

The Transformation Of The Automobile

Forecasts, trends, and analyses on the disruption of the automotive industry

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BI INTELLIGENCE



Key Points

- **In 2021 we expect 94 million connected cars to ship, or 82% of total cars shipped that year.**
That's up from an estimated 13 million shipped in 2015. We define the connected car as a car that is connected to the internet over a cellular or tethered connection.
- **Automakers and other companies are recognizing that the connected car is the next mobile platform and, as such, presents a major business opportunity.** Tech, insurance, media, and cellular companies are clamoring to provide products or services to the automaker and/or its driver via the connected car.
- **It's not just about revenues. Connecting cars will also help automakers improve service.**
Automakers can push over-the-air updates to the connected car, monitor its use to improve future models, and leverage the internet connection to cross-sell new products or services.
- **Consumer adoption is rising fast.** New car buyers are placing a lot of value on a car's digital capabilities — the majority of consumers say a car's digital technology has a greater influence on their car purchase than the car's driving performance.
- **The data generated by the connected car can be used in a variety of ways.** Consumers can leverage their car's internet connection to track their vehicle's activity. Insurance companies can use the data to provide usage-based insurance policies.
- **Connected cars will pave the way for fully autonomous cars, and this will happen sooner than many people expect.** We expect the first fully autonomous car — a car that can drive itself from point A to point B with no human interaction — to hit the road in 2019. However, this car will still require a driver behind the wheel.
- **With the advent of fully autonomous cars, the car ownership model will change.** Fully autonomous cars will eventually make it cheaper to operate a taxi or shared transit business. Along with the rise of urbanization, this will enable more car-sharing platforms and lead to fewer consumers purchasing cars.
- **The fully autonomous car still faces significant hurdles, though.** Overcoming regulatory challenges and gaining consumer trust are key.

Connected Cars, By The Numbers

What is a connected car?



Connected Car *n.* A car that is connected to the internet over a network connection, primarily cellular.

Our forecast

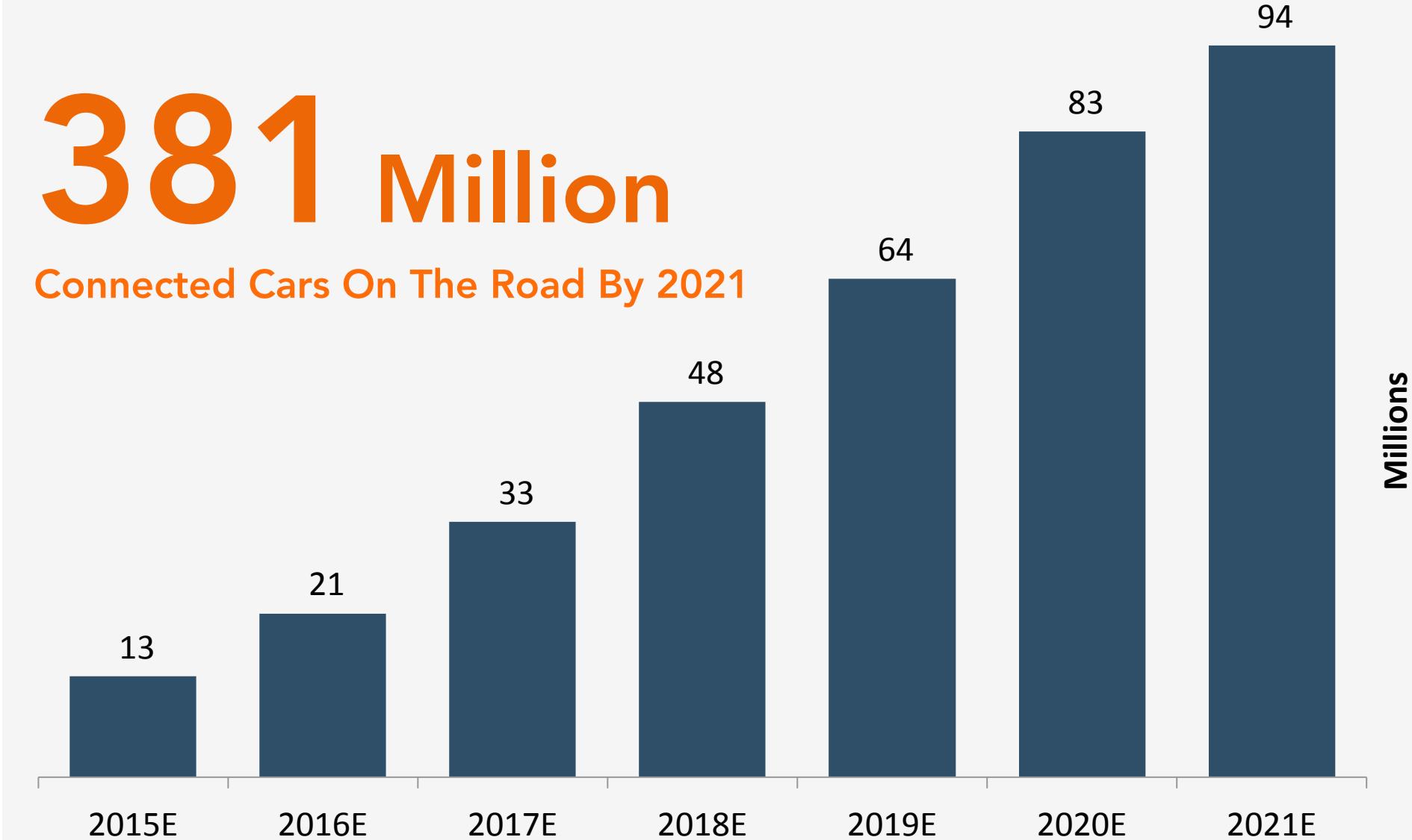
We have revised our forecast to reflect the industry's faster-than-expected rollouts of connected economy cars and our expectation that automakers will soon push connected cars in emerging markets.

We believe that nearly 13 million connected cars were shipped globally in 2015, up from our previous estimate of 10 million connected cars shipped that year.

The top trend in the automotive industry is pushing growth in emerging markets, according to a recent KPMG survey of auto executives. As automakers build out their offerings in emerging markets, we expect them to leverage higher smartphone penetration rates in these regions to sell connected cars.

- **In 2021, 94 million connected cars will be shipped,** according to our model, or 82% of all cars sold that year.
- That's up from 21 million connected cars sold in 2016, for a 35% five-year compound annual growth rate (CAGR).
- In total, **381 million connected cars will be on the road in 2021, up from 36 million at the end of 2015.**

Estimated Connected Car Shipments



Methodology

To create our forecast, we looked at estimates of light vehicle car shipments across 150+ countries provided by OICA, alongside KPMG's forecast for total light vehicles sold between 2015 and 2020, and then expanded that forecast to reflect a steady growth rate into 2021. Next, we utilized data from the ITU, Google's Consumer Barometer, and GSMA Intelligence to assess mobile infrastructure and determine a country's readiness for connected cars. Finally, we examined automakers' stated plans for connecting vehicles.

How Cars Are Being Connected

Two ways a car can connect to the internet:



Embedded

Automakers embed an antenna and corresponding cellular chipset into the car, similar to how smartphones operate. Embedded connections are becoming more prevalent than tethered connections due to the added capabilities embedded connections provide to automakers, such as the ability to connect to a vehicle without requiring a smartphone.



Tethered

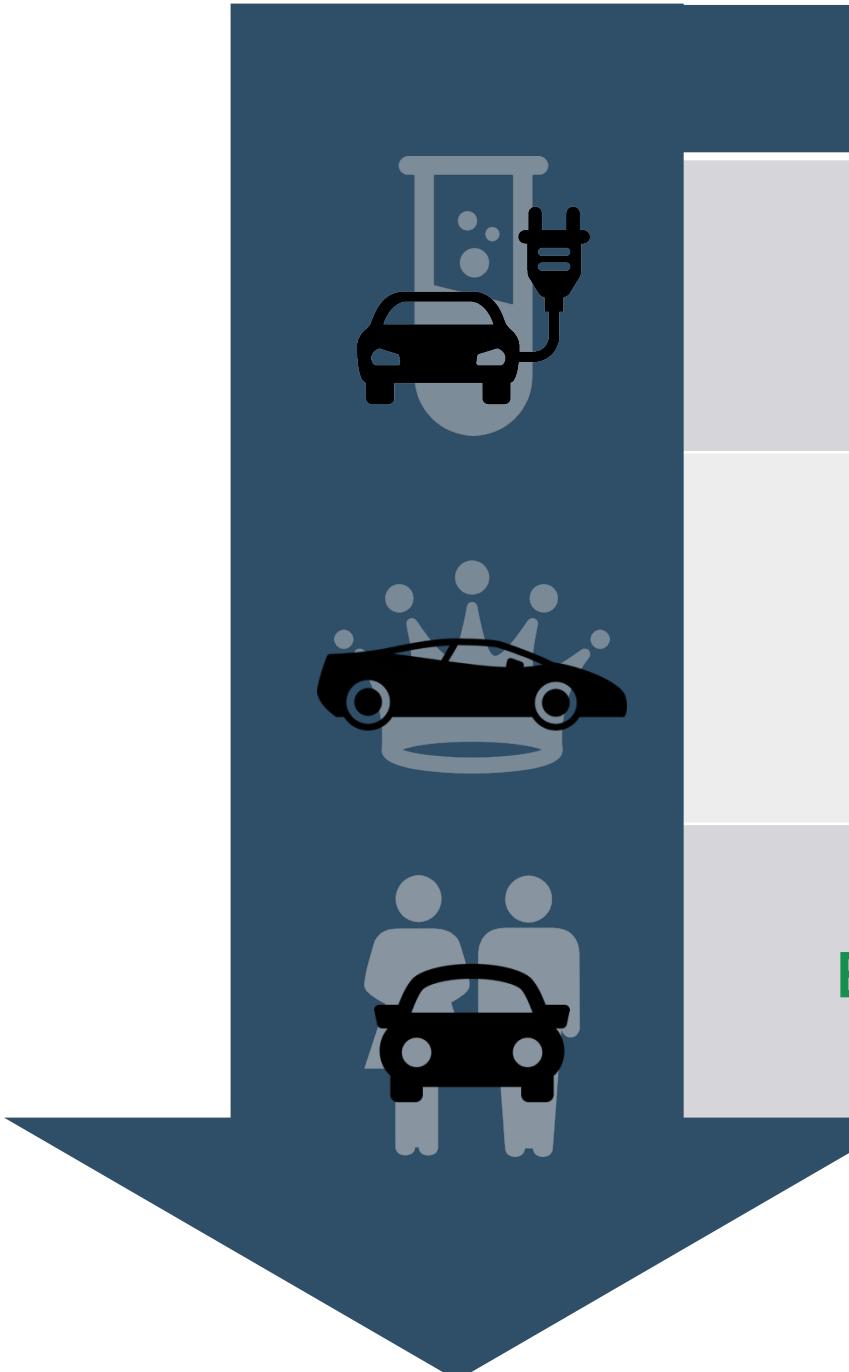
For this type of connection, automakers offer hardware that enables the user to connect their smartphone to the car's dashboard. All data used by the car to power its apps rely on the user's mobile data plan. Components within the car also rely on network technologies to relay information and data to one another.

A connected car can have an embedded connection that the car owner doesn't pay for. In many instances, automakers partner with cellular companies and charge automakers for connectivity in their vehicles on a wholesale basis. This means the automaker is paying the cellular provider for internet connection in the car. They do this so that they can push over-the-air (OTA) updates to the car and receive data about the car's use. In addition, the automaker and cellular provider can offer new car owners a free, trial-based connectivity subscription for more advanced services like access to consumer-facing apps, much in the same way they have offered free trials to satellite radio. After the trial, drivers can choose whether or not to sign up for a paid subscription.



Automakers Are Connecting More Of The Vehicles In Their Fleets

Initially, automakers first connected their electric models, followed by their luxury models, and lastly their economy models. But in developed markets, many automakers have quickly moved beyond the luxury phase and jumped into connecting their economy cars. This is helping drive up the number of connected cars on the road.

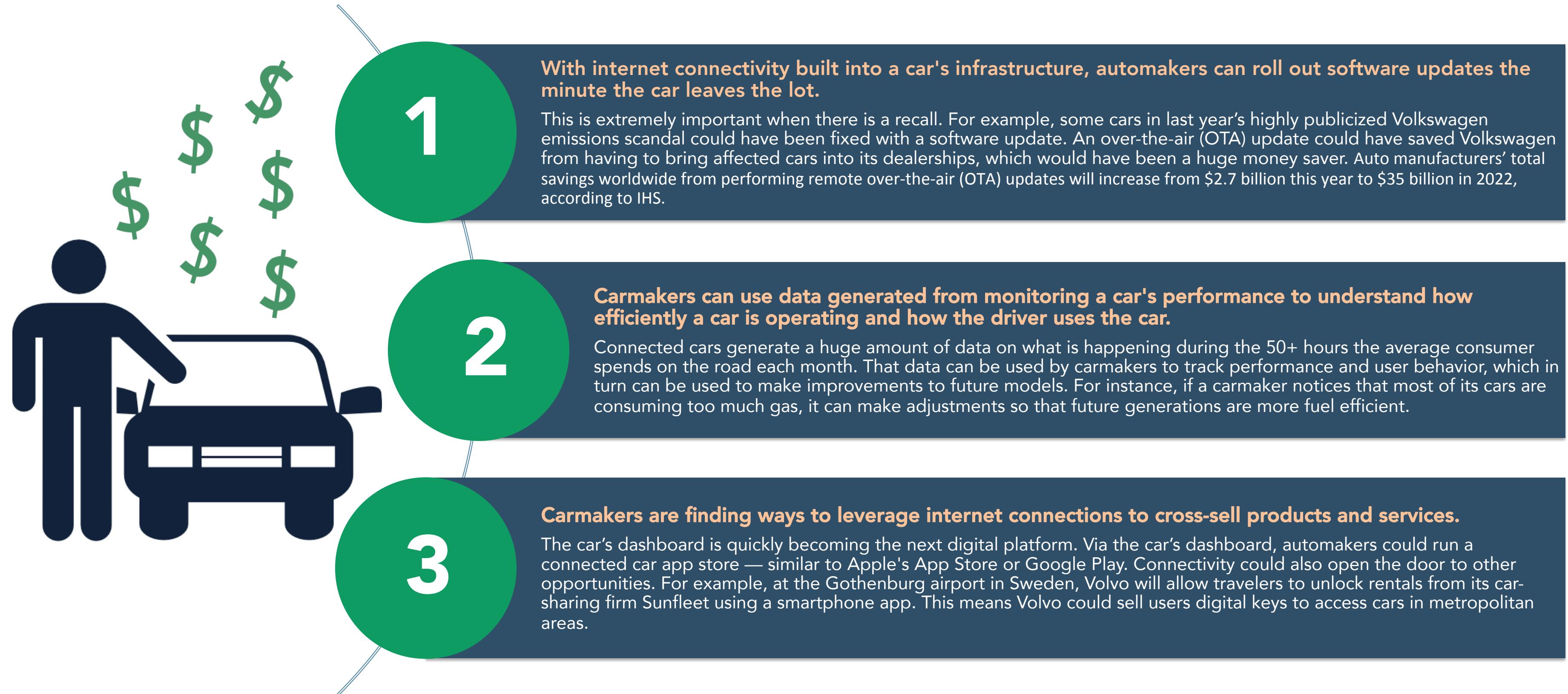


Phase	What happens here
Electric	Automakers test new technological advancements in their electric cars. These cars attract tech-savvy individuals and represent a small portion of total sales.
Luxury	Once a technology is deemed successful in an electric vehicle and there's a proven demand for it, it's then integrated into the luxury vehicle to create a more attractive car for potential buyers.
Economy	During the final phase, automakers connect their economy lineups to the internet. This is when connected cars reach the mass market.



Three Reasons Automakers Are Connecting Cars

Although media reports and research firms have focused on how consumers will benefit from the connected car, automakers also stand to gain significant benefits from increased embedded car connectivity.



Which Automaker Is Leading The Pack?

Almost every automaker has announced plans to connect the vehicles it sells to the internet. Many are going a step further and developing vehicles with self-driving car features. But it's still a tight race in the connected/self-driving car battle.

There is no clear winner, but there are leaders

BMW, Volkswagen, Tesla, and others have all been noted as leading connected car makers in different studies.

But if you ask automakers, BMW is leading the field in terms of connectivity and self-driving features, according to a survey of 200 automotive executives from KPMG. BMW had nearly 25% of the vote and was followed by Daimler — which controls Mercedes-Benz — and General Motors, with 16% and 12% of the vote, respectively.

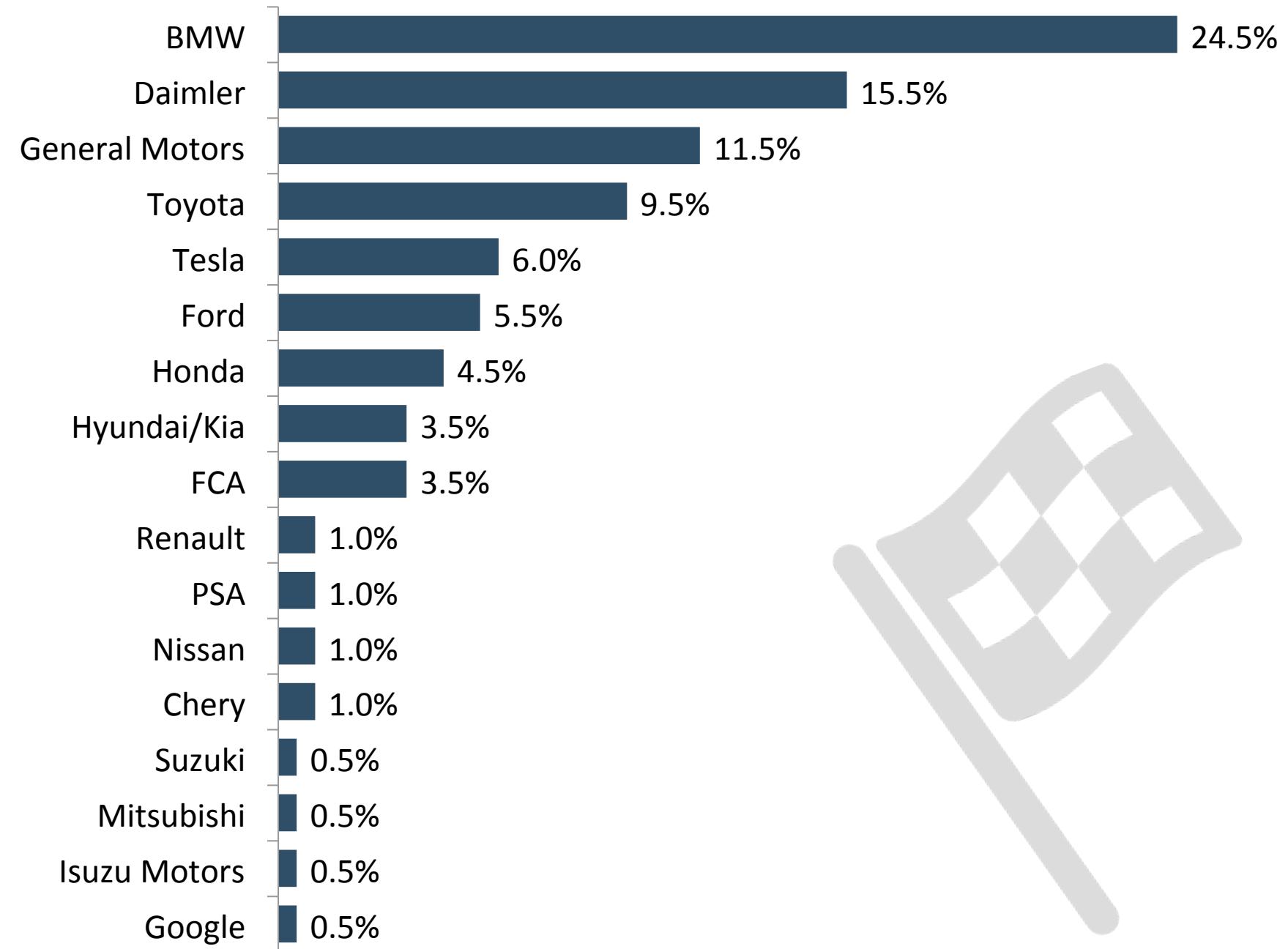
Surprisingly, Tesla, which has released many new connected features over the past few years and is often viewed as a premier connected car, only received 10% of the vote. Similarly, Google, which is pioneering the fully autonomous car, received only 0.5% of the vote. We believe these low scores are due to the limited (or nonexistent) number of cars Tesla and Google make.

Harald Krueger, BMW Chairman of the Board of Management, wrote in the company's most recent annual:

"Connectivity is one of the major trends in our industry. Vehicles, their drivers and their environment will be even more closely connected in the future. The next logical step is highly and then fully automated driving."

Currently, 95% of new shipped BMWs come embedded with SIM cards, according to the report. Connected Drive — BMW's connected car system — has become a major focus for BMW and is now available in 45 markets and 18 countries.

**Global OEM Leading Connectivity And Self-Driving Cars
Automaker Executives' View On Who Is Leading The Field**



Source: KPMG, 2016



The Players In The Connected Car Market

Companies outside of the automotive industry are clamoring to provide connectivity, apps, hardware, and services to automakers and drivers.

In many instances, automakers are partnering with these companies. For example, telcos such as AT&T are providing cell connections to vehicles, while Google and Apple are creating connected car platforms.

In other cases, the automaker is keeping the connected car ecosystem closed and is reluctant to partner with outside vendors. For example, some automakers are reluctant to integrate the Apple CarPlay and Android Auto platforms because they want to monetize their own app store.

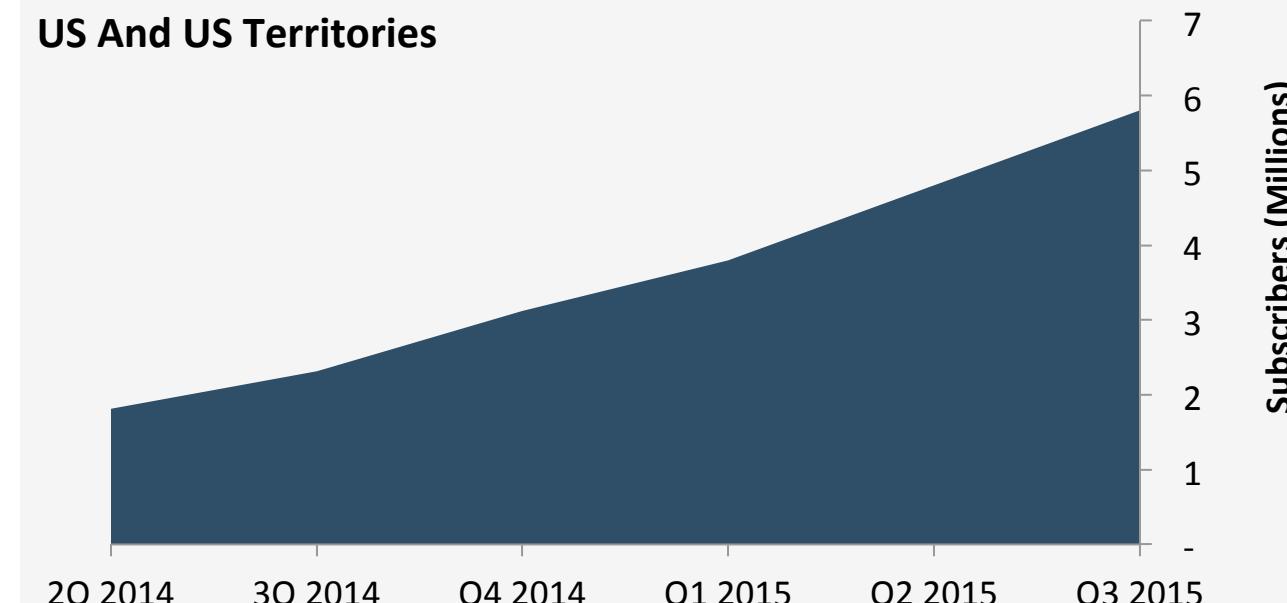


AT&T's Connected Car Growth

AT&T added 2.7 million cars in the US in the first three quarters of 2015 — that's 43% of the 6.3 million cars sold by its eight connected car partners (GM, Ford, Audi, BMW, Tesla, Nissan, Volvo, and Subaru) during that time, according to Motor Intelligence as reported by The Wall Street Journal. This does not reflect the number of drivers paying a monthly plan for added data in their car — this only reflects the amount of cars connected on a wholesale basis to their eight car partners.

Although AT&T does not break out connected car consumer subscribers, or people who convert to paid subscriptions after their free trial expires, the company told us that post-paid connected car subscribers — or active users — are growing.

AT&T Connected Car Subscriber Base
US And US Territories



Source: AT&T Company Filings



Three Factors Driving Increased Demand For In-Car Connectivity

- 1. Consumers' growing "need" to be "always on."** 30% of US smartphone owners said they get "anxious" when they don't have their smartphone on them, and 68% said they check their smartphone within 15 minutes of waking up in the morning, according to a Google survey. Similarly, 38% of millennial respondents said they get "anxious" without a smartphone, according to a recent BI Intelligence survey. Carmakers and tech companies are trying to capitalize on this by making sure the car is yet another device that allows consumers to stay connected.
- 2. Government restrictions on texting while driving.** At any given moment, 660,000 US drivers are using their mobile phones or manipulating an electronic device, which increases the risk of getting in a crash three-fold, according to the National Highway Transportation Safety Agency (NHTSA) and the Department of Transportation. As a result, there has been a major push to use hands-free technology while driving. However, a study from AAA found that using in-vehicle information systems is associated with moderate to high levels of cognitive distraction. As a result, automakers and tech companies will have to figure out how to keep consumers connected while ensuring safety. One solution is through increased safety measures, such as lane departure warnings, which warn the driver when they are drifting out of their lane and into another one.
- 3. Greater awareness of connected cars.** In the past two years, the search term "connected car" has continually risen in Google Keywords. This indicates a steady rise in consumer awareness of connected cars. In particular, CarPlay and Android Auto — popular connected car infotainment platforms — are some of the most searched connected car terms we've analyzed. This suggests that technology companies, like Apple and Google, are helping increase consumer awareness and demand for connected car technology. In addition, many carmakers have begun advertising campaigns featuring in-car connectivity.

Consumer Interest In The Connected Car

The car's infotainment center is becoming the next major mobile platform. It offers access to applications commonly found on phones while providing drivers with a safe, hands-free experience when on the road.

In total, entertainment features provided by the car's embedded infotainment center — composed of a Wi-Fi hotspot, applications, and more — will generate \$15 billion in sales in 2021, up from \$7 billion in 2016, according to Strategy&.

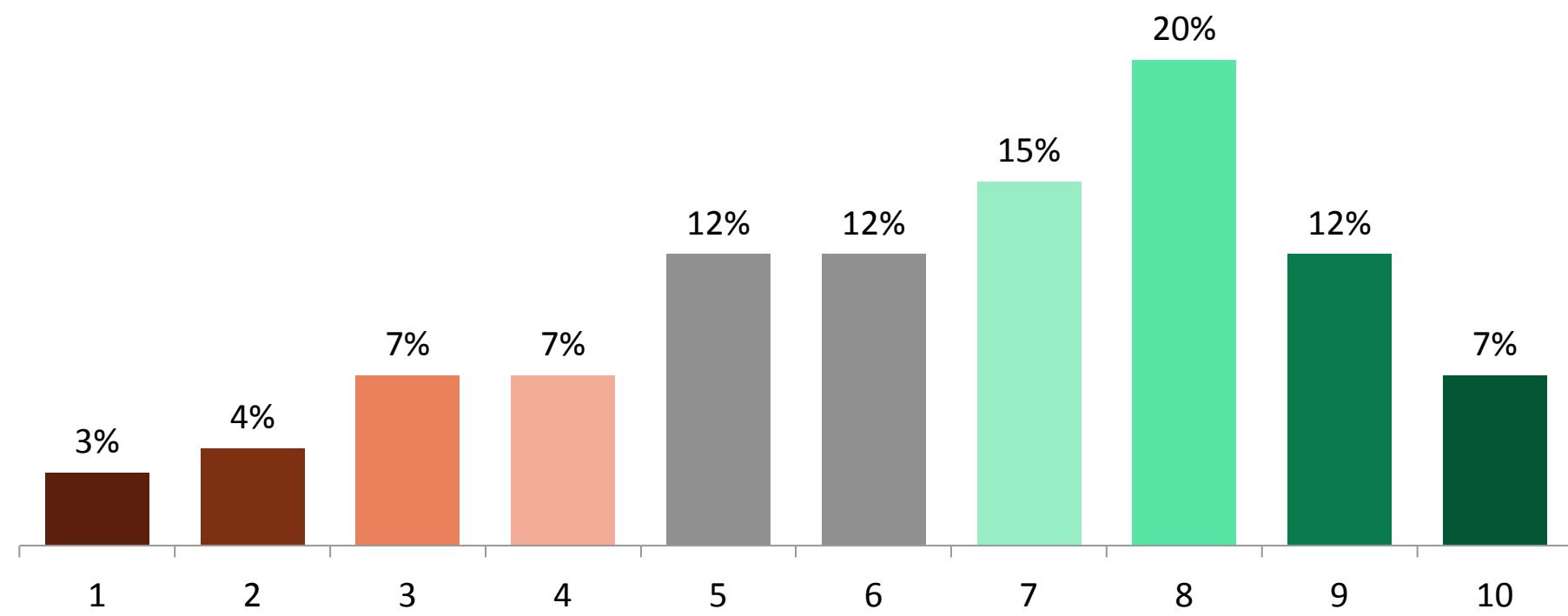
Measuring consumer interest

There has been a significant increase in demand for connected car infotainment features over the past year:

- 62% of US consumers are aware of the term "connected car," according to an AT&T and Ericsson survey. Further, Google Trends shows the search term "connected car" reaching new highs month after month.
- Among recent car customers in Germany, the US, and China, 37% agreed they would switch to another manufacturer if it was the only one offering a car with full access to applications, data, and media, up from 20% in 2014, according to a McKinsey survey.
- Asked which feature they valued the most in their car — its technology or its driving performance — the majority of global consumers surveyed by Accenture chose technology.

Global Demand For In-Car Technology Vs. Car's Driving Performance

Q: "What has more influence over your car-purchasing decision?"



The Car's Driving Performance Has The Greatest Impact

Source: Accenture Connected Vehicle Survey, 2014

The In-Car Technology Has The Greatest Influence

Apple CarPlay Vs. Android Auto

Apple CarPlay and Android Auto will likely be the dominant connected car infotainment platforms. Both platforms are extensions of each company's respective operating system and enable drivers to run a selection of their smartphone apps on a connected car's infotainment center. It's important to note that both CarPlay and Android Auto can run on the same car. Sixty-one percent of consumers believe it's either essential or important that their car have the same operating dashboard as their phone, according to an Accenture survey.

CarPlay has become popular in luxury vehicles

iPhone owners have historically been higher-income consumers, so it's no surprise that luxury vehicle makers have flocked to partner with CarPlay.

Several of the top cars unveiled at this year's Geneva Motor Show — which focuses heavily on high-end, luxury, and sports vehicles — were heavily marketing their inclusion of Apple's CarPlay, while Google's Android Auto was an afterthought, The Verge reported.

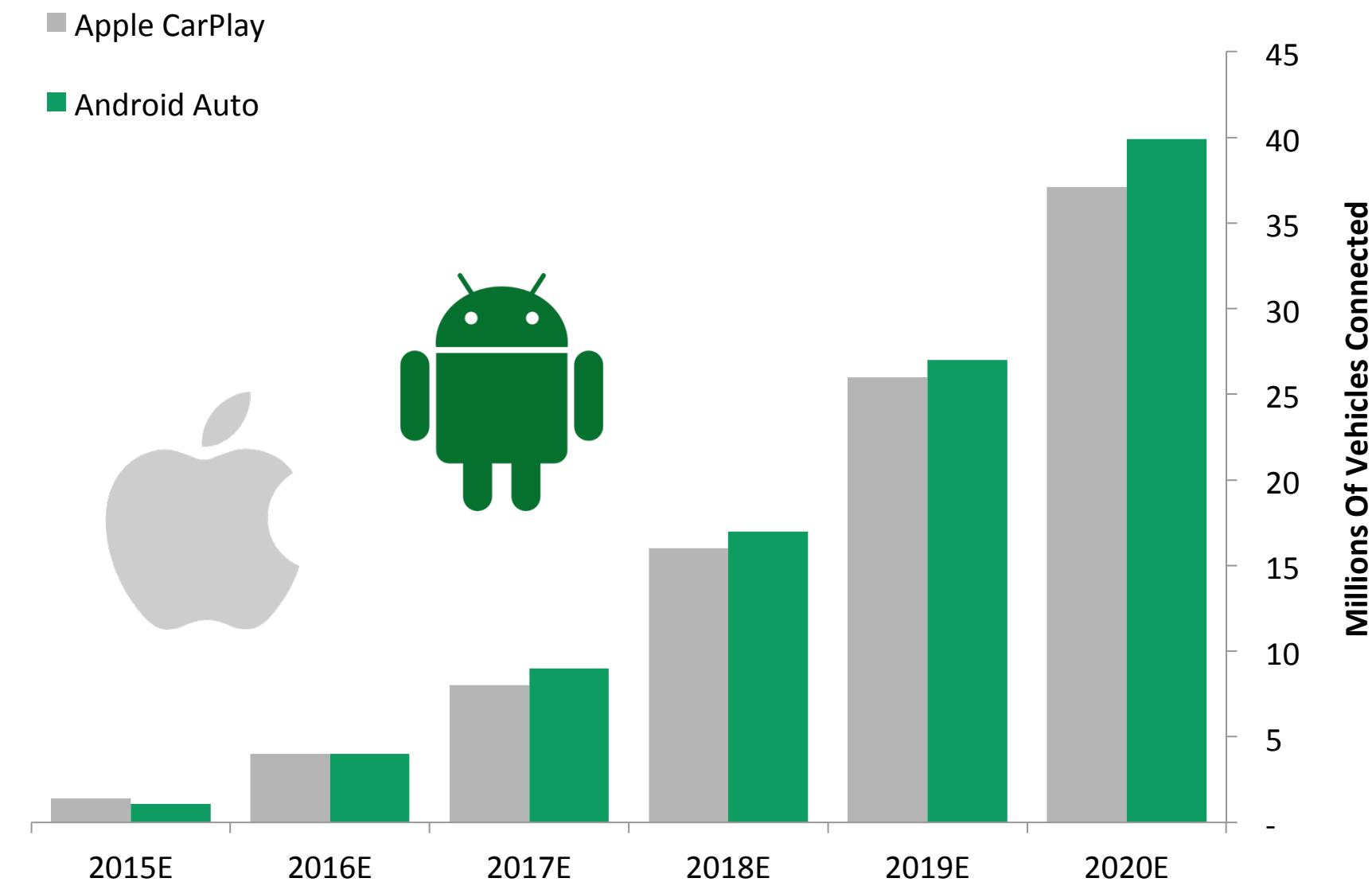
The new Maserati Levante, Hyundai Ioniq, Audi Q2, Koenigsegg Regera, and updated FIAT 500S all support both platforms, but these manufacturers are only marketing CarPlay as a key feature.

In 2015, we only saw a small number of vehicles with CarPlay built in. Since then, there have been many more automakers that have announced CarPlay availability in their 2017 models.

But Android Auto will be used by more consumers

We estimate 80% of new phones shipped at the end of 2015 were running Android. Android's larger market share means that more people will adopt Android Auto because they are already running Android on their phone.

Estimated Number Of Cars Globally Running Android Auto Vs. Apple CarPlay



Source: IHS, BI Intelligence Estimates, 2015

Top Connected Car Apps

Audio

Audio will continue to play a major role in car entertainment. Music applications, like Pandora, Spotify, etc., have been quick to embrace the connected car as the next major mobile device. Similarly, radio applications, like Slacker Radio and CBS Radio are currently streamed in Apple CarPlay. Similarly, some major league sports have created apps to stream the audio from games into the car. Finally, audiobooks apps, like Amazon's Audible, are making a splash in the connected car.

Maps

The smartphone quickly replaced GPS navigation systems, like Garmin and Tom and Tom, as a more cost-effective way to get mapping technology in the car. In the coming years, in-car infotainment centers may take the place of the smartphone in the car and will provide mapping technology applications. Google Maps and Apple Maps will likely find a new home in the car's infotainment center through integration in Apple CarPlay and Android Auto, respectively.

Messaging

Apple CarPlay and Android Auto have messaging technology embedded into the car. Using voice recognition assistants, like Siri and OK Google, the passenger can hear and dictate messages to the car. This helps the consumer remain connected and essentially text hands-free.



Tracking The Car's Usage Creates New Opportunities

A vast majority of today's cars are equipped with a special port that generates data about how a car is being used in order to give repair workers access to vital car information. Today's internet-connected cars, however, can generate the same information without the need for a plug.

Like a Fitbit for your car

Many startups and established tech companies offer special plugs and apps that track a car's activity. These plugs connect into a port called the car's On-Board Diagnostics Port (OBD-II). The Fitbit-like plugs can then track various aspects of the car, like its fuel consumption, engine temperature, amount of time driven, breaking habits, and more.

Today, automakers are bypassing the need for an OBD-II plug by directly sending car data to an automaker-branded app using the car's internet connection. Some apps, like Hyundai's Bluelink app, provide additional features on top of the features the OBD-II plug normally offers, like geofencing, automatic collision notification, remote unlock, and emergency assistance.

This means OBD-II plugs will likely be phased out over time as newer cars come with built-in diagnostics capability.



Sources: Dash, Amazon



Usage-based insurance

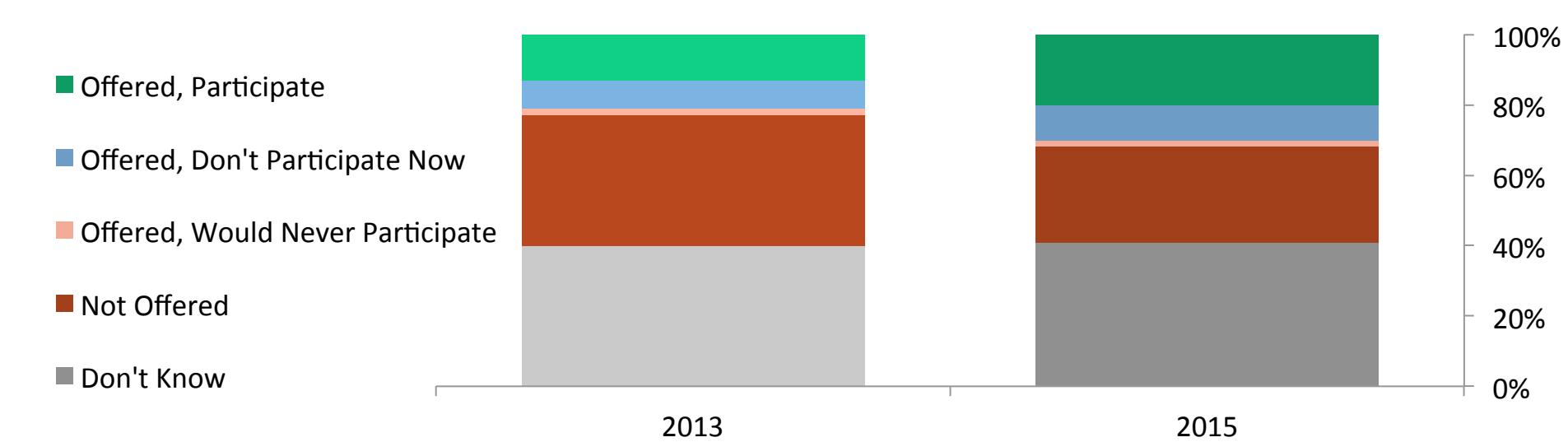
Currently, many auto insurers are offering clients the opportunity to potentially lower their premiums by allowing the insurance company to monitor their driving habits: If a driver's habits are deemed safe, the client's insurance bill could be reduced. This practice is called Usage-Based Insurance.

OBD-II plugs are currently the prevailing way that insurance companies collect driving information. The Progressive Snapshot, for example, programs the OBD-II plug to record changes in speed, how often customers drive, and the time of day they drive. Drivers use the device for 75 days, and they are then given their adjusted insurance premium rate.

However, there is a rising trend to utilize the data available from connected cars instead of the OBD-II plug. State Farm has partnered with Ford's SYNC platform, which enables drivers with an active SYNC account to have their vehicle monitored by State Farm for a discount on their policy.

Americans Use Of Usage-Based Insurance

Q: Does your primary insurance policy offer you a discount for installing a device that monitors your driving behaviors?



The Next Evolution Of The Car Is Here

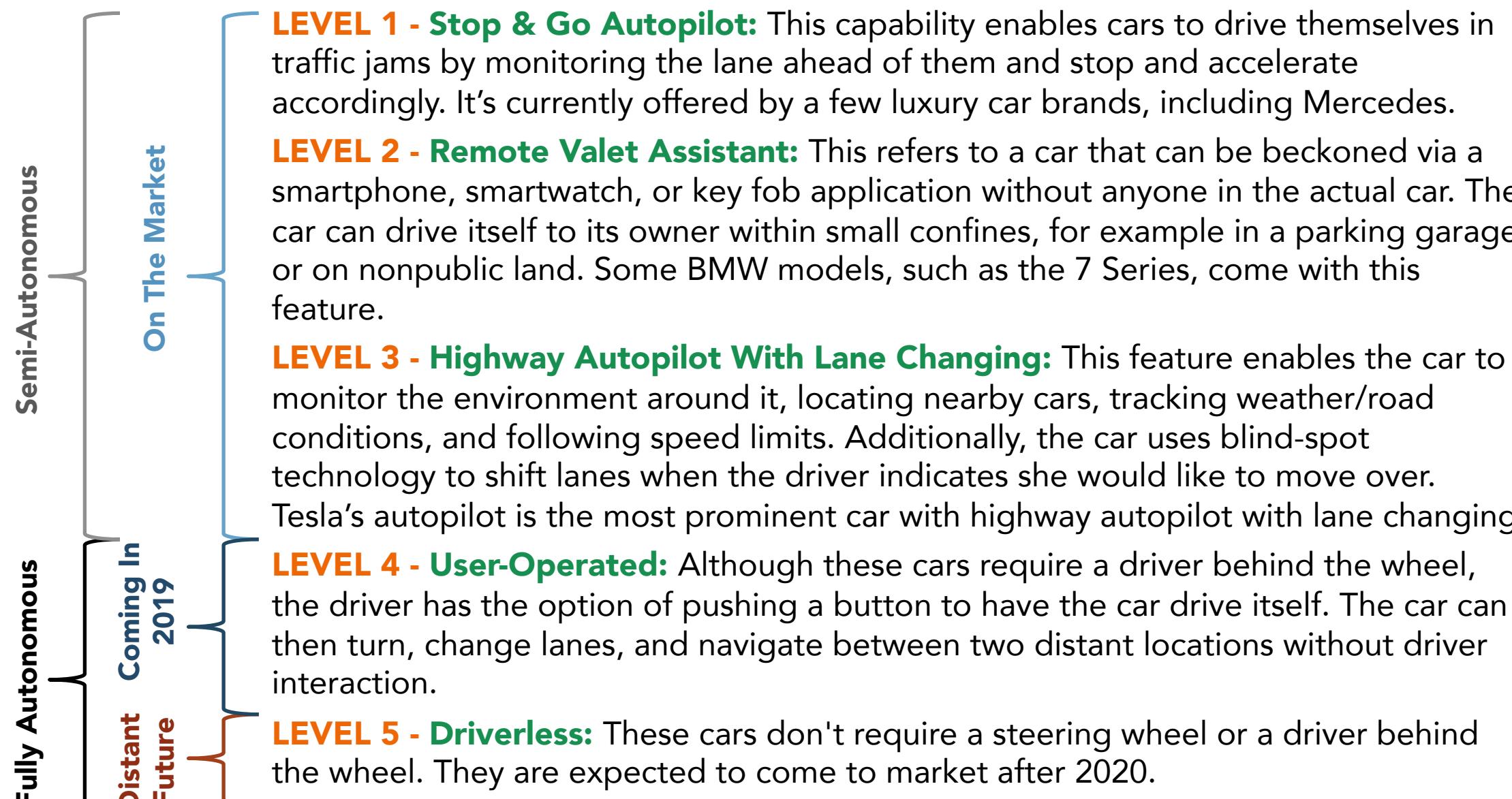
The futuristic idea of a car that can drive itself is quickly becoming a reality. But to get to that point automakers and tech companies will have to overcome many barriers, such as regulations, gaining consumer trust, and perfecting the technology. Therefore, reaching that level has been, and will continue to be, a step-by-step process.



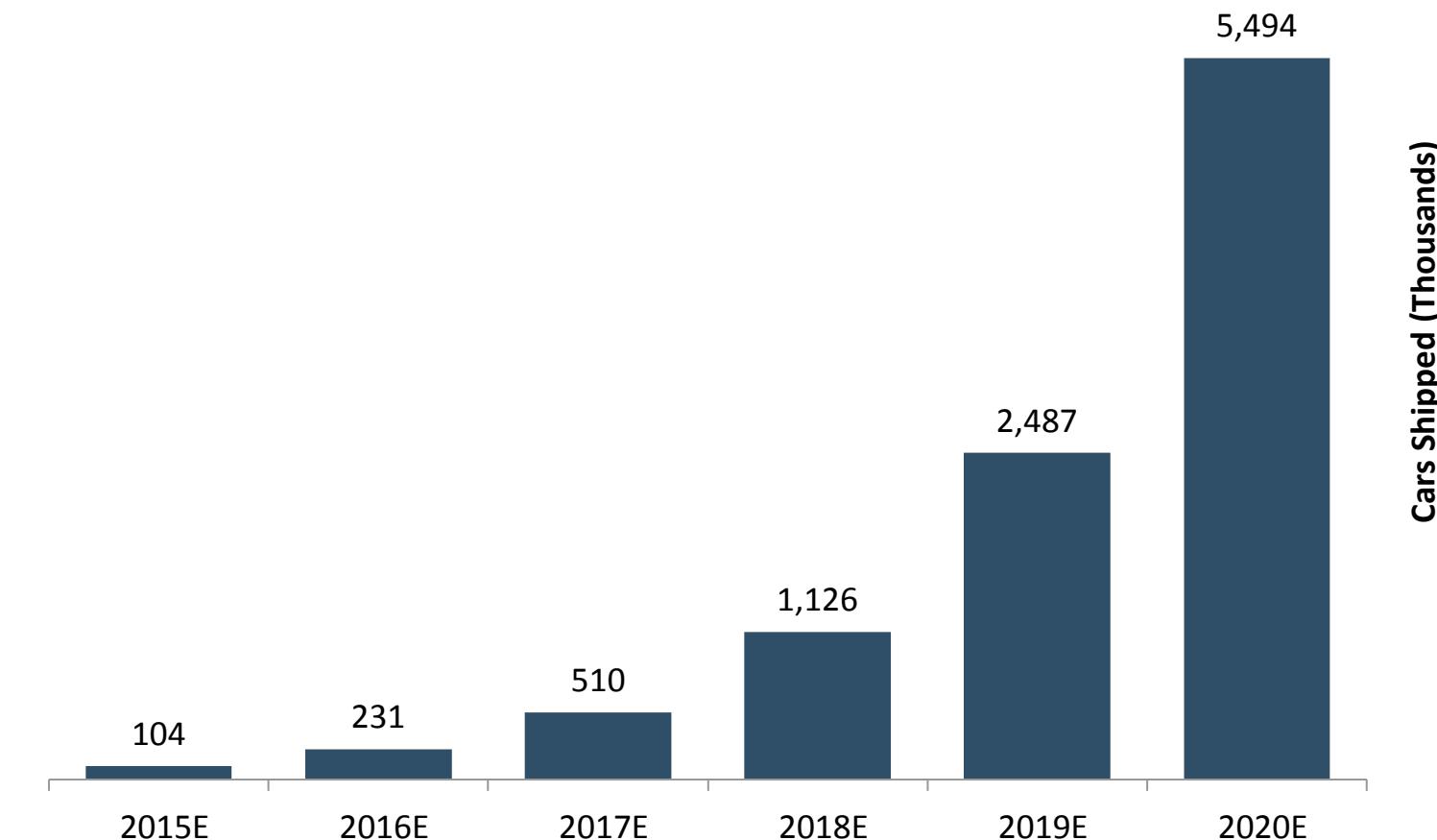
What is a self-driving car?

Self-Driving Car *n.* Any car with features that allow it to accelerate, brake, and steer a car's course with limited or no driver interaction.

Here are the different levels of semi-autonomous and fully autonomous driving capabilities and the order in which we expect these technologies to come to market:



Global Self-Driving Car Shipment Forecast



Source: BI Intelligence Estimates, 2015

Fully Autonomous Cars Are Three Years Away

Fully autonomous cars have the potential to be the most revolutionary technology of the next 20 years. They could disrupt shipping industries — as evidenced by Mercedes' self-driving truck — taxi industries, and even the ownership model of cars. But reaching the level where a car can fully drive itself from point A to point B without driver interaction will be difficult because technology needs to be continually improved, legislators have to create regulations around self-driving cars, and consumers have to trust the technology.

When will there be a fully autonomous car?

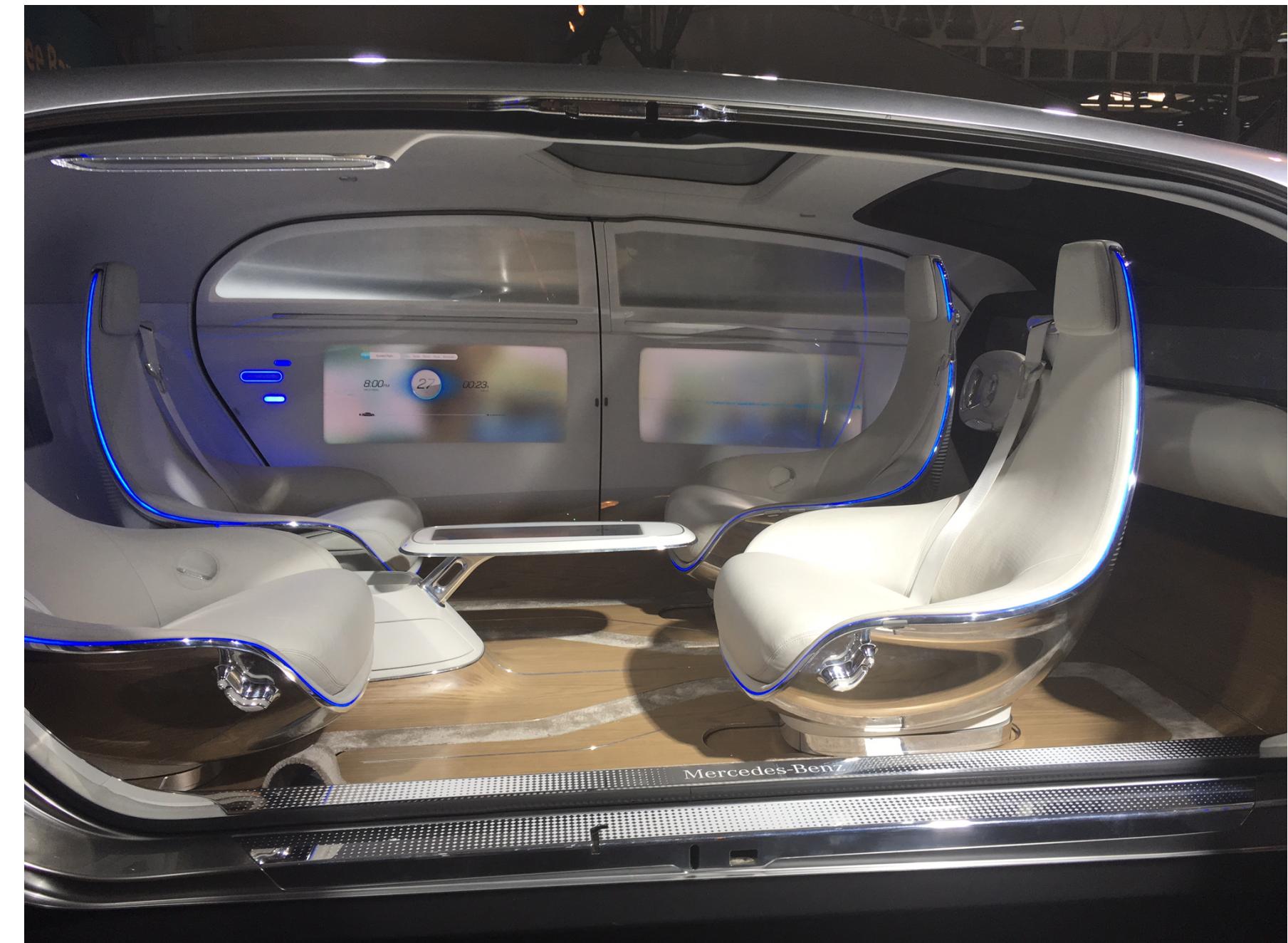
BI Intelligence expects the first fully autonomous car, or a car that can drive from point A to point B without driver interaction, to be available in at least one consumer market in 2019. This car will be a user-operated car, meaning that there will still need to be a driver behind the wheel.

We believe user-operated cars will have to come before driverless cars to convince consumers and regulators that the technology is safe. In addition, insurers and legislators will need to determine liability in a car crash with a fully autonomous car.

We believe significant advancements in fully autonomous technology have occurred over the past two years and automakers are adamant about getting a fully autonomous car on the road. Once the technology has been proven, driverless cars will follow. For driverless cars, the question isn't if, but when.

Who do consumers trust to make it?

When it comes to fully autonomous cars, 46% of global consumers believe a traditional automaker would be the most trustworthy entity to build such a car, according to a recent World Economic Forum survey. But 69% of global consumers want the automakers to work with tech companies. Only 10% of consumers want the automakers to work alone.



Daimler's vision for the future of the car showcased at Mobile World Congress 2016

Will Tech Companies Be The Next Automakers?

Tech companies like Google and Baidu have made it clear that they are trying to get into the automotive space, primarily by working on self-driving technology. In addition, for the past year rumors have swirled that Apple might be making its own car.

Building cars on a large-scale is difficult

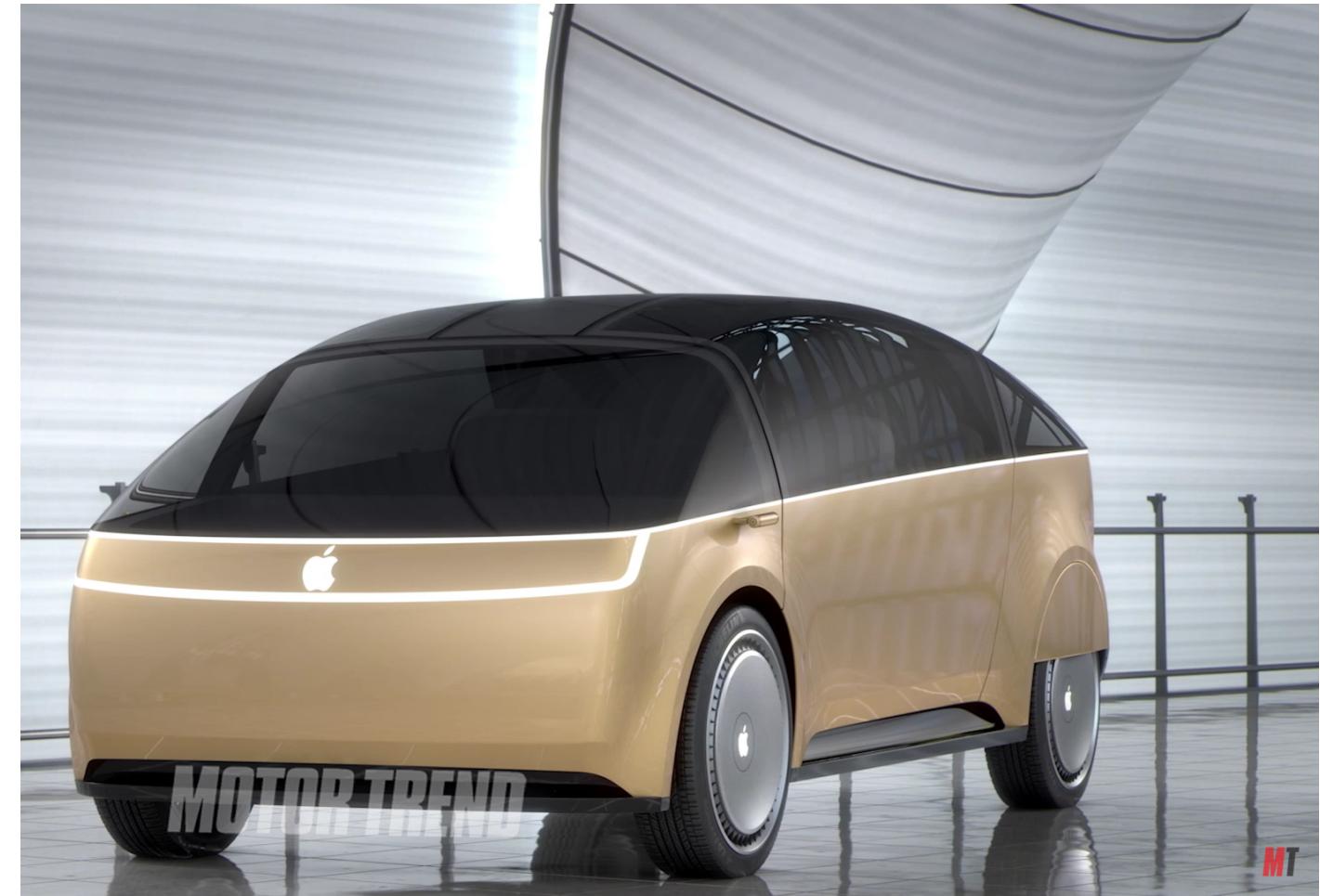
Although Apple has not confirmed it is building a car, if you ask the larger automakers, many of them state that they'd be happy to see Apple enter the market and aren't worried about losing a significant market share. Why? Primarily because **it is so difficult and costly to build the components required to produce a car on a mass-scale.**

Tesla, which is the most recent success story of a car manufacturer startup, has owned a former GM factory since 2010 but is still aiming to ship only 80,000-90,000 Tesla models in 2016. By comparison, BMW, which is a mid-size automotive company, produced over 2.2 million cars in 2015.

Other motives for making a car

Google's Chris Urmson, the project director of the self-driving car, recently stated at South by Southwest that Google wants to remain a platform and does not want to manufacture cars.

It's more likely that Google's self-driving car project is taking aim at ride-sharing apps, like Uber and Lyft. Hypothetically, Google could partner with a car manufacturer to integrate its driverless technology into a line of cars and then will run a platform to provide rides. In addition, providing driverless cars could also strengthen other business areas of Google. For example, because Google owns the car they could use the car to advertise directly to the passenger. This would be similar to how public busses and trains have advertising on them. Further, they would get a better understanding of the passenger's habits, like where they are going, and could build more targeted ads.



Source: BI Screenshot/Motor Trend Channel

Will The Car Ownership Model Change?

Over the last five years, the auto industry has been in a panic. The assumption was that millennials wouldn't purchase cars, but would instead rely on rental services like ZipCar, or ride-sharing applications like Uber and Lyft. However, in 2015 JD Power found that US millennials accounted for 28% of new car sales in the US, behind only the baby-boomer generation. The takeaway: Millennials are actually buying cars.

But will that hold steady as car-hailing app services grow and on-demand rental services, like ZipCar, are launched by automakers?

The key factor is the increase in urbanization

Approximately 66% of the global population is expected to live in an urban environment by 2050, according to data from the World Bank. Cities will become more crowded and expand outward. This will make traffic more of a problem and sharing more possible. Car-sharing apps offer an opportunity to minimize congestion and maximize the sharing of resources.

We believe the rise of urbanization will increase the use of car-sharing apps like Uber and Lyft.

Automakers are wising to this trend and starting to launch their own services. A variety of automakers including BMW, GM, Ford, and Daimler run their own car-sharing services similar to ZipCar.

Driverless cars could set this over the edge

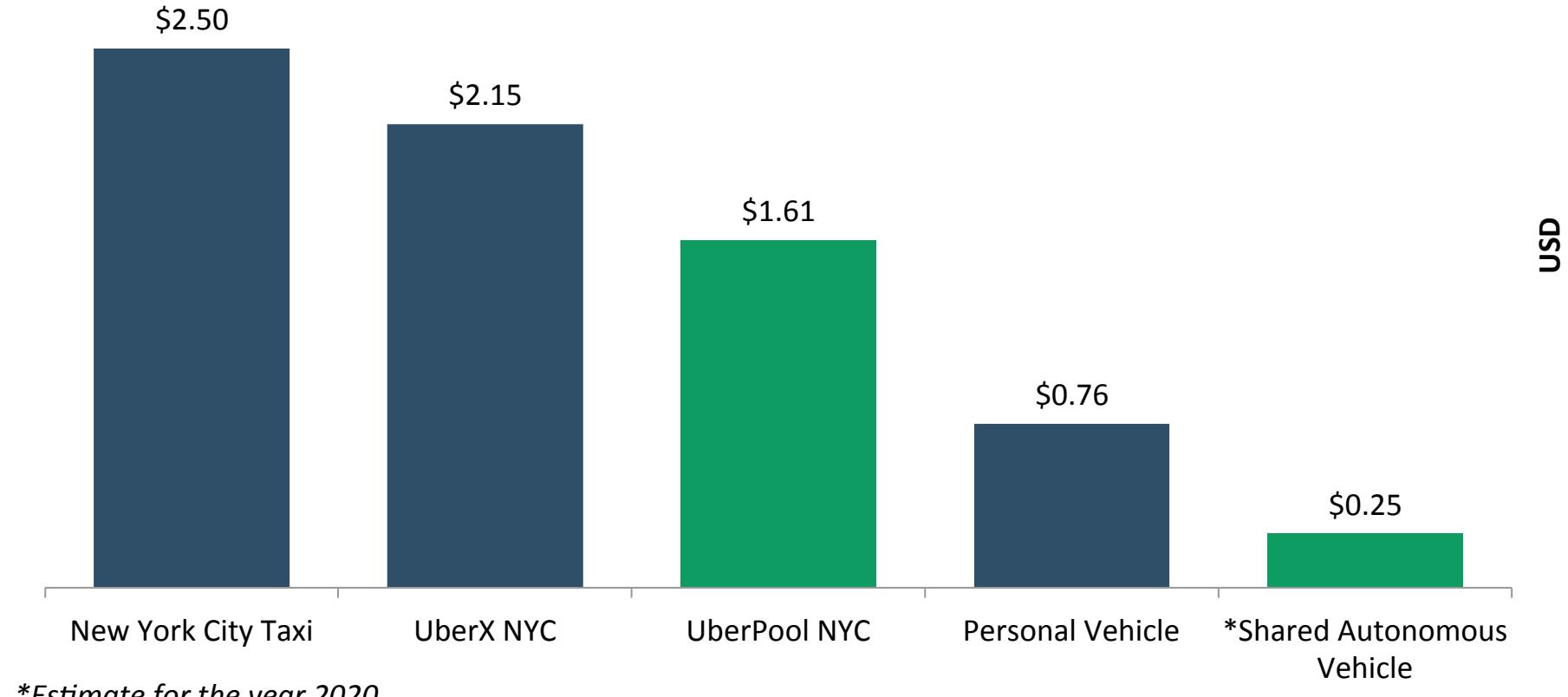
Recently, it was reported that Google would spin off its self-driving car division to become an Uber competitor, rather than sell self-driving cars directly to consumers. Likewise, Uber announced in February that it was partnering with Carnegie Mellon University to work on fully autonomous technology.

If the companies are successful in creating a fully autonomous car service, it could be a very lucrative business. By cutting out the driver, companies could earn 100% of the fare. This would significantly drive down the cost for ride-sharing riders.

What to watch for in the short-term

A small but noteworthy trend in the industry is that automakers are trying to shift away from the car-selling model to a long-term leasing model — such as 100 years — to deal with the challenges around software manipulation in the age of the connected car. Leasing would prevent the consumer from accessing or manipulating the vehicle's software. The US Copyright Office under the Digital Millennium Copyright Act has said consumers can alter the software in their owned vehicles.

Estimated Cost Per Mile Of Vehicle Services For Consumers



The Barriers

Both the connected and fully autonomous car market face many barriers. For automakers in the connected car market, the primary barrier is the availability of cellular connection and smartphone adoption. For the self-driving car industry, the barriers are regulatory and winning consumer confidence.

Connected car barriers

Lack of mobile infrastructure: In developed nations, this barrier is relatively nonexistent because 3G connections are ubiquitous. It's a different story in emerging markets where only 69% of the population is connected to the internet.

However, it's important to note that developed nations account for the vast majority of car purchases, and over time it's expected that emerging markets will continue to build out their mobile infrastructure. This expansion will enable car makers to embed connections in all of the vehicles they sell.

High cost: For consumers, the primary barrier to adopting in-car technology is the high cost of a connected infotainment package, which most often requires an ongoing subscription fee. In addition, there is often a subscription cost for wireless data. About one-third of consumers in Germany, the US, and China are willing to pay for connected services on a subscription basis. Although this has grown since last year, the percentage of people willing to pay for such services is low.

Fully autonomous car barriers

Technical requirements: There are still many technical problems that automakers have to overcome to perfect the fully autonomous car to be able to adapt to all of the different scenarios a car faces. For example, how can the driverless car react to environmental conditions, like snow or dust.

Consumer trust in the technology varies: More than half (58%) of global consumers are likely to take a ride in a fully autonomous car, and more than one-third (35%) would be willing to let their children ride in one, according to a World Economic Forum Survey. So while consumers are willing to ride in fully autonomous vehicles, they don't trust them enough to let their children ride in one.

Regulations are relatively nonexistent: While there has been progress in setting up new regulations, the lack of standards is making it difficult for automakers to release a fully autonomous vehicle.

Cybersecurity barriers

Carmakers are not doing enough to prepare for the possibility of security hacks of connected or autonomous cars. Seventy-five percent of automakers do not have a countermeasure strategy in place should their vehicles undergo a hack, according to a McKinsey survey. Similarly, only 30% work with "white-hat" hackers — specialists who look for vulnerabilities and then help the automaker patch any exploits.

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