



The Connected Vehicle: Viewing the Road Ahead

A digital dashboard overlay with a dotted border, divided into four sections:

- Autonomous Driving Off**: A steering wheel icon and the text "Autonomous Driving Off".
- Message Alert**: An envelope icon and the text "Message Alert" and "1 Message Unread".
- Tablet Battery Charging**: A battery icon and the text "Tablet Battery Charging" and "90% Charged".
- Music**: A music note icon and the text "Music" and "Playlist on Shuffle".

The background of the dashboard shows a road with a blue navigation line and a location pin.



High performance. Delivered.

Introduction

In the past decade, auto manufacturers have installed various technologies designed to make cars safer, more responsive, and more pleasurable to drive. From the hands-free cellphone, to iPod berths, to satellite radio, to automated parking—not to mention Google's self-driving vehicle—the automobile is undergoing an electronic overhaul that promises to transform its role for consumers. What once was perceived as personal transportation is fast evolving into a new mobile device, merging with the digital world into an all-encompassing communications environment.

This ongoing transformation is poised to shift into high gear as cars display still greater connectivity and broader capabilities than ever. What makes this shift different from the way automobiles adopted new technologies in the past is that this time, automakers may have to consider how they can quickly merge consumer electronics and software with their traditional automotive systems.

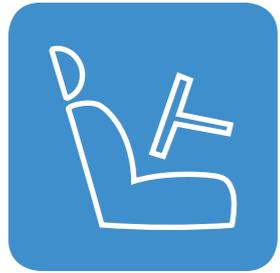
Moreover, the consumer—whose platform preferences have already been made clearly and decisively known in the electronics marketplace in general—could exert a greater influence on the automotive industry as well.

The overwhelmingly broad acceptance of technologies from Apple, Google, and Microsoft will easily spill over into the automotive interior. This shift could have major implications for automotive OEMs.

As consumers express their preference for the in-vehicle technologies, form factors, and brands they have grown accustomed to using elsewhere in their lives, automotive manufacturers may be forced to follow suit. In other words, if automobile Brand X is the first to offer Apple CarPlay™ to rave reviews and brisk sales, can other carmakers afford to stand by idly and watch?

This paper examines the key trends affecting the connected vehicle, the role of the consumer in deciding these technologies, and the likely role that third-party technology leaders such as Apple, Microsoft and Google may play in determining in-vehicle technologies. We also look at how the concept of the connected vehicle extends to services in a B2B setting—such as fleet management—and the importance of vehicle use data collected by telemetry technologies to OEMs' connected vehicle services.

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the driver seat



Good timing
for the
connected
vehicle



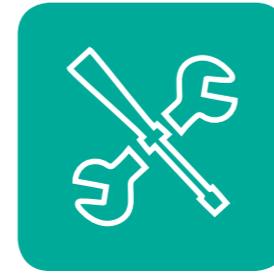
Non-passenger
cars welcome



Looking down
the road



Connected
vehicle will
spawn business
opportunities



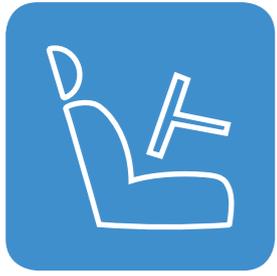
How to make
the connected
vehicle a reality



Mobile device
the gateway?



How should
companies
prepare for this
market?



Consumer in the driver seat

Positive consumer attitudes toward a variety of technologies and services in vehicles, such as reports on the vehicle's health and maintenance, are driving these changes. According to Accenture research, some of the most popular features are safety-oriented.

These include fully automated parking, lane-changing warnings, lane-keeping systems, collision warning devices, emergency calls, and automatic braking that prevents the car from running into an object.

In fact, consumers so heavily favor the purchase of a vehicle based on its in-vehicle technology options, that performance—traditionally

one of the top factors swaying a purchase decision—takes a back seat. Drivers are twice as likely to choose a car based on its technology options than on its performance according to Accenture research.¹ For example, some 39 percent of drivers surveyed said their primary consideration in choosing a new vehicle is in-car technology.

This compares with 14 percent who said driving performance was the biggest influence on their choice.

Nor is this preference confined to the traditional automotive markets. Consumers in emerging markets were similarly favorable toward in-car technologies. Accenture research found strong demand from consumers in emerging markets, as drivers

in China, Brazil, Indonesia, and Malaysia expressed the greatest interest in all of the connected vehicle technologies and digital capabilities currently available and used widely by consumers in more mature markets.

¹ Accenture Connected Vehicle: What Drivers Want 2014 research - <http://www.accenture.com/us-en/landing-pages/products/Pages/connected-vehicle.aspx>



Good timing for the connected vehicle

Several factors have converged to make the connected vehicle not only possible today, but essential from a consumer view. For one thing, barriers that once made machine-to-machine communication difficult to achieve are coming down across the board.

With the smart home equipped with sophisticated electronics—entertainment, energy management, security, and other systems—as well as emerging “smart city” applications such as parking location, intermodal transportation, and traffic control, it’s no wonder consumers are waiting for the “next big thing.” Indeed, there is pressure to not only meet, but exceed, customer

expectations for interaction between devices, and for digital intelligence to augment the consumer’s physical experience.

The auto industry is responding with innovations of its own—often led by newcomers that are changing the industry paradigm, such as Google with its autonomous driving car, Tesla with the electric vehicle, or Daimler with its car2go™ car-sharing business.

Some 90 percent of survey respondents² expressed an interest in some autonomous driving options, primarily those related to safety. This demand for aspects of autonomous driving has already encouraged automotive OEMs, regulators, and industry organizations to address the current barriers to widespread use of such technology as Google’s driverless vehicle ([see sidebar article](#)).

² Accenture Connected Vehicle: What Drivers Want 2014 research - <http://www.accenture.com/us-en/landing-pages/products/Pages/connected-vehicle.aspx>

Another reason the connected vehicle is timely is the convergence of a robust ecosystem offering a fertile environment for in-vehicle innovation. Numerous companies and parts manufacturers serve this developing industry, including automotive OEMs, telecommunications operators, consumer electronics firms, and software and application developers.

A final factor is the general evolution of the automobile system. The automobile traditionally has been a closed system whose offerings were dominated by the automakers themselves. If a third party wanted to develop an application to play in the vehicle interior, they first had to go through the carmaker. Now, however, the convergence of consumer electronics in the car portends a change in that relationship, one that could well reduce the OEMs' purview.



Non-passenger cars welcome

The connected vehicle concept is inherently flexible, enabling the application of in-vehicle technologies to industrial vehicles and heavy equipment.

Industrial vehicles can benefit from a telematics platform capable of transmitting a collection of data from their machines on a global basis.

Heavy equipment operating in remote locations can send engine performance, fuel consumption,

mileage, and other data to a central site for processing and necessary follow-on servicing.

Vehicle data is sent to the connected vehicle platform, with real-time processing of the data enabling decision-makers to act on fuel consumption and other service-related trends.

This could be beneficial to a host of industries—including agriculture, insurance, health, advertising, and location-based services such as couponing and other business promotions—and represents a promising, and potentially very profitable, revenue stream for carmakers.



Looking down the road

With in-vehicle technology currently undergoing a rapid transformation, consumers can expect to see a variety of different telematics solutions in their cars before a common platform is adopted by the community of automotive OEMs.

One factor slowing the in-vehicle transformation is the fact that consumer electronics continues to evolve faster than the OEM electronics in vehicles. For instance, the lifecycle of the consumer cellphone is minimal compared to that of commonly accepted technology inside a personal auto.

In one scenario, a lightweight "silver box" in the car would provide basic Bluetooth connectivity to all technology in the vehicle, but at the same time open to potential upgrades or apps that would enable greater longevity for the technology.

A critical factor is the need for standardization to enable true portability. For instance, consumers could bring their own user interface to this box in the form of their tablet or smartphone and immediately enjoy the full connectivity to which they are accustomed.

If the connectivity between the tablet and silver box is standardized—say, for instance, it's a common USB-enabled "docking station"—then interoperability across different cars becomes possible. To this end, joint ventures may develop between car manufacturers and consumer technology companies.

The current in-vehicle display size also is likely to expand to accommodate a host of new capabilities, some of which the driver or passenger would access when the vehicle is parked or stopped. The current size of six or nine inches could be eclipsed by larger displays that could handle

the many applications that will find their way into the vehicle to add convenience for the driver.

For instance, the display could feature a "smart" instrument cluster that includes traditional dashboard indicators as well as those related to infotainment options, such as the one on the 2015 Audi TT concept car previewed at the 2014 Consumer Electronics Show.³ The display also could more closely duplicate the experience consumers are accustomed to when using their current computing devices—such as a laptop that might have scores or even hundreds of different applications—and

could offers consumers the opportunity to extensively personalize the user interface.

Importantly, displays likely will support different interfaces for various people in the car. For instance, the driver will need a dedicated interface linking to specific content related to vehicle performance, road conditions, and vehicle status. Front-seat passengers will need a separate interface to other content, such as access to the radio controls and navigation. Passengers in the rear of the vehicle will want a third interface, providing access to entertainment content such as videos and music.

³ <http://www.themotorreport.com.au/57982/audi-reveals-new-tt-interior-at-consumer-electronics-show>



Connected vehicle will spawn business opportunities

The ability to source data from vehicles will enable a range of new business-to-business and business-to-consumer digital services, Accenture believes.

For example, data sourced from vehicles could be used to enable a portfolio of value-added consumer services such as vehicle diagnostics, driving dashboards, and concierge services. These could be delivered to drivers through multiple devices—a vehicle's head unit, or a driver's smartphone or tablet.

As the connected vehicle becomes more of a reality, automotive manufacturers also will find it essential to upgrade their online offerings to consumers. With connected vehicle technology rapidly becoming a key car-purchasing criterion, consumer expectations for greater responsiveness to their

needs and desires will require that manufacturers provide more customized, interactive websites to better aid consumers' car-buying decisions.

For instance, based on Accenture's survey findings, the industry should consider adopting digital innovations such as web chat and mobile-enabled websites.

These technologies can not only further enhance the consumer's digital shopping experience, but also enable automakers to stay in closer touch with customers while they own their cars—to strengthen loyalty and to provide offers for after-sales maintenance services, vehicle parts, or even vehicle repurchase.

Importantly, automakers will need to ensure their cars are equipped with over-the-air downloading capabilities to deliver regular updates and new content to the onboard system without the need for user intervention.

The connected vehicle also could spawn new opportunities for businesses in various industries, including agriculture, insurance health care, and advertising, among others. In agriculture, for instance, vehicles could be equipped with a core set of functionalities common

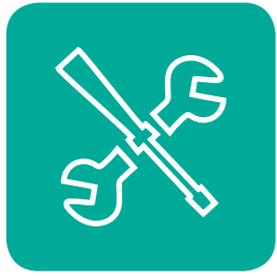
across all industries, and then a set of differentiated vertical applications specific to the needs of agribusinesses.

[Valuable predictive maintenance and remote diagnostics services for agricultural and construction equipment also could be supported by more sophisticated vehicle connectivity.](#)

As long as cars are equipped with OEM systems for connectivity, automakers will have the opportunity to gather a wide range of data from their vehicles and work with specialized service

providers to resell that data to interested parties. For instance, vehicle use data is valuable to such enterprises as fleet operators, rental agencies, and service firms.

Equipped with information on vehicle usage, insurance companies could bill their customers based on the mileage driven. Auto manufacturers, in effect, have an opportunity to create a new line of business as information brokers to complement their traditional role as vehicle producers.



How to make the connected vehicle a reality

For the connected vehicle to become a mainstream reality in the auto marketplace, cooperation among key players in key industries—automotive, telecommunications, and electronics—is essential.

This industry cooperation—and, to an extent, standardization—is being promoted by such efforts as the GENIVI Alliance, a nonprofit industry group committed to broad adoption of an open-source development platform for a variety of In-Vehicle Infotainment (IVI) services, and the Open Automotive Alliance launched by Google.

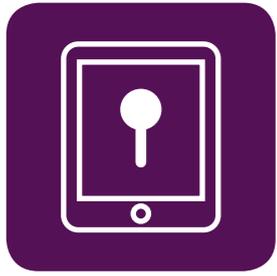
The development of the market for telematics already has progressed for several years, so that auto

manufacturers have begun to install their own systems. Ford's SYNC™ is the first example of the vehicle being opened to a community of developers. A development platform, SYNC allows developers to build their own applications that run on a smartphone that is, in turn, connected to the vehicle and its onboard systems. While controlling the apps that run on SYNC, Ford has positioned itself in the vanguard of the trend for automakers to open their vehicles to enable

consumers to take advantage of connected vehicle services beyond those the OEM provides.

Also pursuing telematics solutions are large telecommunications providers, which have embarked on a variety of efforts to push the connected car forward. Some providers are acquiring companies with telematics capabilities, and others are teaming directly with automotive manufacturers.

Finally, there is the role of technology giants such as Apple, Google, and Microsoft. As leaders in the personal communications market, they exert a huge influence on consumer desires, habits, and expectations for technology. The role they play in the development of in-vehicle systems could have a major influence on the technologies and platforms that ultimately become preferred by consumers and adopted by auto manufacturers.



Mobile device the gateway?

One reason for this is that many of the solutions for the connected vehicle are based on the premise that consumers will bring their own device—i.e., the smartphone or tablet—into the vehicle.

Thus the mobile device, in effect, becomes the gateway between the various technologies that connect within and outside the vehicle, including navigation, entertainment, and the reporting of vehicle health data.

Of course, when it comes to the smartphone as gateway to in-vehicle technology, Apple has to be viewed as the elephant

in the front seat. Apple recently announced a new system called Apple CarPlay™, which considers the vehicle as an accessory to the iPhone. Consumers will be able to attach different accessories to the iPhone, including their vehicles. Google announced a similar technology, called Projected Mode™, and Microsoft has its own solution.

Apple's CarPlay represents a potentially disruptive technology for auto manufacturers, which traditionally have controlled the human-machine interface in the vehicle, including much of the technology that consumers use today to access entertainment systems.

In many cases, the actual branding of a carmaker is reflected in each OEM's human-machine interface in the vehicle, including variations in the control device (joystick or touchscreen, for example), the color, the background materials, buttons, etc.

For this reason, carmakers will see the incursion by the Apple platform as a possible threat to their control of in-vehicle technology.

By contrast, if consumers expect to bring their iPhones into the vehicle as the primary source or gateway to the car's infotainment systems, Apple could become the user interface for in-vehicle infotainment. In other words,

Apple would completely control the user experience into the vehicle the same way it does for the applications for smartphones, the iPad, and the iPod. With CarPlay, Apple promises to bring the dynamics of the Apple stores and smartphone applications into the vehicle.

This, of course, would be much appreciated by car buyers, who would view it as a means to further enhance their driving experience via a common technology that has become a de facto consumer standard.

Android Auto™, Google's answer to CarPlay, could be similarly disruptive. It enables a driver to

plug his Android phone into a car's console and turn the car's center display into a large-screen interface for the phone. The in-vehicle infotainment system is expected to be offered in cars from the 40-plus companies that are members of the Open Automotive Alliance.

In effect, the smartphone and the vehicle's own embedded communication system become the two most important pieces of the connected vehicle. Most solutions in the market today are based on either of these two platforms, and in some cases, on both.



How should companies prepare for this market?

The promise of the connected vehicle is huge—affording the winners in this market increased sales and new business opportunities.

At the same time, making a variety of different technologies come together in a smooth and coordinated fashion presents a significant challenge for auto manufacturers.

Carmakers also must be able to negotiate the challenge posed by big players such as Apple, Google, or Microsoft, whose powerful sway in the consumer marketplace could ultimately enable them to dictate the user interface in their vehicles.

Another important service provider in this market is the telecommunications industry, which, because of its regional and global fragmentation, could require separate solutions for different players. Finally, there are the content providers, the satellite radio companies and other infotainment services that will help create a rich experience for the consumer.

Regardless of which industry they are in, companies must be open to new business models, as well as the need for cooperation with other players to enable business-to-business services. A major facilitator of such cooperation will be a standard platform—such as the open-source, in-vehicle infotainment development platform favored by the GENIVI Alliance—that enables third-party providers of services to develop their own vertical applications.

Ultimately, what's needed is a consistent solution among automobile manufacturers, technology providers, telco companies, and content providers that provides the functionality and user experience that customers have come to expect—and demand—from their mobile devices. Even if that device parks in their garage instead of in their purse or briefcase.

Google's self-driving car—Is the future already in your rear view?

Since 2009, Google has been trying out a fleet of driverless automobiles.

As of May 2014, the company has had its employees driving the cars on the freeway and most recently on the streets around Google's headquarters in Mountain View, California, where the cars have racked up a total of 700,000 miles.

Chris Urmson, director of Google's self-driving car concept outlines on Google's official blog how city driving is more complex and how they have improved the software so it can detect hundreds of distinct objects simultaneously—pedestrians, buses, a stop sign held up by a crossing guard, or a cyclist making gestures that indicate a possible turn.⁴

While the Google self-driving cars until recently were occupied by employees, the company has begun testing two-seat prototypes with no steering wheel, accelerator pedal, or brake pedal. While the only driver controls are a red button for panic stops and a start button.

⁴ The latest chapter for the self-driving car: mastering city street driving, Google Official Blog, May 28 2014. <http://googleblog.blogspot.fi/2014/04/the-latest-chapter-for-self-driving-car.html>

Google plans to build a fleet of these prototype electric vehicles that can be summoned via a smartphone app. Their top speed is 25 miles per hour, with a range of about 100 miles and it's a sign driverless cars are a step closer to transforming transportation.⁵

In the next few decades, self-driving cars are expected to become more mainstream as both consumers and regulators become comfortable with their use on the road.

By 2030, autonomous-driving-capable vehicles will represent approximately 25 percent of the passenger vehicle population in use in mature markets.⁶

⁵ *Can Google Keep Its Self-Driving Car From Re-Igniting More Suburban Sprawl?*, *ClimateProgress*, May 30, 2014. <http://thinkprogress.org/climate/2014/05/30/3442311/self-driving-sprawl/>

⁶ *Maverick Research: Crashing Industries and Our Societal Beliefs – The Real Implications of the Autonomous Vehicle*, Gartner, Published: 3 October 2014



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