-UPS EXHIBITING AT THE CES WITH BUSINESS FRANCE**

| COMPANY NAME | DESCRIPTION |
|---|---|
| DIBOTICS | Using the raw data of any LiDAR, Dibotics, through its real-time embedded software solves some of the key perception challenges facing any mobile robot, including Self-Driving cars: Ego-Motion/Localisation,3D Mapping, Point wise Classification, Object Detection, Tracking and Classification. |
| PROVE & RUN | Prove & Run's mission is to help companies resolve the security challenges linked to the deployment of connected devices and of the Internet of Things. Prove & Run has developed a patented tool chain forged to formally prove the correctness of complex software components and to help certify them at the highest security level, for a reasonable cost. |
| Xee | Xee develops and commercializes XeeConnect that once connected to the car's diagnostic port, gives access to data and allows car's user to remotely track or geolocate its vehicle and receive alerts. |
| TRUST IN SOFT | TrustInSoft is an international software publisher, that provides an advanced static source code analyzer tool founded on formal methods, to verify software. TrustInSoft provides mathematical guarantees on software. The company operates on different markets, both in terms of safety and cybersecurity. |
| ART-Fi | ART-Fi provides solutions to accelerate wireless regulatory compliance across development, pre-compliance testing, and certification using innovative electromagnetic field measurement technologies. |
| ISFM | Intelligent System For Mobility provides a complete mobility system, including manufacture of urban PODs and autonomous shuttles. |
| YoGoKo "You Go, We Konnect" | YoGoKo, through its technology, enables V2X communication between all actors in the ITS domain, including vehicles, roadside stations, central stations. |

Source: CES; Bryan, Garnier & Co

## INTERESTING AUTO TECH NUGGETS

The top 10 countries with the largest number of start-ups had over 800 start-ups at CES 2018, with the US and France leading the pack. It was clear to us that some of these businesses could potentially attract large corporates willing to obtain access to a new technology or gain a dominant position in an early-stage market.

In the automotive sector – a mature industry facing major transformation – most recent investment moves by large automakers or suppliers through their new dedicated VC funds have focused on four areas:

1. **New mobility solutions** (ride-sharing, ride-hailing, P2P parking rental solutions)
2. **Skills in ADAS software** (algorithms, IT solutions to better analyze data, AI)
3. **ADAS hardware** (innovative radar or Lidar technologies, telematics solutions for V2V or V2X…)
4. **Infotainment.**

## BELOW IS A SHORT LIST OF INTERESTING EARLY-STAGE START-UPS WE MET AT CES THIS YEAR (INCLUDING FRENCH START-UPS ATTENDING THE FRENCH TECH BOOTH)

**Almotive – uses AI to power self-driving technology.** Founded in 2015, Almotive is a young start-up that already has more than 150 employees around the world. Its AI-powered self-driving technology uses cameras as primary sensors to mimic the visual capabilities of human drivers.

Almotive has designed aiDrive, autonomous driving software suite to improve data analysis of different driving cultures and climates. Its aiSim, photorealistic simulator recreates real-life scenarios to develop better systems, and aiWare, a neural network accelerator for computer vision, handles the process behind self-driving technology. The group is already supplying automakers and Tier 1 suppliers, albeit mainly for testing purposes at the moment. The main difference with other competitors is that Almotive is developing camera-based autonomous driving systems, and not Lidar-based systems.

Many tech experts believe self-driving development requires a combination of different sensors, especially Lidar notably. Almotive's CEO believes the development of algorithms using AI on cameras to better assess self-driving environments will be enough to develop efficient, secure and cheap self-driving cars. We understand Nvidia was a financial partner for the group (AiDrive currently runs on Nvidia chips) as was Bosch (Robert Bosch Venture Capital).

The recent operation to raise USD38m in funds (January 2018), was backed by Samsung and B Capital Group. We believe Almotive could at some point be purchased by an automaker that does not intend to develop its own self-driving technology.

**Voyomotive – connects the car to a smartphone to collect and analyze data.** This US group has developed a plug-and- play system that connects smartphones to the car, and the car to the Voyomotive Cloud.

The VOYO app allows a user to lock/unlock car doors, detect malfunctions, send alerts to other drivers, while increasing the car's security and fuel efficiency. VOYO connects to the OBD-II port of any car sold in the US since 1996. The Voyomotive platform provides the capability to acquire telematics data but is highly adaptable and can be programmed to any potential partner's unique requirements.

The starting price of the consumer product is around USD100 for the Voyo controller. The group is headquartered in San Francisco with a R&D facility in Michigan. Voyomotive was founded in 2011 and the team comprises 15-20 people. We did not identify any large corporate or non-corporate VC funds in the group's capital.

We assume Voyomotive could interest companies exposed to the aftermarket such as Valeo, Hella or Bosch, or insurance companies wanting exposure to telematics solutions for driving behavior analysis.

**Xee – connects the car to a smartphone to collect and analyze data.** Like Voyomotive, French start-up Xee is positioned as an auto tech entity focused on telematics solutions that provide car users with access to data while remotely tracking or geolocating their vehicles. Once XeeConnect's control box is connected to the car's diagnostic port, the user can access the accelerometer, GPS chip and other technical information.

The box does not, however, access the car's electronic systems. Xee says its solution is compatible with cars manufactured after 2002. This product is currently being sold in consumer aftermarket dealerships in France as Norauto or Midas for an entry price of EUR140. Created in 2011 in Norauto's start-up lab, Xee is now partially owned by Japanese tiremaker Bridgestone and by French group Total following a >EUR12m capital increase in April 2017.

It is still majority owned by Mobivia (a holding structure of Norauto) through Via ID. Back in 2016, Xee posted EUR1.5m in sales with 35 employees.

We assume more cash will be needed at some point to further finance international growth and to develop new products to compete with newcomers such as Drust, Mojo and Automatic. As for Voyomotive, we assume insurance companies such as Axa and Allianz could be interested in investing in this technology, as could automotive suppliers like Valeo, Hella or Bosch, or automakers.

Axa is already a business partner of Xee.

**Tetravue – develops 4D solid-state HD lidar technology.** The US start-up was founded in 2008 and is today a leader in high definition 4D lidar technology.

Its technology differs from current lidar offerings by merging the resolution of HD video with range data to enable long-range 4D motion capture. Tetravue is using its technology to transform different industries such as cinematography, animation, AV reality and the automotive sector.

In November 2017, the group announced new funding (of an undisclosed amount) that adds to its USD10m Series A funding from February 2017 provided by Robert Bosch Venture Capital, Foxconn, Nautilus and Samsung. Given the high level of competition in the lidar market, we assume Tetravue will need further cash to finance new developments at some point, especially for the automotive market.

Both Valeo and Continental are currently developing advanced lidar technologies (HFL 3D Flash lidar for Continental and lidar Scala new generation for Valeo). Expertise in 4D solid state HD lidar could be welcome to both Valeo and Continental.

## A SECTOR WITH A GIANT'S APPETITE

All these start-ups need cash. At the same time, many auto and parts companies need new skills to adapt to the transformations affecting the industry: changes in mobility, the end of internal combustion engine (ICE) vehicles and development of self-driving vehicles. As its technology has mostly been developed in-house or by suppliers' engineers, the automotive sector is not specialized in the venture capital funding environment.

However, automakers are now gradually entering this new world, to the benefit of the entire auto tech start-up ecosystem. To illustrate this point, we decided to identify the most recent large investments made by global automakers through their VC funds (where they exist).

BMW and Daimler are the top investors among automakers.

**FIG. 10: RECENT LARGE INVESTMENTS MADE BY PREMIUM AUTOMAKERS' VC FUNDS**

| COMPANY NAME | | OPERATION | DATE | ABOUT THE COMPANY | FIGURES |
|---|---|---|---|---|---|
| BMW | SHIFT | The virtual used car dealership Shift raises $38 million from investors led by BMW i Ventures | Jul-17 | Online used car reseller | $38m in its ltest fundraisng round ($110 million since the first round) |
| | Xometry | XOMETRY raises $15 million in a funding round led by BMW Group's i Ventures | Jun-17 | Online marketplace for custom-manufactured parts based on machien learning and algorithm predictions technology | "$15m in its latest fundraisng round ($38 million since its founding in late 2013) Anual revenue: $20m" |
| | bus.com | Bus.com, the event shuttle manamgemen,t startup raises $5M Series A round from BMW's i Ventures and Jackson Square Ventures | Apr-17 | The Bus.com model includes online rental, GPS tracking of buses so passengers know exactly when they're arriving, and online ticketing. | $5m in series A fundraisong |
| | Desktop Metal | BMW among investors pouring $45 million into Desktop Metal | Feb-17 | Desktop Metal develops desktop 3D printers that make metal objects | $45m in Series C round ($97 million since the first round)" |
| | BMW i. | BMW strongly increases venture capital fund volume | Nov-16 | BMW is increasing the size of its venture capital fund, BMW i Ventures, to €500m from €100m. So far the fund's focus has been on themes including electric mobility and mobility services, but the focus would be expanded to include autonomous driving, digitalisation, cloud services and artificial intelligence | $500m venture capital fund |
| DAIMLER | WHAT3WORDS | Daimler invests in new infotainement system with innovative adress through mapping startup what3words | Jan-18 | What3words is a geocoding system for the communication of locations with a resolution of three metres. What3words encodes geographic coordinates into three dictionary words | Acquisition of a 10% stake Undisclosed amount" |
| | chauffeur privé | Daimler acquires a majority stake in Chauffeur Privé, one of the leading private hire vehicle services in France | Dec-17 | With more than 1.5 million customers and 18,000 drivers, Chauffeur Privé is a leading provider of private hire vehicle services in France, with presence in Paris, Lyon and Côte d'Azur | Undisclosed financial details 50% stake + 1 share Intention to fully acquire Chauffeur Privé by 2019 €60m in revenue for Chauffeur Privé in 2016" |
| | StoreDot | Daimler Trucks teams up with innovation leader for electric charging StoreDot Ltd, along with Israeli and Chinese banks and existing investor Samsung Ventures | Sep-17 | An Israeli battery-technology startup, StoreDot Ltd. seeks to enable electric vehicles to recharge as quickly as combustion-powered models can refuel. Full charge can be reached in five minutes for a vehicle driving distance of at least 300 miles (480 kilometers) | $60m funding round |
| | via | Via raises $250m led by Daimler to bring its carpooling technology to Europe | Sep-17 | Via developed a shuttle-based carpooling service that it offers directly in the U.S. for a flat-rate starting at $5, as well as through platform partnerships with other transportation providers | $450m to $500m pre-money valuation $250m fundraising (Via's 5th investment round) |

Source: Company Data; Bryan, Garnier & Co

**FIG. 11: RECENT LARGE INVESTMENTS MADE BY MASS AUTOMAKERS' VC FUNDS**

| COMPANY NAME | | OPERATION | DATE | ABOUT THE COMPANY | FIGURES |
|---|---|---|---|---|---|
| Volkswagen | Mobvoi | Volkswagen Invests $180m in a Chinese AI Startup | Apr-17 | Founded in 2012 by a group of former Googlers, the startup develops products based on its voice-recognition and natural language processing technology | $180m investment Google led last round of financing in 2015, valuing the company at $300m |
| | Gett | VW invests $300m in Uber rival Gett in new ride-sharing partnership | May-16 | Gett is an on-demand ride service startup with presence in US, UK, Russia and Israel | $300m investment |
| RENAULT NISSAN MITSUBISHI | ionic MATERIALS | Nissan-Renault Plans $1 Billion Fund for Auto Tech Startups and lead first strategic investment | Jan-18 | The company develops cobalt-free solid-state battery materials that can be used in electric vehicles. | Undisclosed amount |
| | RENAULT NISSAN MITSUBISHI | Nissan-Renault Plans $1bn fund for Auto Tech Startups | Jan-18 | The world's largest automotive alliance will invest as much as $1 billion to fund mobility startups over the next five years. The fund, called Alliance Ventures, will finance new developments in electrification, autonomy, connectivity and artificial intelligence. | $1bn fund |
| | JEDLIX | Groupe Renault invests in the share capital of Jedlix, a start-up specialized in smart charging | Oct-17 | Jedlix is a Dutch startup launched by Eneco Group and specialized in the smart and sustainable charging of electric vehicles | Acquisition of a 25% stake |
| | marcel | Renault invests in mobility service startup Marcel | Sep-17 | Marcel is a car-sharing platform | Enterprise Value > €10m Acquisition of 100% of existing shares |
| PSA GROUPE | KARHOO | Renault wins takeover bid for the start-up Karhoo | Jan-17 | Karhoo is a deal-comparison platform for taxi companies. Its on-demand offering aggregates drivers and ride options from hundreds of existing fleets of car services in an Uber-like app | $1m investement as the company was about to bankrupt ($500,000 for Karhoo, $500,000 towards paying creditors), plus a commitment of $15 million in further investment |
| | CARVENTURA | Groupe PSA expands its used-car offering with Carventura.com | Oct-17 | Carventura.com has taken up the challenge of peer-to-peer used-car sales, offering services and security to buyers and sellers alike, from online ad placement to payment | Undisclosed amount |
| | TRAVELCAR | PSA Group Acquires an Interest in TravelerCar | Jun-16 | TravelCar offers new parking and car rental solutions designed to optimise cars as a resource and ensure they rarely go unused | Undisclosed amount, but PSA notified that this acquisition was part of its "Push to Pass" plan including €100m aimed at venture capital funding |
| | koolicar moteur de libertés | Koolicar Moves up a Gear With PSA Peugeot Citroën and MAIF €18 million to Support the Growth of Peer-to-Peer Carsharing Leader | Apr-16 | Based on a connected box that can be fitted on any type of vehicle – enabling keyless transactions, calculation of mileage and lease duration, and geolocation – Koolicar makes carsharing easy | €18m investement from PSA and MAIF |
| | PSA GROUPE | PSA Group announced that it would be committing €100m in venture capital to investment in the field of mobility. | Apr-16 | | €100m venture capital to invest in mobility services |

Source: Company Data; Bryan, Garnier & Co

# What to expect from these trends in the auto and parts industry?

Investments from automakers and automotive suppliers through their VC funds will further expand in 2018-20. Automakers' need to get access to innovative technologies to adapt to sector megatrends (self-driving cars, new mobility solutions and EVs) is accelerating, obliging them to get closer to auto tech start-up ecosystem.

CES 2018 brought automotive parts suppliers into the spotlight with artificial intelligence applied to automotive and customization of driver experience, particularly through the new shaping of the cockpit. Given AI is a not a competency of OEMs and suppliers, we assume traditional automotive industrials will continue to acquire expertise by getting closer to tech start-ups exposed to this field.

As for "the cockpit of the future" and the "customization of driver experience" trends, lower barriers to entry in terms of tech competencies could alter the dominant market share of traditional suppliers. Despite their lack of exposure to the auto and parts sector, new tech entrants will be able to disrupt current suppliers exposed to auto interiors, such as Faurecia, Continental, Yengfeng JCI and Valeo. In interiors, human-machine interface (HMI) and AI will become a growth priority for the industry.

In the short term however, this will not change the growth potential of traditional auto and parts players.

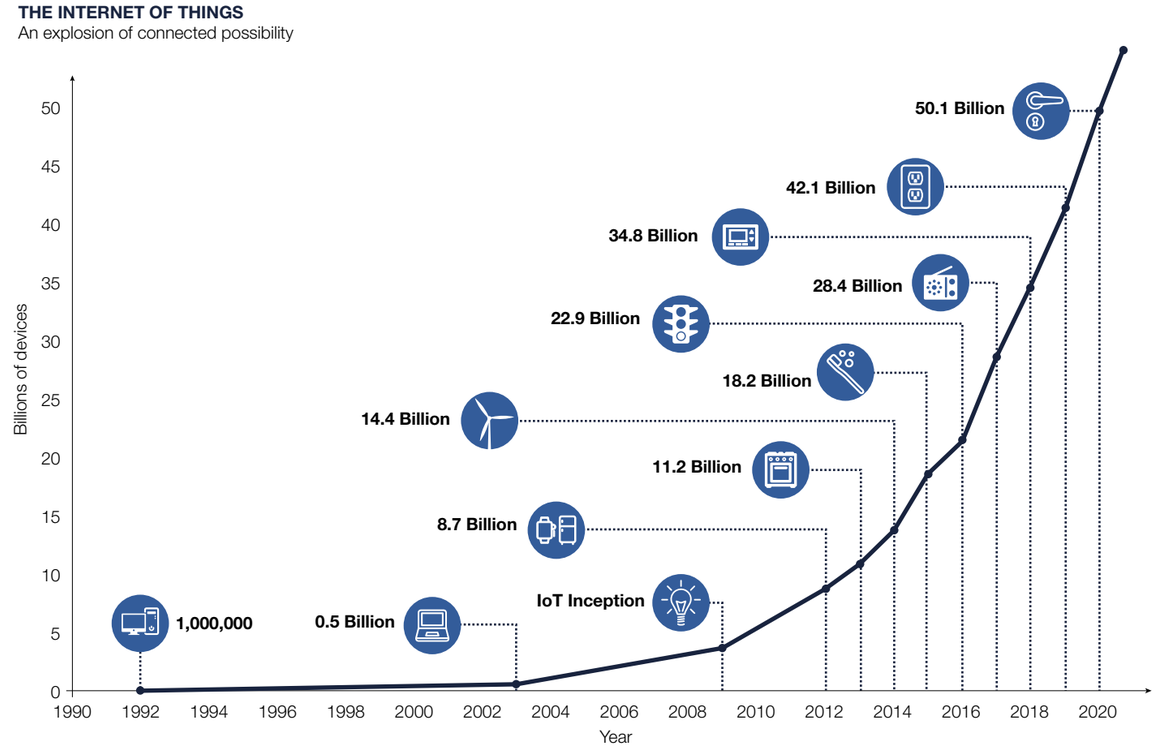

# Part 2.Semiconductors: AI on everyone's lips

## HOPEFULLY NOT AS ELUSIVE AS THE INTERNET OF THINGS

Artificial intelligence was probably the main new topic at CES 2018. AI has a broad meaning so we saw many announcements relating to the topic from start-ups and the largest companies. We hope that AI is more precisely defined than the Internet of Things, which we continue to believe represents a real trend, but one that is hard to measure and pin down because of the ubiquity of the term.

AI is nonetheless widely spread across industries, from autonomous driving systems to robots feeding pets – and it impacts many players in multiple industries, from SAP to Nvidia. While we have never been strongly supportive of IoT as a catalyst for semiconductor players, AI makes much more sense to us as a long-term catalyst. To us, IoT is almost a prerequisite for AI, as it often involves sensors and therefore data creation. For the semiconductor industry, we see AI as the future of high-performance computing. Note however that running an algorithm on a device does not mean it is "intelligent". AI involves learning and

**FIG. 12: SENSOR MULTIPLICATION GENERATES A HIGH LEVEL OF DATA, DRIVING AI**




Source: STMicroelectronics

# Semiconductor makers show muscle as AI demands specific hardware

in computer science, learning means being programmed to recognize patterns to categorize data. This is not just about replacing high-end processors – traditional processors and AI chips have different workloads – but making them complementary. While leading-edge production was gradually filled by smartphone processors that are now almost as powerful as CPUs, the future of high-end production is blurred by rising production costs and stagnating demand for PCs and smartphones. With potentially strong production volumes, we believe AI chips might be growth drivers for leading-edge production.

AI is trending now like IoT was in 2016. However unlike IoT, which looked more like an electronic engineer's dream, we see real valuable applications for AI, right now. The best examples are big data analytics (to finally make sense of the massive volumes of data being collected), speech recognition, learning and decision-making products, and predictive technology. At CES this year, Natural Language Processing (the most dominant form of AI so far) made its mark with smart home assistants and voice-activated products. It is now even possible to flush a toilet using your voice…

AI creates a heavy workload as it requires learning, which depends on running millions of operations per second. In contrast to CPUs used in computers and servers that are designed to accept many instructions and process them as fast as possible, AI chips are designed to accept fewer instructions but do to carry them out more quickly and with less power. The required energy efficiency can only be achieved with hardware design.

## FROM BLUE CHIPS…

**Intel – sees AI in drones and servers.** At CES 2018, Intel CEO Brian Krzanich announced a partnership with Ferrari North America aimed at embedding Intel's AI technology (based on its Xeon and Neon Frameworks) in drones to create and distribute personalized sports broadcast content.

Drones will be able to detect interest in a specific theme – for example a driver – and focus on this point of interest. Other Intel initiatives focus on data processing: the group pointed out that by 2020, every person will generate about 1.5GB of data per day (i.e. 2x today); an autonomous car will generate about 4TB of data; and a smart factory 1000TB per day.

All this data will be processed to extract information and current hardware is not equipped for this type of workload. According to Intel, AI and data will be the key to everyone's future.

**Huawei/Hi-Silicon – puts AI in our hands.** While this is not the first Huawei smartphone to embed this type of processor (Huawei launched the Mate 10 – non Pro – version back in October), the Pro version released at CES has been in the spotlight after winning several awards, including "smartphone of the year".

**AI features enable the smartphone to:** recognise text in camera view and automatically translate into another language, select camera mode automatically by recognising subjects (flower, meal, person, panorama…), or categorize notifications automatically according to different parameters (hours, subjects, triggers, battery state…) and push some while keeping others quiet for later.

The Apple A11 Bionic processor (iPhone X/8) released by the end of 2017 also has a neural engine used for different tasks, namely fast face recognition in photos.

**MediaTek – pushes AI to the edge.** This Taiwan-based leading smartphone processor vendor has demonstrated its readiness for the post-smartphone era by introducing AI chips. MediaTek's strategy is to bring limited AI functions that require only small computational power to a large volume of devices (the edge). The group already sees strong traction from customers for several applications, such as voice-controlled light bulbs.

**STMicroelectronics – has surprisingly joined the game.** The group gave many demos but among these it was new neural networks demo that surprised us. STMicroelectronics is the only group in our coverage that demoed an AI initiative.

Also, unlike most semi makers, who are focusing on voice assistants and data processing, STMicroelectronics focused on computer-vision tasks. The group has developed an ultra-low-power artificial neural network System on Chip (SoC) in 28nm FD-SOI (which is positive for Soitec too, as the French group is currently the only manufacturer of FD-SOI wafers).

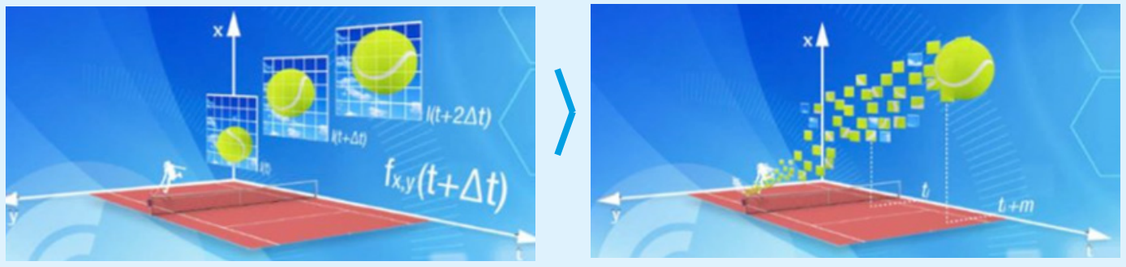
The group is focusing on Deep Convolutional Neural Network (DCNN) architecture as it has been proven to be the most effective for many computer vision applications. According to ST, a deep-learning SoC for embedded applications would be very helpful as IoT devices can greatly benefit from Artificial Neural Networks – a statement we fully agree with. As a result, ST has developed an ASIC that can accelerate object recognition and emotion detection in live video streams with an average peak efficiency of 2.9 TOPS/W.

## ...TO START-UPS

Chronocam – uses AI to improve computer vision. A developer of machine vision sensors and systems, Chronocam has internal resources to design the sensors and the embedded algorithms. The group has been able to develop an image acquisition system working in a high-speed acquisition environment (real-time camera stream), with low bandwidth and low power consumption. As such, Chronocam sensors are perfectly suited to multiple high-value applications such as robotics, automotive, healthcare, aerospace and defence. Chronocam's sensors do not work frame-by-frame like traditional image sensors, but with all pixels being independent. Each pixel is then able to independently collect information if movement occurs in the image. While this innovation mainly refers to the image sensors and the embedded algorithms, it enables AI capabilities – and the group gave an object recognition demo at CES. In our view, this type of sensor technology could drive interest from leading players in the image sensor market. We believe ams could make the most of Chronocam's expertise to broaden its specialty image sensor portfolio.

**FIG. 13: CHRONOCAM HAS DEVELOPED UNIQUE COMPUTER VISION SENSORS**

**WE TACKLE THE MAJOR LIMITATIONS OF CONVENTIONAL COMPUTER VISION AND SET A NEW TECHNOLOGY PARADIGM IN VISION SENSING AND PROCESSING**




**State-of-the-art image sensors** are useful and efficient for ONE thing: **Photography**

In **Computer Vision** changes and motion of objects carry the relevant information

The current solution is to acquire a **series of photographs** and look at them one after the other

This approach leads to:

- TOO MANY DATA (need power/resource-hungry process)
- INFORMATION LOSS (limited speed)
- DEPENDENCY ON LIGHTING CONDITIONS




**Each pixel of CCAM** sensor array **individually controls its own sampling based** on the scene ,content is looking at

**Fast sampling** when the signal changes fast

**No sampling** when the signal does not change

This approach leads to:

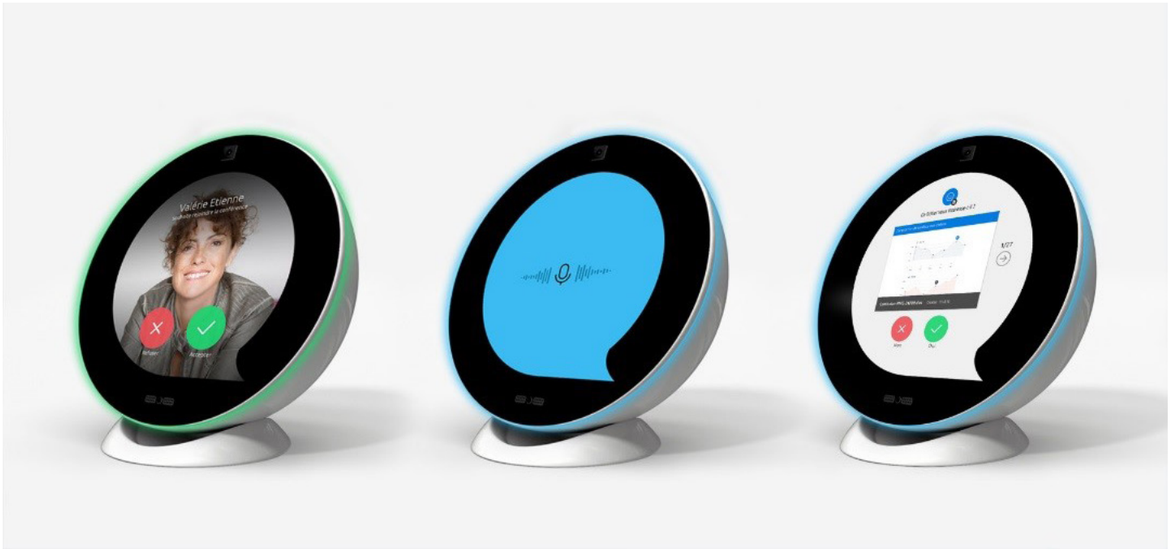
- REDUNDANCY SUPPRESSION
- HIGH SPEED
- WIDE DYNAMIC RANGE

Source: Chronocam

Snips – makes voice capabilities available to all device makers. The French start-up has developed a voice interface using light-weighted AI. Snips' platform is only six months old (commercially) but we believe has a great future. While everyone at CES was looking to include AI-empowered voice assistant services to devices, Snips proposes a ready-to-go solution to hardware companies. The main advantage of the Snips solution is that it is not tied to any major voice assistant systems, namely Alexa, Google, Cortana, and Siri. Additionally, the Snips solution does not need any connectivity, nor massive computing power to work. Unlike major voice assistants it does not rely on massive data collection to work and, as such, is compliant with EU regulations on privacy (applicable by May 2018). We believe the technology would fit perfectly into STMicroelectronics' comprehensive offering: ST maintains a one-stop-shop strategy, which requires offering more and more turnkey solutions. As such, from time to time, ST buys small companies that can strengthen its portfolio and help its technology to proliferate among new IoT players, which are often small companies or start-ups. A recent example is the acquisition of Atollic (December 2017), which eases embedded OS development).

LinTO – makes smart assistants open-source. While Snips focuses on light embedded voice assistant services, LinTO pushes further to becoming a full smart assistant, but open-source. As such, the LinTO system compares directly with Amazon Echo, Google Home and the future Apple HomePod. Like others, LinTO can read and answer emails or consult personal schedules. However, with an open-source architecture the system could be personalized and rebranded so device makers could develop their own features such as videoconference services or interacting with lightbulbs. The start-up's business model aims to encourage widespread adoption of its system and charge OEMs for assistance and maintenance. As it is a voice assistant, it relies on artificial intelligence to enable Natural Language Processing. The rationale behind a potential acquisition of LinTO would be similar to that for Snips, although we believe LinTO systems go a step too far for semiconductor manufacturers.

**FIG. 14: LINTO OPEN SOURCE SMART ASSISTANT**

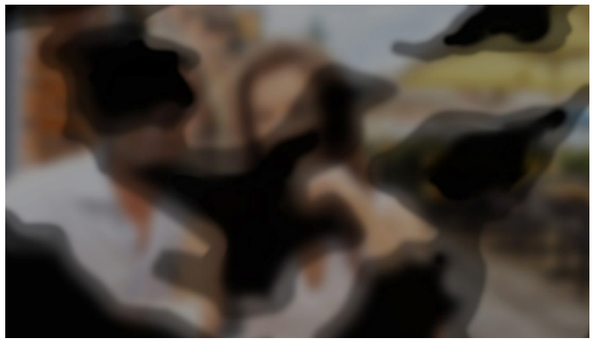



Source: LinTO

ICI Vision – pushes AI to healthcare. The start-up focuses on next- generation sight enhancement digital eyewear. In other words, ICI Vision develops glasses, called Enhanced Vision Engine, which restore sight for the visually impaired. The algorithm developed by ICI Vision makes extensive use of artificial intelligence techniques to make the most of an image feed provided by embedded cameras. The system can analyze and highlight focus points in real-time and helps users in daily activities, mostly visually impaired people. More importantly, the device can map patients' unique retinal damage and project enhanced images directly onto the healthier parts of the retina. ICI Vision's EVE is a consumer product. Although it is a perfect example of the advantages of AI, there is no sense in the start-up being a target for any semiconductor company. However, we have seen closer M&A initiatives in optics with Essilor taking a stake in DeepOptics (also an Israeli start up) in 2016, and acquiring Humanware in October 2013.

**FIG. 15: ICI VISION USES AI AND SENSORS TO HELP VISUALLY IMPAIRED PEOPLE**

**WITHOUT EVE**



**WITH EVE**

Source: ICI Vision

Horizon Robotics

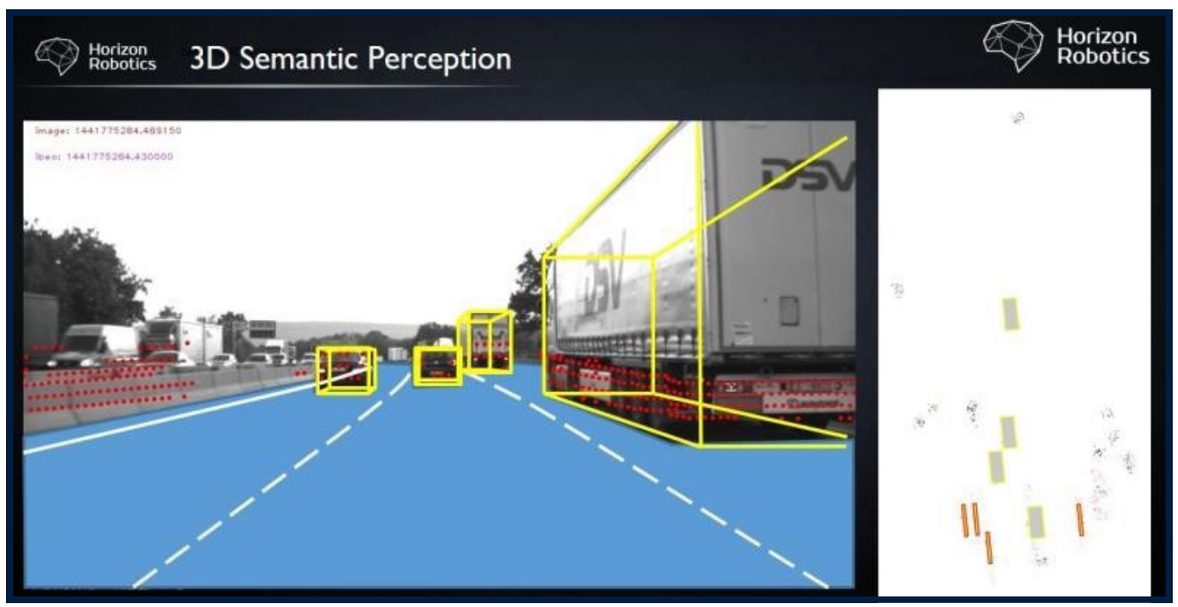
Horizon Robotics –the start-up that scares semiconductor giants. The not-so-very start-up calls its chip a BPU: Brain Processing Unit, a chip said to be capable of object detection, tracking and recognition of 200 objects per frame, with a 1080p@30fps video feed. But more surprisingly, the company says the chip only consumes 1.5W, which compares with 8.5W for low-power Intel CPUs. The group has developed two flavours for its chips:

1. Sunrise: targeting smart camera for face recognition and intelligent high-performance video analytics solution

2. Journey: targeting automotive applications, especially detection (pedestrians, vehicles, lane lines, traffic lights, etc.) and recognition processing capacity for Level 2 ADAS.

This start-up's expertise in AI and deep-learning scares semiconductor giants and is pushing these players to react. In October 2017, Horizon Robotics raised USD100m through Intel Capital. Additionally, the group boasts an impressive list of partners such as Audi, arm, Bosch, SIM Technology, TSMC, Synopsys, Changan, SIM Technology, and multiple other Chinese Tier 1 players.

**FIG. 16: HORIZON ROBOTICS USES AI FOR 3D SEMANTIC PERCEPTION**




Source: : Horizon Robotics

## SMARTMEUP

Smartmeup – enables object recognition on low-power devices. This French start-up has developed a deep-learning technology that requires low training and low power to run. Using a precisely tailored deep-learning algorithm, Smartmeup makes computer vision possible on traditional microcontrollers such as the one-dollar version from STMicroelectronics. This makes computer vision possible on battery powered devices such as drones, small portable cameras or security cameras for specific tasks such as people or vehicle counting, or animal classification, counting or tracking. Such technology might drive interest from some semiconductor players specialised in computer vision such as Ceva, ams, Lattice or Ambarella to further develop their expertise in deep-learning.

# Potential impacts of artificial intelligence in the semiconductor industry

Currently, only a few players in the semiconductor industry have convincing AI initiatives. CES 2018 was a great occasion for many of them to showcase new solutions but few of these are mature. In our view, Nvidia and Ceva are the ones that had the most convincing AI products. These two players started to invest in AI a few years ago and are now able to propose solutions that stand out from the crowd.

Given this unique situation – AI is a new focus for semiconductor makers while traction is building up – we believe AI could be the next focus for M&A. AI start-ups have already been able to raise a significant amount of fresh cash. We have already listed Horizon Robotics here but Graphcore, Cerebras, Wave Computing, Mythic and the two Chinese companies Deephi and Cambricon have similar initiatives in AI and have been able to raise between USD10m and USD110m recently.

Beyond pushing further M&A activity, we also see another positive impact of the rapid development of AI in semiconductors: advanced manufacturing. A large part of the industry (foundries and equipment makers) is closely linked to the health of advanced computing and memory sales. While we see growth in smartphones coming to an end, we believe AI has the potential to be the next big thing. Nevertheless, while it remains a strategic development for most semiconductor makers, it should not have impact on semiconductor stocks.

Leading-edge foundries such as TSMC and Samsung are continuing to install additional capacity for leading-edge nodes, however potential customers for the trailing edge between 28nm and 10nm tend to be limited by higher production and design costs. Production at 10nm is about 30% more expensive than it is at 28nm. Additionally, the design cost for a chip produced at 28nm was USD30m on average and has jumped to USD271m for a 10nm chip. This mechanically limits demand for new nodes to players who really need high computing performance. So AI could be the next big thing driving growth in leading-edge production.

**FIG. 17: STRONG SUCCESS IN FUND-RAISING AMONG AI START-UPS**

| Company | Found raised (in USDm) | Known investors |
|---|---|---|
| Wave Computing | 115 | Samsung / Southern Cross Venture / Tallwood |
| Graphcore | 110 | Sequoia Capital (USD50m) / Atomico (USD30m) |
| Horizon Robotics | 100 | Intel Capital |
| Cambricon | 100 | Alibaba |
| Cerebras Systems | 100 | Benchmark |
| ThinkForce | 68 | Sequoia / Yitu Technology / YF Capital |
| Deephi | 40 | China's Ministry Of Science & Technology |
| Mythic | 15 | Lux Capital / AME Cloud Ventures / Draper Fisher |
| Grog | 10 | Social+Capital |
| SmartMeUp | <10 | Private investors (o/w Xavier Niel, Antoine Granjon and Jean-David Blanc) |

Source: Company Data; Bryan, Garnier & Co

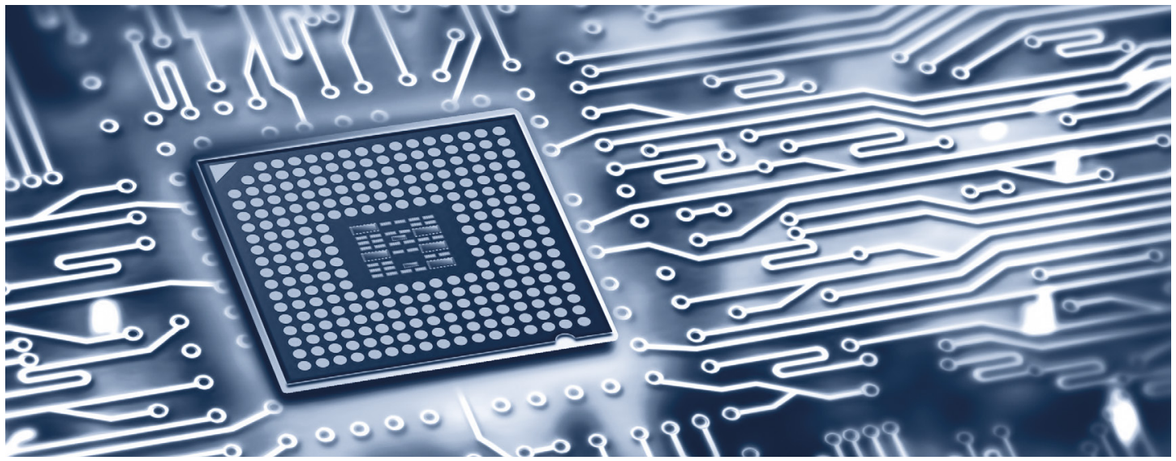
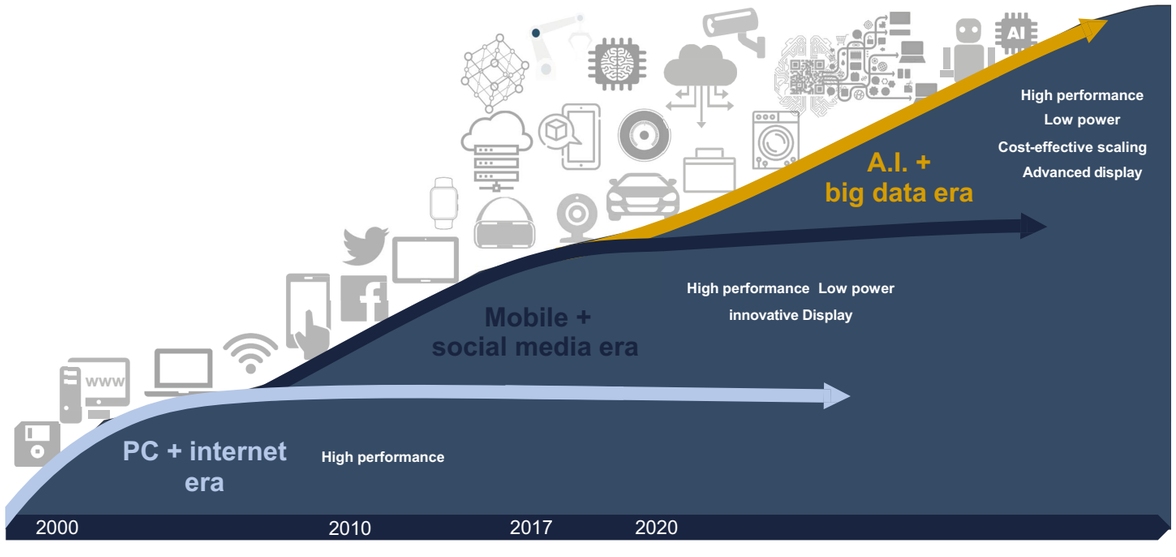


**FIG. 18: AI – A NEW WAVE OF OPPORTUNITIES FOR SEMICONDUCTORS**




Source: : Bryan, Garnier & Co; Applied Materials

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| | | | | |
|---|---|---|---|---|
| xerox RESEARCH CENTER EUROPE<br>Acquired by<br>NAVER<br>**Undisclosed**<br>*Sole Advisor to the Seller* | REstore<br>Acquired by<br>centrica<br>**€70 000 000**<br>*Advisor to the Sellers* | CANATU<br>Private Placement<br>Series C & D<br>faurecia<br>European Investment Bank<br>**€34 000 000**<br>*Sole Financial Advisor* | DEVIALET<br>Private Placement<br>Investors including<br>FOXCONN NAVER<br>RENAULT playground...<br>**€120 000 000**<br>*Sole Placement Manager* | tado°<br>Private Placement<br>INVIEN CAPITAL CEZ GROUP<br>SIEMENS<br>**€45 000 000**<br>*Sole Manager* |

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The firm provides equity research, sales and trading, private and public capital raising as well as M&A services to growth companies and their investors. It focuses on key growth sectors of the economy including Technology, Media & Telecoms, Healthcare, Smart Industries & Energy, Consumer, Brands & Retail and Business Services. Bryan, Garnier & Co is a fully registered broker dealer authorized and regulated by the FCA in Europe and the FINRA in the U.S. Bryan, Garnier & Co is headquartered in London, with additional offices in Paris, Munich, Zurich and New York. The firm is a member of the London Stock Exchange and Euronext.

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