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(World Wide Web Consortium)
Amazon Pushes Ahead in Race to Embed Voice Assistants

Google has been patiently elbowing its way into the car experience. Most carmakers now offer Android Auto, through which Android smartphone applications can employ the vehicle’s human-machine interface, letting drivers safely use services such as Google Maps and Google Assistant while driving. At CES 2018, Google announced that Google Assistant—its virtual assistant—will now be included in Android Auto, replacing the less capable Google Voice Search. Google Assistant is also available on iPhones.

Siri, Apple’s personal assistant, has been featured on iPhones since the iPhone 4S was introduced in 2012. And now that many carmakers offer CarPlay, Siri has been widely available to drivers. They can ask Siri for directions, listen and respond to voice mail, read and reply to text messages and play music.

Apple and Google have dominated the market for automotive voice assistants by virtue of their dominance of smartphones. And now comes Amazon, the dominant supplier in the hot new market for voice-enabled smart speakers for the home. According to businessinsider.com, “The best smart speaker is the new Amazon Echo with its 15,000+ skills [capabilities], the ability to buy items on Amazon, support for dozens of smart home devices, and stellar audio quality.” Twenty-five million smart speakers were sold in 2017, according to billboard.com, three times as many as in 2016. Amazon’s market share in December 2017 was 69%; newcomer Google Home’s was 25%, according to a study by Edison Research and NPR. The same study found that 64% of owners of smart home speakers are interested in having smart speaker technology in their vehicles as well.

Amazon has aggressively parlayed its success in the home market to penetrate the automotive market. “BMW, Mini, Ford, Volkswagen, Toyota, Lexus, and SEAT have announced that they will bring Alexa into vehicles,” said John Scumniotales, head of products for Amazon Alexa Automotive, in a written statement to the Hansen Report. “In addition, Mercedes, Hyundai, Genesis, FCA, Nissan and Infiniti have
developed skills for Alexa so customers can interact with their car from inside their homes. Or [from the car] you can ask Alexa to turn off your connected lights at home, turn your thermostat up or check the status of connected appliances.” Ford and Toyota require a connection via a brought-in device.

While Alexa requires a connection to the cloud in order to work, Amazon says it is working with carmakers to integrate some capabilities into the car to do things like control temperature or windows even when cellular coverage is poor or nonexistent. Google is doing the same.

What’s especially interesting about Amazon’s incursion into autos is that some carmakers are embedding Alexa into their vehicles, unlike CarPlay and Android Auto, which rely on brought-in devices. With Alexa embedded, the carmaker is in a better position, not only to influence the user experience, but to profit from the engagement with Amazon. Amazon makes money when Alexa is used to order things from Amazon.com. By extending Alexa to vehicles, users will be able to buy more things.

Google Assistant, which comes pre-integrated with Google’s embedded Android operating system, named Android Automotive, will also be embedded, but it will take years for the operating system to penetrate the vehicle fleet as new infotainment systems based on Android are adopted by carmakers. Early adopters of Android Automotive include Audi, Volvo and FCA.

Embedded penetration of virtual assistants is near zero today, but will grow as cars are increasingly connected. “Annually, the number of OEM-sourced speech [recognition] solutions, excluding smartphone based solutions, will grow from 10 million to 12 million new vehicles today to more than 30 million in the next four years,” said Arnd Weil, senior vice president and general manager of automotive for Nuance.

Eventually, the vast majority of cars will come with embedded connectivity, driven by the need to provide software updates over the air, as well as to collect data and link the vehicle to cloud services. With connectivity assured, more carmakers will take charge of what tasks virtual assistants will be capable of doing.

**Multiple Assistants in Each Car**

Panasonic, which offers infotainment systems based on QNX, Android and Automotive Grade Linux operating systems, has been working with both Google and Amazon to integrate voice services into its products.
Each car will likely support multiple virtual assistants. “There are ways to arbitrate [multiple assistants] which don’t require the end user to press buttons,” said Andrew Poliak, vice president of product planning, strategy and innovation for Panasonic Automotive Systems. “I search with Google but I buy stuff on Amazon. So I might say, ‘OK Google, where is the nearest Starbucks?’ and with Amazon I might say, ‘Alexa, put milk on my shopping list.’”

The push for virtual assistants in cars is not only coming from Google, Amazon, Microsoft, IBM and Apple. “Our belief is there will be dozens, maybe hundreds of assistants in the world,” said Mr. Weil. “Nuance has a whole enterprise division that works with companies like banks and pizza chains. All of them want their own intelligent way to interact with their customers.”

Nuance, which has developed its own white-label voice assistant, wants to help carmakers not only integrate multiple voice assistants but also provide carmakers with the means to stamp the user experience with their own brand. “We enhance our platform so it is interoperable with the other assistants. It is an all-in-one voice experience. You can say, ‘what is the warning light for?’ which is a car related function. Or it could be a driving experience that the carmaker wants to own, so you might say ‘find me parking close to the opera that is open after the concert.’” If the driver has a question say about stocks or the weather, something that is out of the carmaker’s domain, it would be transferred to another assistant, Siri, Alexa, or Google Assistant. Nuance believes it should be invisible to the consumer which assistant is addressing his query or request. Microsoft’s Cortana virtual assistant had been part of the automotive discussion a year or more ago but has not been lately.

**Improving the Speech Interface**

While improving, automotive speech recognition continues to confound users. An article published in August 2017 by *Consumer Reports* noted that “an average of only 28% of owners were very satisfied with voice-command systems.” J.D. Power’s 2018 U.S. Vehicle Dependability Study found that voice activation and Bluetooth connectivity are the two in-vehicle technology areas receiving the most complaints from vehicle owners.

Amazon’s voice assistant may improve things. “With Alexa we’re bringing deep neural networks, machine learning and big data together to move natural language understanding forward faster than ever before,” said Mr. Scumniotales in his email to the *Hansen Report.*
Panasonic’s Mr. Poliak believes strongly that the voice recognition technology offered by Amazon and others will improve the automotive speech interface largely because it is cloud based. “The processing power to get really good natural language interpretation in a car is very cost prohibitive in terms of RAM, ROM and ECU processing power. Nuance has had a monopoly. Now they have competition that will pressure them to up their game. Speech recognition and navigation are the two most expensive software items on a vehicle bill of materials. Speech recognition hasn’t lived up to that pricing. When there is no cloud connection, though, Nuance will continue to be the leading provider,” he observed. Forty-five million cars shipped with Nuance technology onboard in 2017. Revenue for the automotive business totaled $250 million for the year. Nuance also offers voice processing that is cloud based.

“Three or four years ago, a speaker you could talk to was unheard of; now they are pretty common in a lot of homes,” said Tim VanGoethem, vice president of automotive research and product strategy at Harman. “The speakers understand what you are asking them to do, and that has raised expectations for what people now expect to be able to do in the car. Carmakers are quite eager to get this in. My sense is the growth curve for the car will follow what we are seeing in the home, going from nothing to a substantial take rate in the next five years.”

Industry Snapshot
◆ Amazon Alexa
Ford owners with SYNC 3 infotainment systems can access Alexa by plugging their smartphone into the USB outlet. The feature was first available in the summer of 2017.

Alexa will be integrated in all BMW and Mini models beginning in mid-2018. A smartphone is not required to benefit from Alexa in the car, as all BMW models and select Mini vehicles come equipped with a built-in SIM card and modem. The service will be available in the U.S., Germany and the U.K.

Toyota and Lexus models with the Toyota Entune 3.0 App Suite or the Lexus Enform App Suite 2.0 offer Alexa beginning in 2018. Additional models will be added in 2019.
SEAT models Ateca and Leon offered integrated Alexa features at the end of 2017, with more models to be added in 2018. Alexa is activated with a tap on the steering wheel.

At CES 2018, Panasonic announced that it would offer embedded Alexa service in its next generation IVI systems.

Elektrobit will offer Alexa integration software to carmakers to make integrating Alexa into vehicles simpler and faster.

◆ Google Assistant
Google announced at CES 2018 that Google Assistant will now be included in Android Auto, replacing the earlier Google Voice Search. According to Google, Android Auto is available in tens of millions of cars—more than 400 models from 40 brands including Ford, GM, Nissan, Volkswagen and Volvo.

Google says it is working with automakers to integrate Google Assistant directly into their cars, so that no mobile phone is required to use it.

With Google Assistant on a phone, speaker or TV you can check your car’s fuel level, lock the doors and operate similar remote functions. The feature is already accessible on cars from BMW, Mercedes and Hyundai and is coming to models from Kia and FCA.

Google will be pre-integrated into the Android Automotive operating system.

◆ Apps
The BMW Connected skill for Alexa (home to car) has been available since Sept. 2016. Google Assistant has been available through BMW Connected since December 2017.

Daimler announced in April 2017 that customers with Mercedes me and mbrace accounts can connect with Alexa to control vehicle functions such as remote start, door locking and destination input.

FCA launched a Jeep skill for Alexa on the 2018 Jeep Cherokee and will offer it on the new 2018 Wrangler in mid-2018. Commands can be issued through an Alexa device to start the vehicle’s engine, lock and unlock doors, send navigation instructions to the vehicle, or check fuel and tire pressure levels.

Google Assistant and Alexa can communicate with Hyundai Blue Link to activate remote features, send navigation destinations, etc.
Subscribers to **NissanConnect** services can activate features such as remote engine start and stop, and door locking/unlocking through Alexa smart speakers at home.

◆ **Cortana**

**BMW** demonstrated Cortana at CES 2017 but doesn’t yet offer it in cars.

The **Renault-Nissan** Alliance and Microsoft signed a global, multiyear contract focused on vehicle connectivity and connected services in September 2016. The company announced at CES 2017 that it would offer Microsoft Cortana in future vehicles, but didn’t say when. Nissan would only now say that “Work continues to integrate a virtual personal assistant into our vehicles.”

◆ **Nuance**

**Nuance** offers a white label Automotive Assistant capable of integrating several different brands of virtual assistants.

In February 2018, **Daimler** introduced its in-house developed, proprietary system, MBUX, in the new Mercedes A-Class. Mercedes’ virtual assistant uses embedded software from **Nuance**.

◆ **General Motors and IBM Watson**

GM launched its proprietary in-car commerce platform named Marketplace (formerly called OnStar Go), based on IBM’s Watson technology, in December 2017. Using a touchscreen, customers can order goods and services from select vendors who have partnered with GM. Part of GM’s pitch about Marketplace is the opportunities it provides partner companies to market their products to drivers in their vehicles. Voice activation is not part of the Marketplace platform at this time. GM says Marketplace is just the first in a suite of new “personalization features” that will roll out in the next year and a half. ◆
Roger Lanctot Weighs in on the State of Our Industry

I recently asked some media relations professionals which automotive electronics analysts they find especially credible and insightful. Roger Lanctot, director of automotive connected mobility at Strategy Analytics, was on everyone’s list. Mr. Lanctot graciously responded in writing to some questions I and many in the industry have been thinking about.

I have seen a lot of rosy forecasts, including some from Strategy Analytics, that expect ever greater electronics hardware and software value in future vehicles, especially for autonomous driving and electrification. This will not be sustainable without a substantial rise in the average retail price of vehicles. Higher retail prices will chill individual ownership and likely cause vehicle production to decline. Am I being too curmudgeonly? What’s your take? Will commercial fleet ownership compensate for a decline in individual ownership?

There are a few things to bear in mind. First, the automotive industry is a global marketplace exposed to a wide range of circumstances around the world that are not homogeneous. While Americans and maybe Europeans (the developed world) may seem to be losing their enthusiasm for cars, ownership has yet to show any serious decline and miles traveled continue to grow. So, yes, you are being too curmudgeonly. Something to bear in mind regarding electronics content is the fact that the cost of electronics is ever in a downward spiral even as new expensive capabilities are introduced. While electrification will indeed drive up electronics content, it will simultaneously drive out a substantial amount (some say up to 70%) of non-electronics content, so it is not a straight upward trajectory of added cost.

Large tranches of growing vehicle demand continue to percolate in “under-vehicled” markets such as Russia, Brazil, India and China, and probably Africa eventually. New forms of ownership—more ad hoc or subscription-based—are being developed, introduced and refined and that will make ownership less onerous and maybe more flexible or optional. At the end of the day, though, we will still be solving the majority of transportation challenges with cars or other vehicles. Something else to bear in mind is scrappage. The movement to remove or ban older, more polluting and less safe cars can be expected to gain momentum. Look at the growing roster of states and countries planning to ban ICE vehicles 20-30 years from now.
As you think about where this industry is headed and where companies are investing, what do you see as a realistic future for autonomous vehicles?

Robo-taxis—autonomous vehicles—will, by definition, not be owned by consumers. Semi-autonomous cars/vehicles will be owned, but not Level 4/5. You wouldn’t own a taxi unless that is what you did for a living, so you won’t own a robo-taxi. The full autonomy market is a networked mass-transit proposition that will follow in the footsteps of Lyft, Uber and Via, or replace or supplement them. Once robo-taxis are perfected the barriers to market entry will fall, and everyone with a marketing message or marketing platform or a service delivery proposition will put free robo-taxi pods on the road to deliver services or marketing messages to passengers in exchange for free transportation. So the popular misconception comes from thinking that robo-taxis will replace individually owned vehicles. For decades to come they will supplement owned vehicles. People are likely to hang on to their cars with semi-autonomous functionality.

Where is autonomous driving on your hype cycle? Before, at, or after the peak of inflated expectations? Somewhere else?

First of all, the “hype cycle” is a meaningless contrivance masquerading as deep marketing insight. If this is a measure of press coverage it might have some relevance, but I doubt it. The reality is that autonomous vehicles are being rolled out steadily all over the world in limited-use, defined-area applications. This represents a straight line growth/adoption curve moving ever upward from an admittedly tiny base. Hype or tripe, autonomous vehicles are not new. What is new is the mass application of this technology beyond military and law enforcement markets and use cases. State and federal authorities around the world are competing to facilitate this technological advance in order to capture the job-creating and investment-attracting opportunity to their state or region. This is a straight line, not a curve.

Among the many challenges that must be overcome before a broad market for L4 vehicles can blossom, which are the greatest?

Multiple startups and some established companies are trying to develop systems that can be placed blindly into any operating environment and work instantly. For the foreseeable future, development will be hampered by the need to “pre-map” an area and then drive it to identify “edge cases.” The onset of connectivity in the form of automotive broadband (C-V2X, 5G) will accelerate this development activity. We are currently in a phase focused
around “disconnected” AVs. Connected AVs will be able to perform localization at a faster pace and, eventually, in real time. So connected AVs are five years away and live mapping will come shortly after that. It may be a 10-year horizon in the worst case scenario. In the meantime, we will see city-by-city deployments of low-speed AVs within a few years.

Of all the new companies that have been drawn to the opportunities in autonomous driving, connected vehicles and electrification, which are showing the most promise? Which will disappoint?

I don’t see a single winner, and industry consolidation will likely save a lot of losers. The battle is on to solve an as yet unsolvable problem, so no single company is capable of holding all the cards. At Strategy Analytics we are tracking a couple of hundred companies active in this space. As you can imagine handicapping all of them is a huge challenge. We have some favorites, but we’d like to hold that information a little close to the vest especially since many of these companies are themselves holding their cards closely.

Which AD hardware platforms seem most promising, Nvidia? Intel? Qualcomm? Somebody else?

What about Renesas? All have an equal shot at this point and have early wins to point to. Some, like Nvidia, Intel and Renesas are more focused on AVs. Nvidia and Intel in particular are presenting somewhat conflicting value propositions. Nvidia appears to be emphasizing robo-taxis with supercomputers in the trunk, while Intel is pushing camera-based (with some lidar) semi-autonomous technology that seems more directly focused on mass market, mass produced vehicles. All of these companies and their growing rosters of partners have plenty of work to do and their messages and strategies for delivering solutions will change and evolve over time. The race is neck and neck at this point in time. The important overall message, though, is the need to bring more horsepower into the car to manage software, process data and improve the user experience.

I’m curious about your recent report, “Automotive Data in the Driver’s Seat in 2018.” Tell me a little more about that.

We spend billions of hours in our cars. More often than not that time is spent on the way to conduct some form of commercial or transactional activity. That makes the time-in-car an especially fertile ground for marketing messages—your time in the car may be the last opportunity for a marketer to
steer your transactional behavior. This reality has not been lost on carmakers, wireless carriers and the rest of the connected car ecosystem. Expect a massive assault on in-vehicle privacy presumably in the context of a mitigating value proposition for the consumer, for example a cheaper car or free Wi-Fi.
The Company Profile: Magna International

**Thumbnail Sketch**

**Headquarters:** Aurora, Ontario, Canada; www.magna.com

**2016 Sales:** $36,445 million

**R&D:** 11.5% of sales

**Capital Expenditures:** 5.25% of sales

**Net Margin:** 5.6%

**Cash Flow from Operating Activities:** $3,386 million

**Employees:** 155,000 at year end

**Sales per Employee:** $235,129

**Working Capital:** $15,924 million*

**Long-term Debt:** $3,175 million*

**Stockholders’ Equity:** $25,090 million*

**Market Capitalization:** $19,325 million as of February 12, 2018

**2017 Sales:** $35,900 million to $37,100 million

*As of September 30, 2017

**Background**

Magna International was founded by Frank Stronach in 1957 as a tool and die shop called Multimatic. Multimatic merged with Magna Electronics in 1969, and four years later the name of the company was changed to Magna International. Magna grew through multiple acquisitions including, for example, New Venture Gear, a joint venture of GM and Chrysler, which became Magna Powertrain. Donnelly Corporation was acquired in 2002 and became Magna Mirrors. The company bought transmission maker Getrag in 2016.

In 1998, Magna acquired a majority holding in Steyr-Daimler-Puch AG, which became Magna Steyr. Magna Steyr went on to make several more acquisitions, the most recent Telemotive AG, in 2016. According to the company, Magna Steyr today is “the leading global, brand-independent engineering and manufacturing partner to automakers.”

Mr. Stronach, often described as “mercurial,” continued to control Magna until 2010, when his family’s non-traded Class B shares were bought out for nearly $900 million. Each Class B share carried 300 votes, giving the Stronach Trust 66% of the voting power. The dual-class share structure has since been eliminated.

The Hansen Report on Automotive Electronics, February 2018

www.hansenreport.com
More Transparency

For years, Magna has been guarded about what information it reveals to the public and as a result we have been unable to feature them in a Hansen Report company profile. They haven’t been willing to say how sales break down by product or how much of sales is automotive electronics. That policy was recently changed. Magna outlined its more open approach in a December 2017 statement announcing its new management structure, with new reporting segments, to provide investors with greater transparency. Magna had been reporting its regional results and will now report sales, adjusted EBIT and other items based on four global product groups: Body Exteriors & Structures, Seating Systems, Complete Vehicles, and Power & Vision, which includes powertrain, mirrors, lighting, closures and electronics.

Part of the motivation for changing its organizational structure and public posture was Magna’s view that its strong business profile is not reflected in its share price. In February 2018, Magna’s price to earnings ratio (P/E TTN) was just 9.8 compared with Visteon at 26.0, Borg Warner at 25.2 and Aptiv (Delphi without its powertrain segment) at 18.3. In February Magna’s market cap was just 53% of 2016 sales despite returning to investors $8.1 billion in dividends and share buybacks since 2011.
Magna wants to be seen as a supplier that’s aligned with the cutting edge of the automotive future—specifically electrification, autonomy and new mobility. As such, our profile takes a look at Magna’s Power & Vision segment, where it is today and where it is going.

Magna is making increased investments in electrification and autonomy, but those investments won’t impact sales in the near term. According to the company, its Power & Vision segment is expected to grow annually from 2017 to 2020 at a rate somewhere between 2% and 5%. Faster growth won’t come until later as significantly more xEVs and semi- and fully autonomous vehicles come to market. However, within the $11.6 billion Power & Vision segment, Magna expects its $700 million electronics business to grow at a 12% to 14% CAGR. Magna’s dual-clutch transmission business will also see faster growth than the Power & Vision segment’s average.

Magna lists electronics know-how among its differentiating strengths. Others include strong cash flow, a breadth of technology expertise, and its experience in engineering and manufacturing complete vehicles, which it does for BMW, Mercedes and Jaguar Land Rover at its Magna Steyr facility in Graz, Austria.

**Magna’s Electronics Business Today**

Of the roughly $700 million worth of electronics Magna shipped in 2017, $500 million is tied to vision-based ADAS applications. Magna has secured more than 50 patents supporting its vision-based ADAS IP. Most of the remaining $200 million in the electronics business is from ECUs that control Magna’s all-wheel drive and 4-wheel drive transfer cases, eLatch (Magna’s electronically controlled side-door latch) and adaptive headlight controls.

Forward-looking camera modules based on Mobileye’s EyeQ chips account for the preponderance of Magna’s vision-system business. The EyeQ provides object detection and classification. “From there, we do further processing of the signal in..."
order to provide the desired actuation, be it braking or steering,” said Swamy Kotagiri, CTO. “That IP as well as fusing the camera output with the output from radar or ultrasonic sensors is all from Magna.” Mr. Kotagiri is responsible for Magna’s innovation and new product strategy. He also has P&L responsibility for the Power & Vision Group and serves as president of powertrain within that group.

Software embedded in the Mobileye SoC (system on chip) provides object detection and classification and underpins an abundance of ADAS features including autonomous cruise control, lane-keeping assist, automatic emergency braking (AEB), auto high beam and auto matrix beam lighting, collision mitigation and traffic sign recognition. Magna’s camera modules are employed widely across platforms and models from General Motors (41 models), PSA (8 models), Honda (9 models), FCA (9 models) and Mazda (7 models).

Magna developed the world’s first camera-based AEB system, introduced on the 2016 Chevrolet Volt. The system, which operates at speeds up to 35 mph, detects vehicles up to 197 feet away.

Magna also supplies ADAS systems based on rearview, surround-view and blind-spot monitoring cameras. For example, Magna technology provides the foundation that enables the Trailer Reverse Guidance and Pro-Trailer Backup Assist systems jointly developed by Magna and Ford.

Image-processing software from Magna determines the angle between truck and trailer and provides the most appropriate view to the driver, depending on the trailer’s trajectory. High-resolution cameras and color-coded diagrams of the truck help warn the driver of potential jackknife conditions. Additional technology shows the driver the required steering wheel movement for reversing in a straight line. The trailer assist system is available on Ford F-150 pickups. Ford’s vehicle backup assist system also comes from Magna.

A 360-degree surround-view system from Magna is featured on the Maserati Levante luxury SUV. The front and side cameras are located in the radiator grill and outside mirrors, while the rearview camera is positioned above the
rear registration plate. Unlike the previous analog generation, the electronic control for the surround system operates based on digital video data from the cameras. A Magna surround-view system is also available on the FCA Pacifica.

**Magna’s Electronics Capabilities**
- Image signal processing
- Machine vision
- Multi-sensor fusion
- High precision sensor manufacturing
- Functional safety
- Extensive drive data library
- Large IP portfolio
- Software/algorithms

**Magna’s Future in Electronics**
- **Lidar**
  Magna will bring to market in the 2020-2021 timeframe a solid-state lidar sensor based on technology from the Israeli startup, Innoviz. Magna began working with Innoviz in December 2016 and made a strategic investment in the company in August 2017. Aptiv (formerly Delphi) and Samsung, among others, have also invested in Innoviz. Thus far Innoviz has raised $82 million in funding. InnovizOne is the company’s automotive grade sensor development aimed at high-volume applications. It offers a detection range of 250 meters, a 120 by 25 degree field of view, and a 0.1 by 0.1 degree angular resolution. Samples of InnovizOne will be available in 2019. “We looked at the landscape of 30 or more [lidar] companies and found Innoviz the closest to having a functioning system,” said Mr. Kotagiri.

- **High Definition ICON Radar**
  Magna began working on next-generation, 79 GHz radar with Austin, Texas-based startup

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The Hansen Report on Automotive Electronics, February 2018

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Uhnder, in 2015. “It was a collaborative approach to actually define the specification of a radar as we saw it futuristically in the 2022 to 2025 timeframe,” said Mr. Kotagiri. Now Magna, Uhnder’s first customer, is planning to bring this technology to market as early as 2019 in a product it is calling ICON Radar.

With a range of 300 meters and resolution less than one degree, the sensor will be able to detect and classify static objects such as guardrails, road debris and speed bumps, as well as track a large number of moving objects such as vehicles, pedestrians, cyclists and pets. With changes to the software and SoC, the radar platform can be adapted to mid- and short-range applications such as blind spot detection.

Unlike the typical frequency modulated automotive radar, Magna’s new radar is phase-modulated continuous wave (PMCW) radar, considered ideal for CMOS implementation because the chip architecture is digital. PMCW radar is capable of multiple input, multiple output (MIMO) signal processing to achieve better detection performance than conventional phased array radar.

“We believe this technology will disrupt the automotive industry like CDMA disrupted the cell phone industry,” said Mr. Kotagiri.

- **MAX4 Demonstration Vehicle**
  In August 2017, Magna announced MAX4, its customizable autonomous driving platform that can be scaled up to Level 4 autonomy. Magna built a MAX4 demo vehicle not only to demonstrate its ability to integrate all the pieces required in a fully autonomous vehicle, but also to do it in a vehicle that doesn’t compromise

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**Distinctions Claimed by Magna**
- The world’s only supplier with expertise across the entire vehicle
- World’s top independent supplier of all-wheel/4-wheel-drive driveline components
- World’s number-one independent transmission system supplier
- World’s top independent supplier of fluid pressure systems and controls
- Number-one supplier of outside and inside mirrors
- The world’s largest vision-based ADAS supplier
- Developed the world’s first camera-based AEB system, for the 2016 Chevrolet Volt

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The Hansen Report on Automotive Electronics, February 2018

[www.hansenreport.com](http://www.hansenreport.com)
vehicle design and styling. There is no scanning lidar “coffee can” protruding from the roof. The rear hatch is not stuffed full with electronics. MAX4 was a collaboration across two Magna business groups, Power & Vision and Body Exteriors & Structures.

The platform combines camera, radar, lidar and ultrasonic sensors with a computer platform that is designed for easy integration with any automaker’s existing and future platforms. Scalable for high-volume production, Magna describes MAX4 as flexible, upgradeable and fully functional with a fraction of the power requirements typical of alternative solutions.

MAX4 was built in Berlin, where it has undergone most of its road tests. “We had some interesting challenges there, given the width of the Jeep Cherokee demo vehicle, with the roundabouts and narrow road widths,” said Mr. Kotagiri. The next version of MAX4 will feature Magna’s ICON Radar.

**Complete Autonomous Vehicle Design and Assembly**
With MAX4, Magna is demonstrating that it could well contribute to the design and assembly of the robo-taxis or other autonomous vehicles that the new automotive entrants are developing. “We are one of the few companies who can do that,” Mr. Kotagiri asserted. “We have the body exterior structures, whether it’s steel, aluminum, composite or carbon fiber. We have the actuators, the mechanisms, closures, lighting, door modules, ADAS, and powertrain [components]. Our Magna Steyr branch gives us the unique advantage of vehicle engineering knowledge. We engineer full vehicles and we build them.”

Magna, which assembles vehicles for three OEMs, expects its complete vehicle business segment to grow from about 10% of Magna’s total sales in 2017 to 16% by 2020.

**Magna Joins BMW, Intel, Mobileye Self-Driving Platform Alliance**
Magna will serve the alliance as a tier-one integrator of the domain controller designed by BMW and Mobileye and contribute its expertise to the development and manufacture of the sensor suite. The self-driving platform will be made available to multiple carmakers starting in 2021.

**Vehicle Electrification**
Magna is well positioned to benefit from the anticipated growth in hybrid- and electric-vehicle (xEV) production. Several key products will benefit from the trend, including e-motors, electrically driven pumps, gears and shafts, hybrid dual-clutch transmissions, inverters and software. Magna’s electrification portfolio also includes electrified auxiliaries such as thermal management modules, electric water pumps and electric oil pumps.
Magna’s experience as a key supplier to xEV-makers goes back to the Ford Focus Electric, in production since 2012. Responsible for system integration, Magna produces the vehicle’s e-motor, inverter, transmission/gearbox and electronic control module and handles system integration.

Also in production since 2012 in Europe are the Volvo V60 and S60 plug-in hybrid vehicles. For those Magna supplies the complete electric axle including e-motor, inverter and transmission/gearbox.

Today Magna is able to support series production of many of the key components required of modern electric drive systems. Products include a range of transmissions, gearboxes, axles, electric motors, inverters, control software and engineering expertise.

In October 2017, Magna announced a deal with Huayu Automotive Systems Co. (HASCO) to form a joint venture in China to produce an electric drive powertrain system for Volkswagen’s two Chinese joint ventures, with SAIC and with FAW. Magna will have responsibility for the design of the electric drive system, manufacturing the gears and shafts through Magna Powertrain and supplying the integrated inverter through Magna Electronics. The JV will focus on the fast-growing Chinese xEV market. HASCO is a subsidiary of SAIC Motor.

Magna brought its e1 concept vehicle to CES 2018 to demonstrate different electric drive systems while also demonstrating Magna’s vehicle integration capabilities. The e1 features one highly integrated e-drive system on the front axle and one on the rear axle with two electric motors. With this approach the demo achieves superior longitudinal and lateral dynamics with excellent stability. Combined, each of the three 140-kilowatt motors produces overall performance of 420 kilowatts, peak.

**Magna’s Served Market Powertrain Content per Vehicle by Powertrain Type**

- AWD ICE powertrain: $2,000
- 48V AWD mild hybrid: $2,600
- 300V AWD HEV/PHEV: $3,000
- Full AWD EV: $2,500
- 48V 2WD mild hybrid: $1,000

Mild hybrids, defined as vehicles equipped with internal combustion engines, 48-volt start/stop functionality, regeneration and boost capability, will account for 33% of vehicle production in 2025, and 41% by 2030, according to Magna. (See chart, below.) To respond to this hot market for 48-volt components, Magna has been developing 48-volt hybrid powertrain modules that include a rotor and stator (the active components of a 48-volt motor), the power electronics (often referred to as an
The Hansen Report on Automotive Electronics, February 2018

Despite the rise of electrification, 94% of vehicles will have an internal combustion engine onboard in 2025.

- **ICE**: Internal combustion engine
- **Micro Hybrid**: ICE with 12V start/stop and regeneration capability
- **Mild Hybrid**: ICE with 48V start/stop, regeneration and boosting capability
- **PHEV/HEV**: ICE with high voltage eMachine, full electric drive, external charging
- **EV**: No ICE. Battery or fuel cell electric vehicle
The Case for Membership in the W3C (World Wide Web Consortium)

With greater participation from the global community of carmakers, the full promise of the Internet-connected car can be realized sooner rather than later. “Apple phones and Android phones are big because developers can use their APIs and build apps. We are still missing something like that in the car; that is why we joined W3C,” said Patrick Bartsch, an infotainment platform engineer for Audi. Audi participates in the W3C on behalf of Volkswagen Group. Mr. Bartsch likes the W3C’s approach of using Web APIs to connect to the vehicle’s computers, similar to Volkswagen’s Infotainment Web Interface (VIWI) protocols. It doesn’t matter what platform the computer is running on, whether it’s Android, QNX or Linux, because the Web is ubiquitous.

“The Volkswagen Group is a microcosm of the problem with the industry at large,” said Martin Voshell, responsible for W3C business development within the automotive community. “They have a number of brands with entirely different computing platforms. They can’t easily write applications to run across all of them; they can’t get third party developers to do it either. Developers want to be able to write something that can run on any make or model.”

The W3C standards organization, founded in 1994, is led by Tim Berners-Lee, inventor of the World Wide Web. The W3C’s mission: Lead the Web to its full potential by developing protocols and guidelines. Among the W3C’s 473 members are Apple, Baidu, Google, IBM, Intel and Oracle. Aware of what W3C standards have already enabled, key members including some telcos, IT and big tech companies have identified automotive as an industry that would benefit greatly from standards.

The consortium, which has been working on automotive standards for the last several years, has lately been making a concerted effort to build automotive membership, especially among carmakers, who they hope will specify W3C standards in their RFQs. “We are making progress but we can progress faster with more members,” asserted Ted Guild, IT head and connected vehicle lead at the W3C, and research staff member at the MIT Computer Science and Artificial Intelligence Research Laboratory, where the W3C was founded. “We are not just creating standards, we want their wide adoption.”
Thus far two carmakers, Volkswagen and Jaguar Land Rover, have signed up for full “Member” status in W3C. In addition, Mitsubishi Electric, LG Electronics and Samsung Electronics are active automotive tier one members. Tier-one members Sony, Panasonic and Visteon are monitoring W3C activity as well. Volvo and Bosch are observers who are considering further participation. Member organizations pay an annual fee based on the member’s income, with lower tier payments for smaller companies. Full membership entitles a company to participate in the Automotive Business Group, the Automotive Working Group and any Automotive Task Force (for example, Automotive Web Payments). Full membership also provides the opportunity to more broadly interact and work with the leading companies, organizations and individuals in all W3C groups, not just those working on automotive issues. In addition, full member status allows a company to provide strategic direction to the consortium through review of W3C activity proposals and operational policies.

A more modest fee entitles companies to “Participant” status, which lets them participate only in the Automotive Business Group. Participants can provide input in the standards-making process, and developers and designers have a place to hold discussions and publish their ideas. Participant status organizations in the Automotive Business Group include INRIX and Valeo.

The Genivi Alliance is also an active W3C Member. In addition, W3C has liaisons with numerous other standards bodies and trade associations.

The simple progression of the standards process is incubating ideas for new work, including prototyping and early specification drafts, in a Business Group and then transitioning to a Working Group for formal standards development. Working Groups typically produce deliverables (e.g., standards-track technical reports, software, test suites and reviews of the deliverables of other groups).

**Vehicle Signal API, v1 and v2**
The W3C’s first automotive standard, Vehicle Signal API v1, has already been implemented in the Genivi Development Platform and by Mitsubishi Electric on an Android platform. The API provides a common abstraction layer for all telematics information that is available in the vehicle such as engine temperature, speed and fuel level.
The Volkswagen Group had been working on its own VIWI API, taking an approach that was similar to the W3C’s Vehicle Signal API. In November 2016, the VW Group presented its approach, now known as the Restful Service Interface (RSI), to the W3C and sought to converge the two APIs. The result will become Version 2 of the Vehicle Signal API. According to Mr. Bartsch, Volkswagen’s decision to become a full member of the W3C meant that VW could find broader support in the community for what it was already developing and perhaps influence standards the W3C was developing. “We joined because having an API that is an industry standard helps not only us but the entire industry. It allows third parties to build applications that interface with your system,” he said.

The first public draft of RSI should be ready this spring. Developers are encouraged to submit their early implementations based on the draft and contribute feedback to strengthen the standard, which should be finalized by Q3 2019.

**Secure Web Payments**

Last October, the W3C’s Automotive Business Group set up a joint task force with the Commerce Interest Group to consider what standards are needed to apply secure Web payment standards to automotive use cases such as fueling, charging and parking. “This is of extreme interest to car-makers and tier ones,” said Mr. Guild. “We have all the major credit card companies involved—Amex, Visa, MasterCard and Discover—and we are starting to get interest from fleet management companies.” Other automotive initiatives under consideration by the W3C include standards for media, user notifications, security and location-based services.

To learn more about involving your company in the good work of the W3C, please contact Marty Voshell (marty@w3.org) or Ted Guild (ted@w3.org).