How Software Will Shape the Future of Driving

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Introduction: What the Future of Driving Looks Like

One of the top tech stories over the past five years has been the development of autonomous vehicles. Once something seen exclusively in science fiction movies, today the market for autonomous vehicles is projected to reach more than USD 556 billion by 2026[1]. And while the technology is still in its infancy to a certain extent, industry analysts predict that autonomous vehicles will make up about 10 percent of all vehicles (commercial and consumer) by 2034[2]. With over 1.5 billion cars currently on the road today, that would be about 142 million autonomous vehicles in the near future.

Today, consumer and commercial vehicles with limited autonomous driving capabilities are already available for purchase, with every major car manufacturer working to develop and enhance the technologies fueling this driving revolution. But to get an idea of what the future looks like, it's important to understand the six levels that define autonomous driving.

Levels of Autonomous Driving

0 **No Automation**—Vehicles have no autonomy whatsoever.
1 **Driver Assistance**—Vehicles are controlled by the driver, but the vehicle offers driving assistance features.
2 **Partial Automation**—Vehicles offer "combined automated functions" such as speed and steering, but the driver must maintain control of the vehicle and retain awareness of the driving environment.
3 **Conditional Automation**—Vehicles can operate at a low level without the driver, and the drive must be ready to take full control of the vehicle at any moment.
4 **High Automation**—Vehicles can perform all driving functions without the driver's assistance, but only under certain conditions (highway only, for example).
5 **Full Automation**—Vehicles are fully autonomous, performing all driving functions in any condition. Drivers have the option to control the vehicle, but do not necessarily need to do so.[1]

1 https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

Most semi-autonomous vehicles available on the market today hover between levels one and two. For example, cars equipped with cruise control are considered level 1. Level five autonomous vehicles are actually already in existence and are being tested, refined and improved so they can one day be mass marketed. At some point in the future, it's almost certain that autonomous vehicles will hit a critical mass, and we can expect that driving will look dramatically different than it does today.

Imagine: Fleets of vehicles that drive themselves entirely independent of human input. This possible future is devoid of traffic jams and deadly accidents, while time spent in transit will likely look more like leisure time with passengers watching movies, reading books, or just enjoying the scenery without having to pay attention to the cars around them.

1 https://www.alliedmarketresearch.com/autonomous-vehicle-market
2 https://www.cnbc.com/2019/07/29/experts-say-its-at-least-a-decade-before-you-can-buy-a-self-driving-car.html

While this future is somewhat far off, the technology driving its development already exists today. In fact, the emergence of autonomous vehicles has only been possible thus far thanks to sophisticated software and realtime sensors that have transformed every aspect of driving into digital data.

Let's take a closer look at some of the technologies currently available and how they can contribute to furthering the march towards fully autonomous vehicles.

The Current Connected Car

The term "connected car" was first used in the mid-90s by General Motors, referring to the launch of its OnStar system, which connects drivers to a support service in case of an accident or other roadside emergency.[3] However, today's connected cars are far more advanced than a built-in roadside assistance program. Think about connected cars (and other vehicles) as a bridge between what's available now and what we can expect to see in the future.

Today's connected cars are vehicles that connect to high-speed data networks, allowing for real-time functions that require data such as GPS tracking. Connected cars can help drivers find optimized routes that avoid traffic, remotely start the car engine, remotely lock the car or turn its lights on and off.

What's more, connected vehicles can share that data connection with other devices both inside and outside the car, including smartphones, but more importantly sensors. Sensors can be used to identify road obstacles, other vehicles on the road, signs, and more. These enable some vehicles to enjoy some of the benefits of low-level autonomy and make the car part of the Internet of Things (IoT) revolution, which has quietly but quickly grown into a widespread data collection network that gathers a wide variety of data points such as road and traffic conditions.

On top of that, today's connected vehicles can also gather a wide variety of data about the vehicle and its operations. Vehicles generate a huge amount of data from their Electronic Control Units (ECUs) and Controller Access Networks (CANs). This includes (but is not limited to):

- Engine temperature
- Vehicle speed
- Position of the accelerator
- Fuel-to-air ratio
- Vehicle tilt angle
- Speed limit
- Road and tire conditions
- Transmission state
- Brake moisture

Typically speaking, the more advanced a vehicle is, the more data it generates and collects. Connected cars generate a huge amount of data, as much as 40 TB in only eight hours of driving.[4] And because autonomous vehicles by their nature will need to be connected, we can see the enormity of the amount of data that will be generated, as more and more autonomous vehicles hit the road.

3 https://www.dtinsights.com/updates/the-rise-and-rise-of-connected-cars
4 https://www.futurecar.com/876/Think-Your-Cellphone-Uses-a-lot-of-Data-Report-Claims-Autonomous-Cars-Will-Use-4000-GB-in-one-Day-

This poses a significant challenge for engineers and manufacturers looking to build the next generation of autonomous vehicles. That data is essential to train and develop systems that can manage all the complex aspects of driving that we, as humans, already do. The phrase "data rich, information poor" is an apt description of all these disparate data points.

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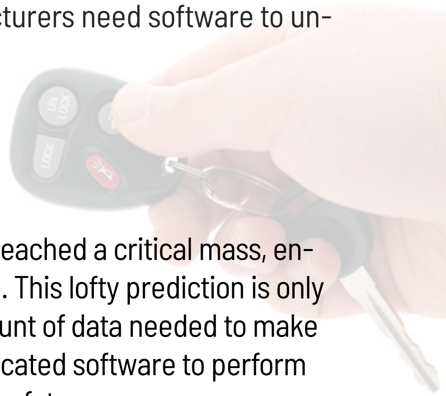
To make sense of them, to transform the data into something useful, manufacturers need software to unlock the full potential of an autonomous vehicle.



Unlocking the Future with Data

Earlier, we briefly described a future where autonomous driving vehicles have reached a critical mass, enabling both safer, more efficient roads and unlocking a new form of leisure time. This lofty prediction is only possible once manufacturers can gather, store and manage the enormous amount of data needed to make autonomous driving possible. And to achieve this, vehicles must rely on sophisticated software to perform these functions seamlessly in realtime in order to maintain both efficiency and safety.

We call this "software defined vehicles," where every function associated with vehicle operation is managed through a software vs. through human intervention. With software defined vehicles, data assets must be managed effectively while the software managing them should be reusable between vehicles, controllers or systems.

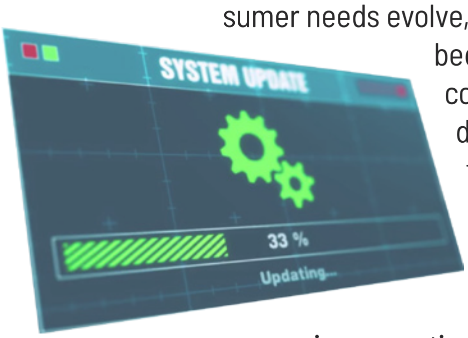
One way of overcoming this obstacle is to create a data lake, a central repository that holds both structured and unstructured data. The issue with this approach is finding the right data quickly and easily so that the vehicle can make use of it; a difficult thing to do in realtime as a vehicle is in motion, possibly going highway speeds. Despite the speed at which data can be processed, this approach has its drawbacks given the split-second decisions needed to create a safe driving environment.

An alternative approach is for the software to monitor data sets in the vehicle for results outside normal ranges and then guide the vehicle to react immediately. This approach allows for greater flexibility in the logic, the underlying systems, as well as the targeted systems (e.g. a data cloud provider). Using this model, vehicles can stay in constant communication with cloud-based data processing, ensuring intelligence fluidly moves between the cloud and the vehicle. This method will likely grow in importance as environments where artificial intelligence is deployed, such as with predictive maintenance and driver assistance.

The bottom line for manufacturers is that the automated cars of tomorrow will rely on software to do, well, everything the car needs to. Luckily, that software already exists and can serve as a bridge between today's connected cars and tomorrow's autonomous vehicles.

Meet the Software that Will Fuel the Autonomous Driving Experience

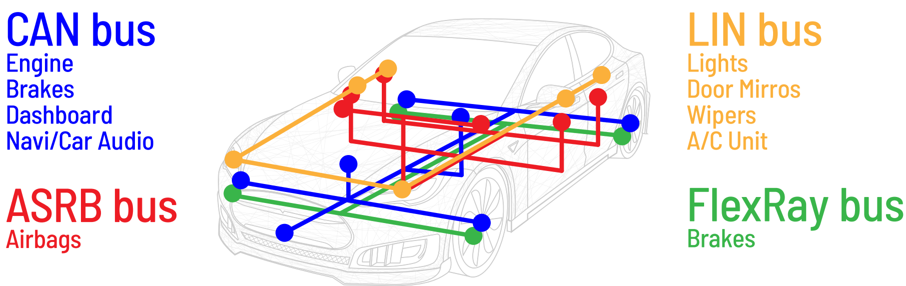
With so much data to manage, realtime performance in autonomous cars is a significant problem that needs to be solved. That is, software needs to do more than simply manage data; it needs to deliver unimpeded performance of critical systems while also being flexible to allow for future expansion. And it needs to do all of this flawlessly. What's more, it needs to be thoroughly tested before being deployed in a real-world environment.



Because software development and deployment is always an ongoing endeavor, as both vehicle and consumer needs evolve, it's essential for manufacturers to have the utmost flexibility to manage embedded systems. That's where software development kits like aicas' JamaicaVM comes in. This Java-based development kit provides an ideal platform for developing and running critical embedded systems. With stability being the top priority, JamaicaVM provides uninterrupted operations, full code control, integration with over 50 programming languages, and the ability to test and deliver updates and prototypes for new services.

In fact, as vehicles become more sophisticated as they move towards incorporating more autonomous features, embedded systems management will become increasingly essential. The more complex the functions a vehicle is expected to perform without human input, the more complex these embedded systems themselves will become. As a result, it is essential for manufacturers to be able to seamlessly connect more systems to the vehicle without having to do massive upgrades to its hardware or software infrastructure.

By employing a sort of master software manager, such as aicas' JamaicaEDP, vehicle makers can deploy the right software and device configuration with tools that allow them to efficiently distribute, manage, and check the applicability of software components, examine runtime behavior, and protect components against corruption without any downtime. Such a system allows them to test and validate code on each device before fully rolling it out. This approach enables full integration of embedded assets and resources, independent of the hardware or operating systems, thus also ensuring maximum flexibility without sacrificing stability.



Another essential aspect of managing data is managing applications in realtime; i.e. while the vehicle is in use. Data in the vehicle not only needs to be collected, but the right data must be delivered to the right system enabling the right decision at the right time. And with connected cars and the autonomously driving vehicles of the future, there are literally hundreds of applications that need to be effectively deployed and managed at any given time the car is in operation. This can range from safety applications, such as those needed to maintain appropriate speeds, distances from other vehicles, etc., but can also include connected services for the driver, such as GPS or onboard entertainment applications.

The challenge is that software needs to control multiple applications simultaneously, while also being able to deliver customizable in-vehicle experiences. Because applications often are not always developed to the same standards or even by the same party, it can be difficult to connect them all to the right system, creating a significant hurdle to innovation.

Luckily, software like our own JamaicaCAR enables automakers to efficiently deploy and manage in-vehicle applications for intelligent functions and connected services. By using software, manufacturers can even connect legacy hardware systems while still deploying new applications, extending the vehicle's life and value while customizing the user experience. What's more, software can be remotely managed, allowing manufacturers to update features as they're developed while maintaining both performance and security.

Conclusion: The Future Starts Today

At the beginning of this white paper, we asked the reader to imagine a world filled with autonomous vehicles that will reduce traffic, increase safety and change how people drive. But there is one other aspect of the evolving autonomous driving industry that needs to be not only considered, but envisioned and then built.

Specifically, we're referring to how we will power over 100 million autonomous vehicles. The truth is that the industry has been shifting away considerably from gas-powered to electric vehicles over the past 25 years or so. There are currently approximately 5.6 million electric vehicles on the road, but to achieve the scale needed for this revolution, a significant amount of energy is going to be needed. That calls for a better developed energy infrastructure, which in turn demands the connection of vehicles to the energy grid. This will be an essential development that will make electric, autonomous driving feasible.

So, again, we ask readers to imagine a world where highways aren't just paved roads, but are in fact part of a broader energy ecosystem that can interact with each vehicle on the road. It is in this imagined future where software not only manages every aspect of the vehicle itself, but also directly connects and manages the relationship between the vehicle and its surroundings. Once realized, ecosystems like this will allow electric vehicles to travel much further distances by efficiently managing functions like load balancing, energy usage, and power storage.

Ultimately, our limits as a society to develop and deploy autonomous vehicles on a large scale will greatly depend on software. The more flexible, extensible and secure that software is, the greater our ability to achieve this vision of the future. The good news is that software like that already exists, allowing vehicle manufacturers to develop and compete in today's world, but to envision and build the transportation industry of tomorrow.

Get in touch with us to learn more about our solutions!

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