FISH & RICHARDSON

# Technical Advancements and the Legal Considerations of **Autonomous Vehicles**

# Introduction

The concept of commercial autonomous vehicles, also referred to as AVs, is not new. Indeed, ships and aircraft have been equipped with some level of autonomous operation for decades. But only recent technological advances have made it possible to develop and implement sophisticated autonomous driving functionality in wheel-driven vehicles. The market reflects the opportunities associated with these new AV technologies. Over the past decade, the AV market has been one of the most rapidly growing markets in the automotive industry. According to IHS Markit, more than 33 million AVs will be sold annually as early as 2040, which is more than 26 percent of new car sales.[1] Allied Market Research indicates that the AV market is expected to grow from $54 billion in 2019 to $557 billion in 2026.[2]

The development and implementation of AV technologies are complex and present a broad range of technological and regulatory challenges. In addition, automotive manufacturers and integrators face legal obstacles, such as the protection of their intellectual property (patents, copyrights, and trade secrets), data privacy and security, and product liability.[3]

This paper provides an overview of the AV industry and discusses some of the legal challenges associated with the development and implementation of AV technologies.

1. https://technology.ihs.com/599099/autonomous-vehicle-sales-to-surpass-33-million-annually-in-2040-enabling-new-autonomous-mobility-in-more-than-26-percent-of-new-car-sales-ihs-markit-says
2. https://www.alliedmarketresearch.com/autonomous-vehicle-market
3. Fish & Richardson has significant experience in handling a variety of legal issues related to AV technologies, including intellectual property counseling, patent prosecution, patent litigation, and post grant proceedings. Fish has also handled numerous copyright, trademark, and product liability matters on behalf of companies operating in the AV space.

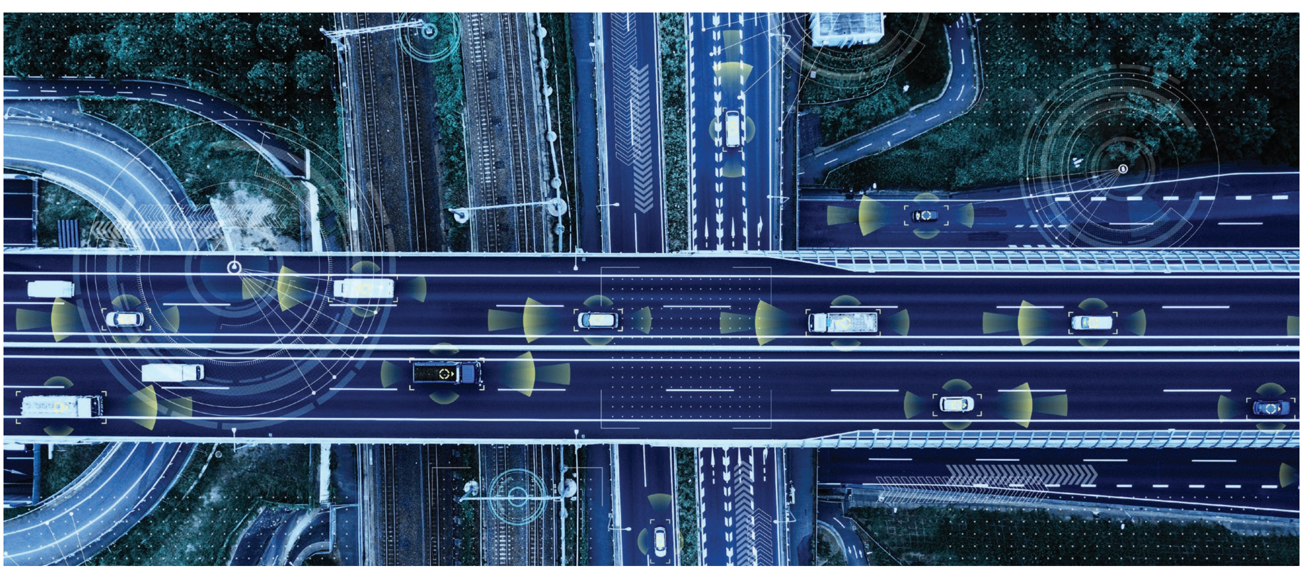
# Technology Overview

When talking about AVs, one might think of pop-culture references to fully independent vehicles such as Herbie the Love Bug, the Batmobile, or KITT (from the TV show "Knight Rider") that drive themselves under any condition. However, AVs do not necessarily operate entirely independently. Rather, AVs are defined by several levels of "self-driving" capability.

## A. SAE Automation Levels

The Society of Automotive Engineers (SAE), a standard-setting organization for the transportation industry, has defined six levels of autonomy for vehicles. SAE divided these levels into two main categories. The first category (levels 0-2) defines levels of autonomy that require the driver to operate at least some of the vehicle functions. The second category (levels 3-5) defines levels of autonomy that require the vehicle to operate without driver input under some or all conditions. This paper primarily focuses on levels 3-5.

Most of the current AV development focuses on level 3 autonomy. Level 3 autonomy allows for partial automation, such as the vehicle driving automatically during a traffic jam or when overtaking slower-moving vehicles. However, at level 3, a driver must take control of the vehicle when the vehicle requests it. Levels 4 and 5 autonomy do not require human interaction. The main difference between the two is that level 4 requires autonomy under limited conditions (e.g., not under snow or rain conditions), whereas level 5 vehicles must be capable of operating fully autonomously under all conditions. All levels provide the option to manually override the system.



## B. Connected Cars

Vehicle connectivity, while not an autonomous capability itself, is one of the primary building blocks of AV systems. The first “connected cars” were produced by General Motors in 1996, offering OnStar technology that automatically contacts emergency responders when an airbag is deployed. Of course, with further development of wireless technologies and the internet, connectivity has advanced to new levels. Connectivity generally refers to five communication methods between the vehicle and other entities, as shown in the figure below.[4]


Graphic used with permission. Center for Advanced Automotive Technology.[4]

Several tech companies and automotive manufacturers have started developing and implementing V2X, which is a peer-to-peer wireless technology that can warn vehicles about obstacles and environmental conditions the sensors of an AV on their own may not identify quickly enough.[5] V2X systems incorporate the five communication technologies shown above: vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), and vehicle-to-network or vehicle-to-cloud (V2N or V2C).

Currently, two communication standards support V2X. One is based on the cellular network (C-V2X), and the other is based on dedicated short-range communications (DSRC) 802.11p.[6] DSRC provides for communication without a cellular network but is limited to short range, whereas C-V2X requires a network but supports a broader range.

A fast and reliable network is fundamental for the integration of C-V2X systems. The 5G cellular network technology provides cellular coverage, reliability, low latency, high data speed, bandwidth, and geolocation services that can vastly improve C-V2X technology. According to Gartner research, more than 250 million connected vehicles will be on the road by 2020.[7] Acumen Research and Consulting announced in a research study of C-V2X technology that the estimated market value may be around $1.1 billion by 2026.[8]

The connectivity of AVs also enables the deployment of software updates and patches. For example, in 2015, Tesla introduced the Autopilot feature, enabling hands-free control for highway and freeway driving, which was deployed wirelessly via software update. Over-the-air software updates will be important for the safe and effective operation of AVs. Another benefit of vehicle connectivity is the ability to manage fleets autonomously. Currently, fleet managers require, at least in part, human operators to handle product and passenger transportation. AV technologies will allow fleet managers to maximize the efficiency of product delivery, ridesharing, vehicle sharing, vehicle charging, and more.

Overall, connectivity will play an important, if not a fundamental, role in the development and deployment of AV technology.

4. http://autocaat.org/Technologies/Automated_and_Connected_Vehicles/

5. http://gmauthority.com/blog/2019/02/two-v2x-communication-standards-fight-for-supremacy/

6. https://www.digitalengineering247.com/article/the-v2x-standards-faceoff/

7. https://www.gartner.com/en/newsroom/press-releases/2015-01-26-gartner-says-by-2020-a-quarter-billion-connected-vehicles-will-enable-new-in-vehicle-services-and-automated-driving-capabilities

8. https://www.globenewswire.com/news-release/2019/06/11/1867219/0/en/Cellular-Vehicle-to-Everything-C-V2X-Market-Size-Worth-Around-US-1-1-Billion-by-2026-Acumen-Research-and-Consulting.html

## C. Historical Work Leading up to Current AV Efforts

The concept of and desire for autonomous vehicles extend back to the 1500s, when Leonardo da Vinci invented a self-propelled cart that not only is considered the ancestor of the modern automobile, but also included some self-driving capability.[9]

More recent innovations on the path to autonomous driving include cruise control in 1945 and the self-parking systems by Toyota and Lexus in the early 2000s. In 2004, the Defense Advanced Research Projects Agency (DARPA) of the U.S. Department of Defense announced its first competition of the Grand Challenge, tasking researchers with building an AV able to navigate 142 miles through the Mojave Desert.[10] Not one of the participating AVs was able to finish the challenge. In 2005, DARPA held the second competition, requiring AVs to pass through narrow tunnels and complete more than 100 right and left turns. Five participants completed the 132-mile course.[11] In 2007, DARPA held its third competition, the Urban Challenge, which required AVs to navigate a 60-mile urban area course, including traffic regulations, other traffic, and obstacles, in less than six hours.[12]

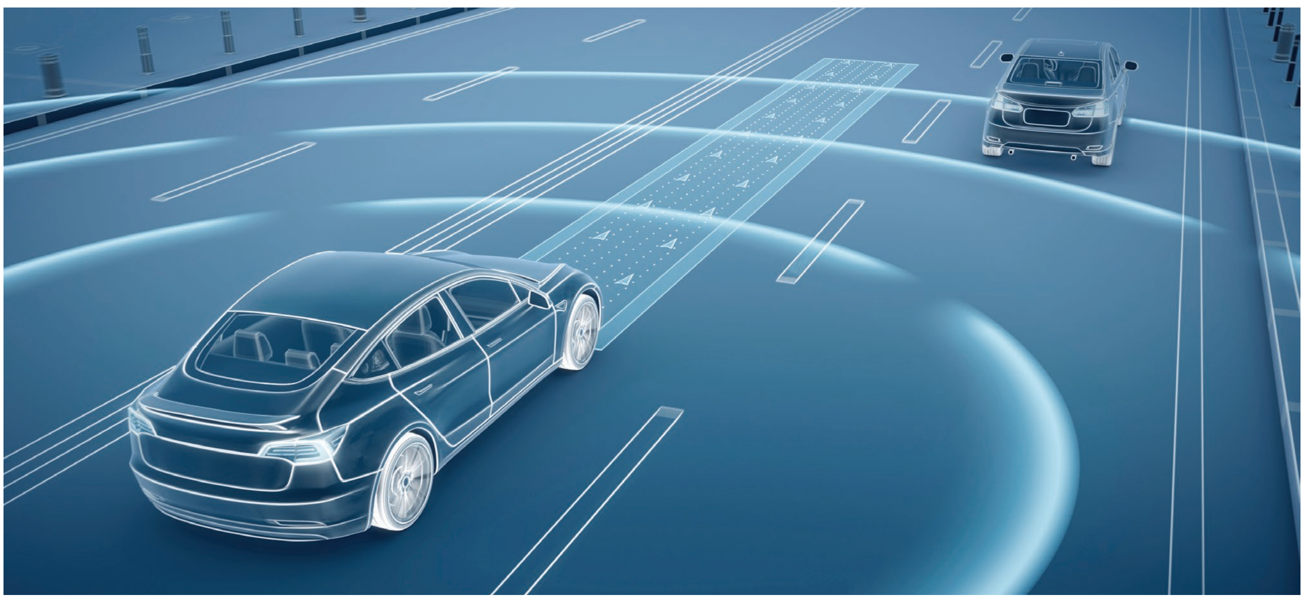
In 2009, Google began its self-driving project, and by 2014 it revealed a prototype of a 100 percent driverless car.[13] In 2013, many of the major automotive companies, including General Motors, Ford, Mercedes-Benz, and BMW, announced that they would begin working on AVs.[14] The race began then for automotive companies to develop commercially available AVs. BMW opened its second autonomous driving campus in 2018,[15] and in the same year deployed about 40 AVs on the roads of Munich and California operating at various levels of autonomy.[16] Toyota formed the Toyota Research Institute Advanced Development (TRI-AD) to develop fully automated vehicles[17] and revealed its latest AV in January 2019.[18,19] Volkswagen formed MOIA, a mobility services provider focusing on the development of ridesharing and ride-pooling sevices.[20,21] And just recently, Ford and Volkswagen announced they are "teaming up to tackle the self-driving challenge."[22]

9. https://www.wired.com/brandlab/2016/03/a-brief-history-of-autonomous-vehicle-technology/
10. https://www.darpa.mil/news-events/2014-03-13
11. Id.
12. Id.
13. https://www.businessinsider.com/google-driverless-car-history-photos-2016-10#in-may-2014-google-built-its-own-car-and-showed-off-a-prototype-of-it-at-the-code-conference-there-were-no-brakes-no-steering-wheel-and-no-gas-pedal-only-a-button-to-turn-it-on-the-company-capped-the-vehicles-speed-at-25-mph-and-planned-to-make-100-to-200-versions-of-the-car-9
14. https://www.digitaltrends.com/cars/history-of-self-driving-cars-milestones/
15. https://www.press.bmwgroup.com/global/article/detail/T0280021EN/new-centre-of-excellence-for-autonomous-driving-bmw-officially-opens-its-autonomous-driving-campus-in-unterschleissheim-near-munich?language=en
16. https://www.bmwblog.com/2017/10/29/bmw-shares-us-autonomous-technology-roadmap/
17. https://www.tri-ad.global/vision
18. https://pressroom.toyota.com/toyota-research-institute-rolls-out-p4-automated-driving-test-vehicle-at-ces/
19. Toyota also entered into a partnership with Uber to develop AVs to be deployed on Uber's network starting in 2021. https://pressroom.toyota.com/toyota-denso-and-softbank-vision-fund-to-invest-1-billion-dollars-ubers-advanced-technologies-group/
20. https://www.volkswagenag.com/en/brands-and-models/moia.html
21. Volkswagen also announced that the I.D. Crozz, which is scheduled to be released in 2020, will retract the steering wheel when the vehicle is operated on autopilot. https://newsroom.vw.com/vehicles/volkswagens-i-d-crozz-the-electric-suv-concept-makes-its-world-debut/
22. https://www.nytimes.com/2019/07/17/business/self-driving-autonomous-cars.html?action=click&module=News&pgtype=Homepage

## D. Market for Current Technology and Current Commercialization Efforts

The potential applications for AVs are staggering. Some players in the field believe that widespread AV use will result in an entirely different transportation system—in some cases, one without self-driven vehicles or the traffic signs we see today. The list of benefits and changes is nearly endless, but predictions include:

- **Reduction of the amount of fuel required to find parking, resulting in environmental benefits**
- **Reduction of real estate required for parking garages and parking lots, providing space for other infrastructure, such as housing or recreational facilities**
- **Optimization of roadways and infrastructure**
- **Optimization of consumer goods deliveries**
- **Conversion of the vehicle into a work, resting, or entertainment space**
- **Obsolescence of traditional drivers licenses**



Some in the industry believe that the rise of AV use will shift personal car ownership to rideshare services. Indeed, several companies, including Aptiv, Lyft, Waymo, and Drive.ai, currently offer AV rideshares in certain locations in the United States, although all of them still have a human backup driver behind the wheel. Since an AV with full autonomy will be mobile on its own and does not need a driver, it could transport passengers throughout the day and night. In this future of ownerless vehicles, the need for infrastructure, such as parking garages, may decrease as well.

AVs may also be able to provide delivery services for groceries, meals, and a variety of other goods. A few restaurants, such as Domino's Pizza, as well as some grocery stores, are already exploring AV technologies to deliver their products. For example, Nuro, in partnership with Kroger, has been testing AVs for grocery delivery, and has completed thousands of deliveries to customers.

AVs are also expected to change the trucking industry, where some players predict that autonomous trucks will reduce operating costs for shipping goods by about 45 percent. As with other types of AVs, autonomous trucks will be deployed in several stages. Currently, several truck manufacturers are testing autonomous platooning, where trucks travel together to save fuel through improved aerodynamic efficiency. In August 2016, Uber acquired Otto,[23] a self-driving truck startup, and is in the process of deploying self-driving trucks on the roads of Arizona. And in 2017, Embark partnered with Peterbuilt to develop and test an artificial intelligence (AI)-based approach to autonomous trucking.[24]

## E. Key Players

Generally, the key players in the AV industry can be split into traditional automotive manufacturers (the "Detroit" companies) and tech companies (the "Silicon Valley" businesses). Many automotive manufacturers—such as General Motors, Mercedes-Benz, Renault-Nissan, BMW, Volkswagen, Audi, Toyota, Ford, Tesla, Volvo, and Fiat Chrysler—either have deployed, or are in the process of developing, vehicles incorporating autonomous driving technology. Commercial vehicle manufacturers such as PACCAR are developing and testing AV technology in the long-haul trucking space. Tech companies such as Waymo, Uber, Mobileye, Bosch, Aptiv, Zoox, Nvidia, Continental, Huawei, and Baidu primarily develop software and other technology to enable autonomous driving functionality—though some have taken on the development of the entire vehicle.

The Detroit and Silicon Valley players are not working in a silo, however. Because of the need to leverage both—the industry experience and manufacturing capability of automotive manufacturers as well as the rapid development of cutting-edge and disruptive technologies of tech companies—several key players in the automotive industry have formed partnerships, or consortia, to develop and commercialize AVs. For example, BMW has formed a consortium with other car manufacturers and tech companies, including Fiat Chrysler Automotive, Intel, Mobileye, Aptiv, and Continental; Waymo entered into a partnership with Fiat Chrysler Automotive, Jaguar Land Rover, and Magna; General Motors has acquired Cruise Automation; Ford entered into a partnership with Argo AI and Volkswagen; the Renault-Nissan-Mitsubishi alliance entered into a partnership with Waymo; and Lyft entered into a partnership with Waymo, General Motors, Ford, and Magna.

23. https://www.uber.com/newsroom/rethinking-transportation-2/
24. https://techcrunch.com/2017/07/18/self-driving-truck-startup-embark-raises-15m-partners-with-peterbilt/

## F. Practical Considerations

While there is much excitement surrounding AVs, there are also obstacles. The “human factor” will be a challenge in the broad adoption of AVs. Experts predict that the hands-off nature of AV technology will make it less likely that drivers will be attentive when it becomes necessary to manually operate the vehicle. The industry refers to this as the “handoff problem.” Level 3 autonomy in particular will require additional technologies, such as a gaze alert or a drowsiness and fatigue detection system, to make sure the driver remains attentive while the AV operates independently. Additionally, as AV adoption grows, human drivers may not develop driving skills that are necessary for manual operation of a vehicle. Some, including lawmakers, are concerned about commercial AV use, which may create holdouts in adopting AV technology. Such holdouts may decrease some of the benefits that can otherwise be achieved with greater AV usage, such as a reduction of environmental pollution and roadway accidents.


The “technological factor” will also be a challenge to the deployment of AVs. For example, automotive manufacturers developing AVs must consider cybersecurity and create security systems that protect the AV from cyberattacks. Additionally, the acquisition, manipulation, and storage of the massive amounts of data generated by devices supporting AV operation, including cameras, radar, ultrasound, and LiDAR, need to happen quickly and effectively in order to be useful.[25] Most industry players also agree that better camera and sensor technologies are necessary before AVs with full autonomy can be deployed commercially. Finally, AVs will need to be able to communicate with everything surrounding the vehicle in order to avoid traffic incidents.

25. In just a single day, one AV produces as much data as the Hubble space telescope produces in an entire year. https://www.nasa.gov/content/goddard/a-look-at-the-numbers-as-nasas-hubble-space-telescope-enters-its-25th-year

## G. Future Developments and Projected Time Lines

The ultimate goal for the AV industry is the broad commercialization of level 4 and 5 AVs. Although some companies have deployed AVs in a handful of cities,[26] all of them still require backup drivers to take over in certain situations.

Industry leaders agree there are many obstacles to overcome before we reach full automation. Industry insiders predict that the first commercially available AVs with some self-driving capability will be deployed in the early 2020s and that full autonomy will not be available until the mid- to late 2020s. Specifically, more than 60 percent of the top automotive manufacturers working on AVs anticipate that they will deploy AVs capable of level 3 or 4 autonomy by 2021, with level 5 capability to follow starting in 2025.[27] Others, however, are more skeptical, predicting that "the industry's bigger promise of creating driverless cars that could go anywhere is 'way in the future.'"[28]

Although sensor, camera, image processing, radar, and LiDAR technologies over the past few years have made extraordinary leaps, further innovation in hardware and software is still necessary to implement a reliable surroundings detection system that is capable of operating in all environmental conditions. For example, cameras are good at object detection but have difficulty operating in low light conditions whereas LiDAR is not sensitive to light conditions, but has difficulty operating in poor weather. Another challenge is processing the collected data. Even when a vehicle has the ability to detect its surroundings, it must understand what it detects and what to do with the information.

To achieve full autonomy, the AV industry is focusing on sensor and software development, but also on communication technologies. For example, as it continues being developed and integrated, V2X will be a critical component for the future of AVs that can improve safety and efficiency of such vehicles.[29]

The AV industry is also developing AI[30] systems capable of processing the massive amounts of data collected by AVs so they can safely navigate all traffic and environmental conditions. AI systems aim to not only respond to actual conditions in the vicinity of the AV, but also predict potentially unsafe conditions—such as pedestrian traffic, objects, or other vehicles—in the AV's travel path. According to MarketWatch research, the automotive AI market is expected to exceed $10.73 billion by 2024.[31] Some experts consider deep learning, a subset of machine learning that attempts to mimic the learning ability of the human brain, as the most significant AI technology supporting AVs.[32] Deep learning provides AI systems with the ability to constantly learn and adjust the rules necessary for the AV to safely navigate to its destination.[33]

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26. Aptiv in partnership with Lyft provides autonomous ride services in Las Vegas, Nevada; Waymo started an AV taxi service in Phoenix, Arizona.
27. https://emerj.com/ai-adoption-timelines/self-driving-car-timeline-themselves-top-11-automakers/; https://www.digitaltrends.com/cars/history-of-self-driving-cars-milestones/
28. https://www.nytimes.com/2019/07/17/business/self-driving-autonomous-cars.html?action=click&module=News&pgtype=Homepage
29. In December 2018, the U.S. Department of Transportation issued a request for comments on the use and integration of V2X communication technologies (DOT-OST-2018-0210) and announced that it intends to maintain the priority use of 5.9 GHz spectrum for transportation safety communications.
30. The term "artificial intelligence" has been generally defined as the ability of a computer program or machine to think, learn, and make decisions. John McCarthy, 1956, Dartmouth Artificial Intelligence Conference.
31. https://www.marketwatch.com/press-release/automotive-artificial-intelligence-market-share-will-increase-us-1073-billion-by-2024-2018-10-07
32. https://www.technologyreview.com/s/612754/self-driving-cars-take-the-wheel/
33. Information sharing between AVs allows AI systems to create a virtual network of AVs.

# Legal Considerations

Legal issues related to AVs touch many areas of the law. This next section focuses on some of the primary legal concerns related to intellectual property, data privacy, product liability, and regulatory.

## A. Intellectual Property

The rapid development of AV technologies requires not only highly-skilled teams but often substantial financial investment. Intellectual property plays an important role for startup businesses and well-established automotive companies to protect their investments in AV development. Thus, all businesses are well-advised to develop a solid strategy to leverage and protect their intellectual property, including patents, trade secrets, and copyrights.

### 1. Patent Portfolios

New patent filings in the AV technology area have skyrocketed since 2016, indicating not only the rapidly growing AV market, but also that companies are invested in protecting, and potentially leveraging, their intellectual property. Patent applications in the AV space have jumped from less than a few hundred in 2010 to several thousand in recent years, logging a steady annual increase in new filings of between 20 and 30 percent since 2016.

Although the number of patent filings related to AV technologies has increased significantly worldwide, the United States accounts for about 75 percent of new patent filings in this space. Some of the most active companies are Ford, GM, Intel, Toyota, Waymo, LG, Uber, Qualcomm, Samsung, Here Global, Bosch, IBM, Honda, Hyundai, Toyota, and Volvo.

The move from hardware- to software-based innovations in the AV industry poses a variety of legal challenges. For example, in the United States as well as in many other countries, the law may impose limitations on patentability for data compilations, source code, machine learning, and iterative or incremental development of algorithms, which are often at the heart of AV technologies.[34] However, even with these limitations, software-based inventions may be patentable if they are directed to improving the function of the device in which they are implemented or a technical process, but much thought and care are required in order to develop a strong and defensible patent portfolio.

Inventorship for patents and authorship for copyright are yet another challenge for software-based creations when the complex code that controls devices used in AV technologies is developed, at least in part, by AI systems. For example, at this stage, a company cannot obtain patent or copyright protection unless the inventor or author is a human.[35]

The rapidly evolving technologies around AVs also provide a broad range of opportunities for patent protection. Businesses should carefully decide which opportunities to pursue and where to invest company funds. Some technologies may quickly become obsolete in this space; companies may be better served by spending their dollars to protect carefully selected innovations.

### 2. Standards Setting/Patent Pools

Similar to the communications industry, the AV industry is expected to establish standards to enable connectivity across the various system platforms, exposing the companies operating in this sector to Standards-Essential Patents (SEPs) and fair, reasonable, and nondiscriminatory (FRAND) licensing issues. For example, the implementation of AV technologies requires increased connectivity, including V2I, V2V, V2C, V2P, and V2X communication. Without collaboration between companies operating in the communication industry sector to ensure interconnectivity and interoperability, the required connectivity would not be achievable.

Some key players in the industry may elect to form patent pools[36] that include complementary patents directed to AV technologies. Although patent pools can have positive effects on innovation and competition, such as allowing companies to more efficiently develop new technologies and reduce costs, they also can lead to antitrust issues.

### 3. Patent Litigation

Historically, automotive companies have engaged in little intellectual property litigation among each other. However, this may change with respect to AV technologies. Litigation is also expected to extend to original equipment manufacturers and component suppliers for automotive manufacturers. Such third-party litigation would likely involve automotive companies, at least in part because of the abundant financial resources of the automotive industry. For example, American GNC Corp., a California-based technology company, filed suit in May 2019 against Toyota and three of its subsidiaries alleging that their AV features, such as lane assist and collision avoidance, infringe American GNC's patents.[37] This case, filed in the Eastern District of Texas, is ongoing.

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34. 35 U.S.C. §101 defines patentable subject matter as "process, machine, manufacture, or composition of matter" and specifically excludes abstract ideas, laws of nature, and natural phenomena.
35. http://cardozolawreview.com/artificial-intelligence-systems-produce-inventions/
36. A patent pool is an agreement between at least two companies to license one or more of their patents to one another.
37. https://www.law.com/texaslawyer/2019/05/15/tech-company-alleges-toyotas-autonomous-driving-features-infringe-its-patents/

Considering the predicted size of the AV market coupled with the significant increase of new patent filings since 2016 in the field of AV technologies,[38] patent litigation in this field is expected to increase over the next few years.

### 4. Copyright

Historically, copyright has not received much attention in the automotive industry. However, since patent protection may not be available for software-based inventions, copyright can be a powerful tool to protect source code underlying the software-based innovations used to control AV technologies.[39,40] Software provides significant value to AV development, as AVs are highly dependent on software managing some, or potentially all, vehicle functions. Because development of AV software is complex and can be very costly, it is expected that the automotive industry will, at least in part, revert to copyright to protect its investment in software development.[41]

### 5. Trade Secrets

In addition to patent and copyright protection, trade secrets provide an option to protect intellectual property. Unlike with other types of intellectual property, a trade secret holder does not disclose the innovation to gain protection. Instead, trade secret holders protect their innovations by implementing technological as well as contractual security measures to avoid disclosing their ideas. Contractual measures include nondisclosure agreements, work-for-hire clauses, and noncompete clauses.

Trade secrets are a useful tool to protect intellectual property in the AV context for three primary reasons: (1) patentability challenges, (2) cost to obtain patents, and (3) no public disclosure of the "secret recipe."

Some AV developers may prefer trade secret to patent protection because of the limitations on patentability. As explained previously, there can be challenges to obtaining patent protection on data compilations, source code, machine learning, and iterative or incremental development of algorithms, but such limitations do not apply to trade secrets as long as the trade secret holder maintains strict confidentiality of the invention. Additionally, under current patent law, an inventor must be human, and where the self-learning process of AI "invents" code for an AV system, a company may not be able to claim patent protection on that invention. Instead, a company can treat that invention as a trade secret.

While there are several benefits to using trade secrets in the AV space, companies need to be aware of the great risk of trade secret misappropriation, particularly because of the high employee mobility in the AV industry. It has become common for companies to hire key employees of competitors, which creates a significant risk that confidential information will be disclosed to the competitor. The *Waymo v. Uber* case was one of the first of what may become many trade secret cases related to employees moving between AV competitors.[42] The *Waymo* case ultimately settled, but it provides important insight for companies to consider when protecting their trade secrets, such as defining what their trade secrets are and litigating their trade secrets under the new federal law, the Defend Trade Secrets Act.

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38. On average, it takes approximately three to four years from patent filing to patent issuance. Patent applications filed in 2016 are expected to issue within the next couple of years.
39. Many tech companies write their applications using open-source software that requires compliance with open-source licenses.
40. As it does with other software products, the automotive industry will have to establish end-user license agreements (EULAs) for the software incorporated into AVs.
41. Copyright protects against direct copying of the source code and may also protect nonliteral components of software, but knowing the extent to which certain software functions are protected requires a fact-intensive inquiry. Ralph Oman, Computer Software as Copyrightable Subject Matter: Oracle v. Google, Legislative Intent, and the Scope of Rights in Digital Works, Harvard J. Law & Tech. (2018).
42. https://www.newyorker.com/magazine/2018/10/22/did-uber-steal-googles-intellectual-property

More recently, Tesla filed suit against AV startup Zoox alleging that ex-Tesla employees improperly disclosed Tesla's trade secrets to Zoox, including inventory documents, schematics, and other confidential documents.[43]

Although trade secrets can be an attractive alternative to patents, it is important to consider their vulnerability to reverse engineering and that they may require particular security measures in order for confidentiality to be maintained.

## B. Data Privacy and Security

The amount of data collected by AVs is staggering and complicates issues of data privacy and data security. For the integration of AV technologies, AV companies collect personal data on location, speed, daily routes, and more, which creates a risk that the data will be used in an unauthorized manner. AV manufacturers need to have robust data collection and privacy procedures in place, and must make these procedures transparent to consumers. AV manufacturers also need to consider privacy laws, including those that protect the information of minors. Data ownership will also present new legal challenges in the AV space. Many of the AVs are set to be deployed by rideshare services, and the question of who owns the data for each individual ride is currently unresolved.

AV manufacturers are challenged to employ physical and technological security measures to protect this data and to comply with privacy laws in the various jurisdictions. While AV-specific privacy provisions are being drafted in most jurisdictions, it is expected that the EU will continue to have more restrictive privacy laws than the United States.

The National Highway Traffic Safety Administration (NHTSA), which operates under the U.S. Department of Transportation, has released multiple versions of federal guidelines for Automated Driving Systems (ADS).[44] The guidelines aim to provide voluntary and nonregulatory guidance with respect to the development and deployment of AVs. Specifically, the NHTSA has stated that the U.S. Department of Transportation takes privacy seriously and is working with the Federal Trade Commission to protect consumer information. The NHTSA specifically recommends that AV manufacturers develop a robust and ongoing process for minimizing cybersecurity risks. AV manufacturers are encouraged to follow the guidance of governmental agencies and standard-setting groups when developing and deploying AV technologies.[45]

## C. Product Liability

Product liability for conventional vehicles is well-established and defined through a series of product liability cases, such as the exploding Ford Pinto in the 1970s and Toyota's Takata airbag inflators. Tort law with respect to vehicular accidents is also well-established. However, the analyses of negligence and the "reasonable person" require significant reconsideration for driverless AVs.

Legal scholars are considering product liability and tort litigation related to AVs in parallel. AVs are designed to remove human error from the operation of a vehicle. Thus, for a fully driverless vehicle, it may be presumed that an accident was caused by an error in the software or hardware of the AV and not by a human.

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43. https://www.engadget.com/2019/03/21/tesla-lawsuit-trade-secrets-zoox/
44. NHTSA released in October 2018 AV 3.0 (Preparing for the Future of Transportation), a version of the guidelines that builds on AV 2.0 (A Vision for Safety), which was released in September 2017. https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf
45. Several automotive manufacturers and suppliers have established the nonprofit information-sharing organization Automotive Information Sharing and Analysis Center (Auto-ISAC), which provides a central hub for coordination and communication of cyber threats and vulnerabilities to AVs.

Ultimately, however, the applicable laws and resulting liability will depend on various factors, such as:

- **Types of vehicles involved in the collision:** Non-AV accidents are typically litigated under tort law, whereas AV accidents may be litigated primarily under product liability law. It is unclear how courts will handle AV/non-AV accidents, which may not fall squarely under either tort law or product liability law.

- **Causation:** The different types of causation in accidents involving AVs may result in differing liabilities. Complex forensic and technical investigation may be needed to determine the cause of the accident—i.e., whether the accident was caused by human error or defect of the AV.[46]

- **Fault allocation:** Ultimately, the individual or entity to receive fault will likely depend on who or what had control over the condition causing the accident. Courts may presume that the passenger is not at fault when traveling in a level 4 or 5 AV.

- **Supplier liability:** AVs include copious specialized components with important roles for autonomous driving functions provided by a variety of suppliers. All these component suppliers may be subject to product liability litigation.

- **Cybersecurity/product liability:** The deployment of AVs carries severe cybersecurity concerns. For example, if a hacker gains access to AV functions and causes an accident, the software developer may be subject to product liability based on vulnerabilities in the software.

- **Indemnity:** To build consumer confidence, some AV manufacturers have indicated that they will accept liability for accidents involving their vehicles. However, it is unclear how and to what extent indemnification would be offered.

The number of cases involving AV accidents is relatively small at the moment, but legal experts expect this number to increase in the future. One of the first cases relating to AV accidents involved General Motors. A motorcyclist sued GM alleging that a Chevrolet Volt, which was operating in autonomous mode with a backup driver, veered into the motorcyclist's lane. Although the accident report indicated that the motorcyclist was at fault for attempting to overtake another vehicle under unsafe conditions, the parties settled the case.[47]

More recently, the family of a Tesla owner involved in an accident in Silicon Valley filed suit against Tesla alleging product liability, defective product design, failure to warn, intentional and negligent misrepresentation, and false advertising. The autopilot function of the Tesla Model X was engaged when the vehicle collided with a concrete median the vehicle did not detect.[48]

In another case, the family of a pedestrian involved in an accident with one of Uber's self-driving prototypes in Arizona sued the city of Tempe after settling with Uber, alleging that a median created a confusing and dangerous situation that encouraged the pedestrian to jaywalk.[49]

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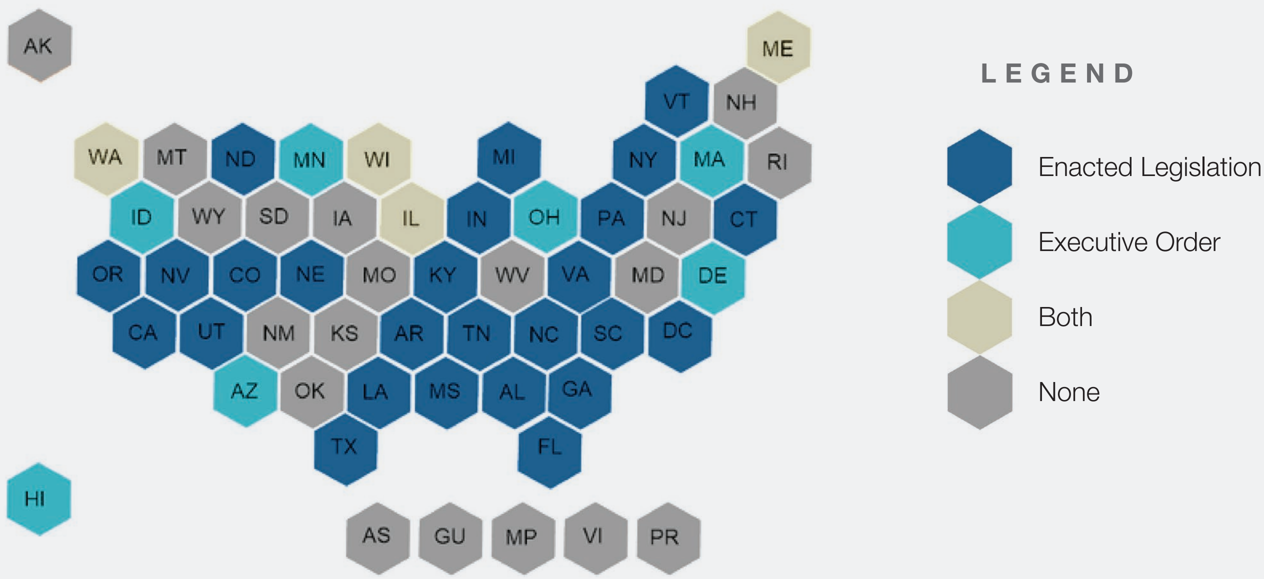
46. Technical expertise for such investigations may span multiple areas, such as mechanical engineering, biomechanics, computer science, data analytics, and programming.
47. https://www.theguardian.com/technology/2018/jan/24/general-motors-sued-motorcyclist-first-lawsuit-involve-autonomous-vehicle
48. https://www.forbes.com/sites/alanohnsman/2019/05/01/tesla-sued-by-family-of-silicon-valley-driver-killed-in-model-x-autopilot-crash/#f7e0e0f1c3f6
49. https://www.azcentral.com/story/news/local/tempe/2019/02/02/tempe-faces-10-million-claim-uber-self-driving-vehicle-fatality/2744423002/

## D. Regulatory

Many jurisdictions either have developed or are developing specific AV rules and regulations. As of March 2019, 37 U.S. states have enacted legislation and/or executive orders to regulate the development and deployment of AVs.[50] Some cities are also promulgating laws to regulate AVs.

**States with Autonomous Vehicles Enacted Legislation and Executive Orders**




Graphic used with permission. National Conference of State Legislatures.[50]

California, Arizona, and Nevada allow AV testing without a human driver in the vehicle. Notably, as of January 28, 2019, the Department of Motor Vehicles of the State of California has issued AV Testing Permits (with a driver) to 62 entities.[51]

Additionally, the NHTSA has stated that it "intends to reconsider the necessity and appropriateness of its current safety standards" as applied to AVs, particularly by changing those safety standards "to accommodate automated vehicle technologies and the possibility of setting exceptions to certain standards—that are relevant only when human drivers are present."

50. http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx
51. https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/permit

# Current Federal Legislation

To date, the AV industry is still waiting for federal standards to replace a patchwork of state laws and voluntary guidelines.[52] The incentive for the automotive industry to develop AVs depends heavily on the establishment of a solid legislative framework that permits fully autonomous vehicles on public roads and alleviates liability concerns.

The House unanimously passed legislation (H.R. 3388, the SELF DRIVE Act) to ensure "the safety of highly automated vehicles as it relates to design, construction, and performance, by encouraging the testing and deployment of such vehicles." However, the companion legislation remains tied up in the Senate (S. 1885, the AV START Act). Although Congress is looking to reintroduce a version of the regulations proposed during the previous session, it is unclear when (and whether) Congress will pass federal legislation to regulate the development and deployment of AVs.

52. On May 22, 2019, the U.S. Department of Transportation issued advance notices of proposed rulemaking (ANPRM) on the removal of unnecessary regulatory barriers to the safe introduction of automated driving systems (ADS) vehicles in the United States. https://www.nhtsa.gov/press-releases/us-department-transportation-seeks-input-testing-vehicles-automated-driving-systems

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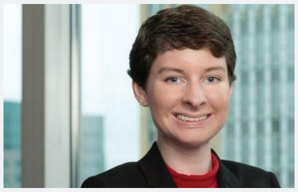

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