OPENING THE DOOR TO SELF-DRIVING CARS: HOW WILL THIS CHANGE THE RULES OF THE ROAD?

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Abstract

The advent of driverless vehicles will usher in a new age in road-based transportation. Developing and implementing the technology will require the industry to relax intellectual property rights in order to standardize safety and security features. Increased governmental regulation may be necessary to ensure public safety. Importantly, there will be a transition period of many years during which mixed vehicle technologies will share the roadways. This paper envisions a future in which few cars are privately owned and the automotive industry functions primarily as a provider of autonomous vehicle transportation services. Driver liability and insurance issues are examined in that light. Applications to law enforcement and private security are discussed.

I. Introduction: Fueling the Driverless Revolution

That which only a few years ago seemed futuristic or even unattainable is now bearing down on us with the momentum of an 18-

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wheeler: vehicles that autonomously drive passengers or cargo to predetermined destinations.[1] However, widely publicized accidents involving semi-autonomous vehicles including fatal crashes of Tesla cars operating in "Autopilot" mode have heightened safety concerns.[2] In September 2016, President Obama and Transportation Secretary, Anthony Foxx touted the promise of self-driving cars to enhance the convenience, efficiency and safety of day-to-day travel.[3] The federal government is budgeting for an expanded role in regulating this emerging automotive technology.[4]

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** The author dedicates this paper to his son, Ethan Paul Pearah, whose enthusiasm for and curiosity about automobiles was an inspiration. The author also gratefully acknowledges useful discussions with Timothy Maxwell Estes.

[1] *See* Bernard Meyerson, *Autonomous Vehicles Shift into High Gear*, SCIENTIFIC AMERICAN (June 23, 2016), *archived at* https://perma.cc/6TME-MQLZ (highlighting the technological advances of autonomous vehicles); *see* Keith Naughton & Dana Hull, *Ford Plans Leap From Driver's Seat With Autonomous Car by 2021*, BLOOMBERG NEWS (Aug. 16, 2016), *archived at* https://perma.cc/7KAC-8MNS (discussing auto manufacturing with an autonomous future).

[2] *See* Neal E. Boudette, *Autopilot Cited in Death of Chinese Tesla Driver*, N.Y. TIMES (Sept. 14, 2016), *archived at* https://perma.cc/4SAK-FMBM (questioning the safety of Tesla Motors Autopilot technology following a deadly automobile crash); *see also* Bill Vlasic & Neal E. Boudette, *Self-Driving Tesla Was Involved in Fatal Crash, U.S. Says*, N.Y. TIMES (June 30, 2016), *archived at* https://perma.cc/NM9L-Q6AV (reporting on the first fatal accident involving an autonomous vehicle).

[3] *See* Joan Lowy & Justin Pritchard, *Feds Preview Rules of the Road for Self-Driving Cars*, ASSOCIATED PRESS (Sept. 20, 2016), *archived at* https://perma.cc/M84V-TF6H (acknowledging the need to balance the benefits of autonomous vehicles with that of safety concerns); *see also* Rich McCormick, *President Obama says self-driving cars could save tens of thousands of lives*, THE VERGE (Sept. 19, 2016), *archived at* https://perma.cc/H2WY-27F6 (proffering benefits of autonomous vehicles); *but see* Avi Chaim Mersky & Constantine Samaras, *Fuel Economy Testing of Autonomous Vehicles*, 65 TRANSP. RES. PART C 31 (2016) (concluding that unless efficiency is considered, fuel economy for autonomous vehicles will degrade).

[4] *See* Lowy & Pritchard, *supra* note 3 (asserting that a change in federal guidelines could signal the embrace of autonomous vehicles); *see Secretary Foxx Unveils President Obama's FY17 Budget Proposal of Nearly $4 Billion for Automated Vehicles and Announces DOT Initiatives to Accelerate Vehicle Safety Innovations*, U.S. DEP'T. OF TRANSP. (Jan. 14, 2016), *archived at* https://perma.cc/6XUE-B82G

Diverse considerations compel governmental intervention to address legal, technological and public safety concerns.[5] These issues affect nearly everyone due to the pervasive nature of automobile travel in modern society – drivers in America drive an average of more than 1100 miles per month.[6] Automobile travel entails inherent safety risks as evidenced by the more than 35,000 traffic fatalities occurring annually in the United States alone.[7] Autonomous vehicles[8] pose a devastating threat to the automobile collision repair and insurance industries,[9] which may attempt to put up roadblocks to the technology.[10] Many people are inherently fearful and skeptical of science

(unveiling a new budget proposal that considers new. technological advances in automotive technology).

[5] *See* Lowy & Pritchard, *supra* note 3 (summarizing the intent of lawmakers and their strides in the autonomous vehicle industry).

[6] *See Average Annual Miles per Driver by Age Group*, U.S. DEP'T OF TRANSP. FED. HIGHWAY ADMIN. (Nov. 3, 2017), *archived at* https://perma.cc/4TUX-DAS9 (reporting the average annual miles driven by age).

[7] *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., DOT HS 812 318, 2015 MOTOR VEHICLE CRASHES: OVERVIEW at 1 (2016) (reporting on the increase in motor vehicle fatalities from 2014 to 2015).

[8] This paper uses the terms "autonomous vehicle" and "self-driving car" interchangeably. "Autonomous vehicle" seems more prevalent in the literature, however "self-driving car" seems more apt for a machine that uses elaborate sensor feedback to optimize safety and efficiency in guiding itself to a predetermined destination.

[9] *See* Jeff McMahon, *Driverless Cars Could Drive Car Insurance Companies Out Of Business*, FORBES (Feb. 19, 2016), *archived at* https://perma.cc/237W-FLBM (suggesting that the autonomous vehicle industry will significantly reduce car accidents).

[10] *See id.* (discussing the uncertain future of automotive insurance companies should autonomous vehicles become more widely accepted); *see also Self-driving cars will disrupt more than the auto industry. Here are the winners and losers.* CNBC (May 3, 2017), *archived at*https://perma.cc/LB8W-878G (discussing the risks posed to many industries, such as automobile repair shops, should autonomous vehicles become more prevalent).

and technology,[11] and will likely condition their adoption of self-driving cars on the assurance of governmental regulation.[12] The U.S. media's unrestrained penchant to sensationalize anomalous occurrences will likely exacerbate public fear and skepticism.[13] For instance detailed media accounts of the aforementioned fatal Tesla crashes create a compelling image in the mind of the media consumer in a way that more relevant and meaningful statistical data cannot rival.[14]

The looming self-driving car revolution raises a multitude of legal and business related issues.[15] For instance, in anticipation of autonomous vehicle safety regulation, manufacturers will likely be required to share pertinent software code and standardize the manner in which conflicts are resolved in complex or ambiguous traffic situations.[16] Corporations, safety experts and the government will have

[11] *See* Joel Achenbach, *Why Do Many Reasonable People Doubt Science?*, NAT'L. GEOGRAPHIC (Mar. 2015), *archived at* https://perma.cc/WSE7-VRVL (highlighting human predisposition to question new scientific information and developments); *see also* Kartik Hosanagar & Imran Cronk, *Why We Don't Trust Driverless Cars - Even When We Should*, HARV. BUS. REV. (Oct. 18, 2016), *archived at* https://perma.cc/Q673-P94E (acknowledging the potential skepticisms of having an autopilot feature in cars).

[12] *See* Nathan Bomey & Thomas Zambito, *Regulators Scramble to Stay Ahead of Self-Driving Cars*, USA TODAY (June 25, 2017), *archived at* https://perma.cc/9J5C-GM36 (indicating the desire of states to enact legislation concerning self-driving cars quickly as the technology becomes readily available).

[13] *See* Tom Englehardt, *How Sensational News Stories Distract Us From Real Crises*, THE NATION (Apr. 3, 2014), *archived at* https://perma.cc/GV5T-ZZ76 (expressing the common sensationalisms that appeal to modern news reporting).

[14] *See Autopilot Cited in Death of Chinese Tesla Driver*, *supra* note 2 (noting the helpfulness of in-car videos of collisions in analyzing car crashes compared to raw statistical data); *see also Self-Driving Tesla Was Involved in Fatal Crash*, *supra* note 2 (providing a diagram of an accident a involving an automated Telsa car)); *but see* David Noland, *Tesla's Own Numbers Show Autopilot Has Higher Crash Rate Than Human Drivers*, GREEN CAR REPORTS (Nov. 10, 2016), *archived at* https://perma.cc/7YGR-FXRB (explaining that the sample size of Tesla autopilot crashes are so low with only one incident, that the results do not demonstrate any meaningful statistic).

[15] *See* Scott Martelle, *Self-driving Cars and the Liability Issues They Raise*, PROTECT CONSUMER JUSTICE (May 11, 2012), *archived at* https://perma.cc/V9NF-4S2D (e expounding on various legal issues that could adversely affect the autonomous vehicle industry if left unaddressed).

[16] *See* Andrew J. Hawkins, *New Rules of the Road for Self-Driving Cars Have Just Been Released*, THE VERGE (Sept. 19, 2016), *archived at* https://perma.cc/6LUZ-ZK8Q (introducing a new "rulebook" introduced by the U.S. federal government that requires autonomous automobile manufacturers to meet a myriad of safety standards).

to work together to strike a balance between patent and trade secret protection on the one hand, and technology standardization for public safety on the other.[17] Given the global nature of the automotive industry, policies addressing intellectual property and standardization concerns should be crafted with an eye toward international implementation.[18]

While self-driving vehicles are expected to be far safer than driven vehicles,[19] no computer, sensor, road, or algorithm is perfect, and accidents will inevitably occur.[20] When driverless cars are used for delivery or taxi service, common carrier liability might be a sensible solution.[21] However it is unclear how much responsibility a self-driving car occupant who programs the destination, route or other parameters influencing the behavior of a self-driving car should assume.[22] For example, an occupant might decide to travel at night in adverse weather conditions such as freezing rain that greatly increase the probability of an accident.[23]

Additional complexity will arise from a period of approximately a couple of decades during which self-driving and legacy

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[17] *See id.* (foreseeing the need for more cooperation by manufacturers to share their data with government agencies).

[18] *See* INT'L TRANSP. F., AUTOMATED AND AUTONOMOUS DRIVING REGULATION UNDER UNCERTAINTY 26 (Philippe Crist, 2015) (addressing uniform policies on an international level to help standardize the autonomous driving industry).

[19] *See* P. Gao, R. Hensley, A. Zielke, *A Roadmap to the Future For the Auto Industry*, MCKINSEY QUARTERLY (Oct. 2014), *archived at* https://perma.cc/28KS-S2EK (suggesting that autonomous vehicles will be able to drive passengers at twice the speed with extreme safety); *see also* Ryan Hagemann, *Autonomous Vehicles Are Coming to a Roadway Near You*, WATCHDOG ARENA (Sept. 4, 2015), *archived at* https://perma.cc/U5BK-C8K4 (noting Google's autonomous vehicle has only been in about a dozen accidents, all stemming from human error).

[20] *See* Alexandra Ossola, *If A Self-Driving Car Gets Into An Accident, Who Is To Blame?*, VOCATIV (June 28, 2016), *archived at* https://perma.cc/SDV4-CQMU (explaining that the programing of the autonomous vehicles can be flawed based on a number of environmental or human errors).

[21] *See* Dylan LeValley, *Autonomous Vehicle Liability-Application of Common Carrier Liability*, 36 SEATTLE U.L. REV. 5, 24-25 (2013) (analyzing the effects autonomous vehicles have on public policies and heightened duties of care put on driverless car carriers).

[22] *See id.* at 25 (addressing the complications of the inability of an autonomous vehicle's occupant to fully control the cars operations).

[23] *See* Joon Ian Wong, *Driverless Cars Have a New Way to Navigate In Rain or Snow*, QUARTZ (Mar. 14, 2016), *archived at* https://perma.cc/JR5U-QBWH (exemplifying potential errors and risks that could occur where an autonomous vehicle's programming employs some form of weather algorithm).

technology vehicles will inevitably coexist on the same roadways.[24] Pioneering applications of autonomous vehicles are likely to be implemented in geographically constrained fleets such as buses, taxis or delivery vehicles for which the challenge of maintaining up-to-date maps and rules is more manageable than in the case of a passenger vehicle that might conceivably travel to any place accessible by road.[25] Even when autonomous vehicles are made available to consumers, adoption will be gradual; the average age of vehicles currently on the road is 11.5 years and increasing.[26] Conventions for allocating liability in the event of collisions between various permutations of fully autonomous, semi-autonomous, and driven vehicles will be required.[27] Liability determinations will further be complicated by considerations of the degree to which driver/occupant distraction or impairment should be taken into account depending on the type(s) of vehicle(s) involved.[28]

The emergence of driverless vehicles has great potential to disrupt the automotive industry model that has been in place for more than a century.[29] Self-driving taxi and delivery services could largely

[24] *See* Sue Halpern, *Our Driverless Future*, THE N.Y. REV. OF BOOKS (Nov. 24, 2016), *archived at* https://perma.cc/9ULF-53FC (citing a recent study by a market research firm who predict that almost all cars will be self-driving by 2050).
[25] *See Emphasizing Safe, Intelligent Transportation, Proterra Begins First Autonomous Bus Program in the United States*, PROTERRA (May 2, 2017), *archived at* https://perma.cc/VP5B-K3X6 (outlining a comprehensive lane for autonomous bus program for the United States).
[26] *See* Michelle Culver, *Average Age of Light Vehicles in the U.S. Rises Slightly in 2015 to 11.5 years, IHS Reports*, IHS MARKIT (July 29, 2015), *archived at* https://perma.cc/BY26-BNWZ (summarizing the increase in the average age of trucks and passenger vehicles).
[27] *See* Corinne Iozzio, *Who's Responsible When a Self-Driving Car Crashes?*, SCIENTIFIC AMERICAN (May 1, 2016), *archived at* https://perma.cc/2LRF-X9ME (outlining the complications to liability with autonomous vehicles because of the multiple parties who could be found liable).
[28] *See* Mark Harris, *Why You Shouldn't Worry About Liability For Self-Driving Car Accidents*, IEEE SPECTRUM (Oct. 12, 2015), *archived at* https://perma.cc/BTX3-TXMR (weighing the liability considerations of human driver errors and technology in an autonomous vehicle accidents).
[29] *See* Kevin Chapman, *Will Self-Driving Cars Disrupt the Auto Industry?*, CLARIVATE ANALYTICS (Sept. 7, 2017), *archived at* https://perma.cc/7T83-X354 (analyzing the extent of the auto-industry's transformation with the emergence of high technology).

supplant privately owned automobiles and sprawling parking facilities.[30] Uber is already testing driverless vehicles in the Pittsburg Area.[31]

This paper sets forth principles and suggestions for devising a system of standardization and regulation promoting safety, economic efficiency and innovation. Collaborative solutions designed to foster innovation while simultaneously conferring benefit to the automobile and transportation industries as a whole are generally favored over intrusive governmental regulation.

II. Road Map

Automation of driving tasks is a road well-traveled.[32] Over the years, drivers have steadily relinquished control over various aspects of their vehicles to automotive technology advances including self-shifting automatic transmissions, sound systems with self-adjusting volume based on vehicle speed, auto-on headlights and windshield wipers, and self-pulsing antilock brakes.[33] Other systems began to automate piloting functions decades ago.[34] Cruise control systems that maintain constant velocity have long since evolved into sensor-equipped self-adjusting adaptive cruise control systems that actively avoid collisions by maintaining a safe following distance.[35]

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[30] *See* Matt Kempner, *Will Self-Driving Cars Give Parking Lots the Boot?* THE ATLANTA JOURNAL-CONSTITUTION (Mar. 15, 2017), *archived at* https://perma.cc/UZZ8-92HD (predicting a change in the need for privately owned cars and the use of parking lots entirely as autonomous vehicles are fully integrated into society).

[31] *See* Mike Isaac, *What It Feels Like to Ride in a Self-Driving Uber*, N.Y. TIMES (Sept. 14, 2016), *archived at* https://perma.cc/6KXT-N6R4 (explaining the reason Pittsburgh was chosen as the test grounds for Uber's self-driving mode on vehicles they are testing).

[32] *See* Wired Brand Lab, *A Brief History of Autonomous Vehicle Technology*, WIRED (Sept. 7, 2017), *archived at* https://perma.cc/S7TM-PCY4 (discussing the timeline and integration of autonomous vehicles in Michigan).

[33] *See* Kumar Chellapilla, *How autonomous is your car?*, LINKEDIN (July 17, 2017), *archived at* https://perma.cc/4L3S-V7B8 (comparing six levels of vehicle automation, some of which are currently available in modern vehicles).

[34] *See* Wired Brand Lab, *supra* note 32 (elaborating on the technology of autonomous vehicles).

[35] *See* RONALD K. JURGEN, ADAPTIVE CRUISE CONTROL 95-96 (Ronald K. Jurgen ed., SAE Int'l, Illustrated ed. 2006) (explaining how rear end crash avoidance and adaptive cruise control capabilities function together to monitor and adjust vehicle speed to a safe following distance).

Several automakers including Tesla, Honda, Volvo, Ford and Subaru currently offer semi-autonomous vehicles that can control at least some aspects of steering.[36] A system supplanting human drivers altogether can be regarded as a predictable step along a well-established historical continuum.[37] However the key distinction is that fully autonomous vehicles must be far more complex and sophisticated than current vehicles in order to operate safely without human oversight.[38] This paper defines self-driving vehicles as those that require no human intervention after the destination is programmed.

There is no question that the current federal regulatory framework and state vehicle codes will require far-ranging modifications in order to accommodate self-driving vehicles.[39] In particular, standardization of the rules of the road would greatly simplify the challenge of designing and optimizing sensor-algorithm systems for safety and efficiency.[40] Greater consistency in state traffic rules, for instance, whether right turns are allowed after stopping for a red light, or who has the right of way in a roundabout, would arguably go a long way toward enhancing safety for all vehicle types.[41] Any potential for autonomous vehicles to compel more uniform state-to-state and international traffic laws can be regarded as a significant indirect benefit of the technology.[42]

In light of the ongoing evolution of vehicle automation, federal auto safety regulators have taken measures to test, regulate, and

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[36] *See* Dee-Ann Durbin & Tom Krisher, *What do Tesla, Honda, Volvo, Ford and Subaru have in common? Self-driving* cars on roads now*, CHICAGO TRIBUNE (Aug. 18, 2016), *archived at* https://perma.cc/282L-JGCD (analyzing the progress of several car manufactures in their attempts towards developing more autonomous vehicles).

[37] *See id.* (summarizing the development of automated technology in vehicles from the late 1990s to the present day).

[38] *See* Jessica S. Brodsky, *Autonomous Vehicle Regulation: How an Uncertain Legal Landscape May Hit the Brakes on Self-Driving Cars*, 31 BERKELEY TECH. L.J. 851, 862 (2016) (explaining that autonomous vehicles may be thought of as robots comprised of complex systems of sensors and hardware).

[39] *See id.* at 861-62, 865, 867, 870-71 (arguing that autonomous vehicles do not comply with existing tort and contract law at both the state and federal levels).

[40] *See id.* at 869, 874 (commenting on the uncertainty regarding state laws not being uniform across the board).

[41] *See id.* at 869 (examining potentiality of state-specific traffic laws for autonomous vehicles).

[42] *See id.* at 875-76 (explaining how non-uniform state traffic laws may impede the introduction and spread of autonomous technology).

even require safety features that will pave the way for self-driving cars including forward collision avoidance, backup camera, vehicle-to-vehicle communication, and lane detection systems.[43] Twenty automakers comprising nearly the entire U.S. automotive market have agreed to incorporate Automated Emergency Braking Systems in all of their vehicles by 2022.[44] Plans to release self-driving car models into the market within the next five years have been announced by mainstream companies including Ford,[45] General Motors,[46] Toyota,[47] and BMW.[48] World leading semiconductor manufacturers are investing tens of billions of dollars to position themselves to provide the sophisticated chips needed to implement the new technology.[49]

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[43] *See* Corinne Iozzio, *4 Driverless Car Features Going Standard*, SCIENTIFIC AMERICAN (Apr. 1, 2015), *archived at* https://perma.cc/R8QH-Q7DK (highlighting four potential features of autonomous vehicles which could increase the safety standards expected of vehicles).

[44] *See* Jeff McMahon, *All New Cars to Have Significant Autonomous Vehicle Technology*, FORBES (June 29, 2016), *archived at* https://perma.cc/BA5C-DNAL (highlighting a recent agreement reached between automakers and the Highway Traffic Safety Administration to adopt Automated Emergency Breaking Systems in a vast majority of new cars as standard equipment by 2022).

[45] *See* Alexandria Sage & Paul Lienert, *Ford Plans Self-Driving Car for Ride Share Fleets in 2021*, REUTERS (Aug. 16, 2016), *archived at* https://perma.cc/248V-AXYS (announcing Ford's plans to launch a fleet of autonomous vehicles for ride sharing services by 2021).

[46] *See* John D. Stoll, *GM Executive Credits Silicon Valley for Accelerating Development of Self-Driving Cars; Head of GM's foresight and treads unit says timetable for autonomous vehicles likely moved from 2035 to 2020, if not sooner*, WALL STREET J. (May 10, 2016), *archived at* https://perma.cc/U3SF-TWUN (highlighting General Motor's plans to accelerate creation of more autonomous vehicles).

[47] *See* Becca Caddy, *Toyota to Launch First Driverless Car in 2020*, WIRED (Oct. 8, 2015), *archived at* https://perma.cc/LL3R-GSHB (noting that driverless cars on public ways is still a distant reality).

[48] *See* Fred Lambert, *BMW Will Launch the Electric and Autonomous iNext in 2021, New i8 in 2018 and Not Much In-Between*, ELECTREK (May 12, 2016), *archived at* https://perma.cc/L9RX-QPY8 (confirming BMW will launch new electric and autonomous models in 2021).

[49] *See, e.g.*, Sonari Glinton, *Qualcomm Spends Big Money To Get In The Car (Chip) Business*, NPR (Oct. 27, 2016), *archived at* https://perma.cc/J6ME-UQ9Q (recounting Qualcomm's $38 million purchase of NXP Semicondutors); *see also* Mark Scott, *Intel Buys Mobileye in $15.3 Billion Bid to Lead Self-Driving Car Market*, N.Y. TIMES (Mar. 13, 2017), *archived at* https://perma.cc/KDD2-F5LH (announcing Intel's $15.3 billion purchase of Mobileye, a developer of various hardware parts for driverless vehicles, in an attempt to enter the self-driving car market).

Paradoxically the incremental and largely foreseeable development of self-driving vehicle technology gives rise to myriad unprecedented issues in areas encompassing tort law, intellectual property law, regulatory law, the automotive industry, the transportation industry, the insurance industry, law enforcement, privacy, security, and ethics.[50] Among the foregoing considerations, the bulk of legal scholarship to date has focused on tortious liability and personal injury considerations.[51] This paper is primarily devoted to other nascent questions and dilemmas arising from the imminent implementation of autonomous vehicles. Policies and solutions are discussed in terms of their conduciveness to safety, efficiency, economics, and technological innovation.

Switching to a self-driving vehicle paradigm will require ambitious technological innovation.[52] Section III discusses how best to balance corporate incentives to develop and implement the new technology with the standardization and testing needed to ensure public safety.[53] Section IV discusses liability issues beyond the scope of the basic issue of determining fault when self-driving cars collide.[54] Transformative effects of the autonomous vehicle technology on established business models in industries such as automotive, vehicle rental, transportation, and delivery services are the focus of Section V.[55] Section VI deals with privacy, security and other issues arising from the use of self-driving and unoccupied vehicles, particularly in law enforcement and related applications.[56]

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[50] *See* Cara Bloom, et. al., *Self-Driving Cars and Data Collection: Privacy Perceptions of Networked Autonomous Vehicles*, USENIX ASSOCIATION (2017) (discussing the implications of new technology and recommending industry guidelines to protect privacy).

[51] *See, e.g.,* Symposium, *Autonomous Vehicles: The Legal and Policy Road Ahead*, 16 MINN. J.L. SCI. & TECH. 615, 617-18 (2015) (advancing the discussion taking place around design, regulatory, liability, and privacy issues of autonomous vehicles).

[52] *See* Marisa Kendall, *Inside the Car-Eat-Car World of Self-Driving Technology*, THE MERCURY NEWS (Mar. 31, 2017), *archived at* https://perma.cc/8NQN-2J9D (noting the fierce competition to seize the autonomous vehicle market).

[53] *See infra* Part III.

[54] *See infra* Part IV.

[55] *See infra* Part V.

[56] *See infra* Part VI.

III. Licensing and Safety Registration, Please

The development and implementation of autonomous vehicle technology will generate critical intellectual property issues, primarily around the software algorithms and sensor systems that will replace human judgment, perception and attention.[57] Fundamentally, the degree to which such systems can be patented or kept as trade secrets is debatable.[58] Some aspects of self-driving automotive technology clearly are patentable.[59] For example, Ford has recently patented an "Autonomous vehicle entertainment system" for displaying movies on the windshield of a self-driving vehicle while it chauffeurs passengers.[60]

Eligibility for patent protection of the core self-driving vehicle technology is called into question, however, by established precedents including *Alice Corp. v. CLS Bank*.[61] The *Alice* Court applied the *Mayo* two-step framework[62] to determine subject matter patentability[63] of a software implementation of an intermediated settlement, a well-known business risk mitigation practice.[64] Because the soft-

[57] *See, e.g.,* Jacob Blamey, *What Role Does IP Play in the Autonomous Vehicle Space?*, CLEARVIEWIP (Apr. 13, 2016), *archived at* https://perma.cc/J8QF-HFJA (summarizing which companies have the largest amount of autonomous vehicle-related patents).
[58] *See* Chuck Tannert, *Will the Patent Wars Kill the Self-Driving Car?*, POPULAR MECHANICS (July 26 2017), *archived at* https://perma.cc/6DHL-A8LH (addressing the increasing difficulty of building autonomous vehicles without infringing on pre-existent patents); *but see* Brady Dale, *Senate Autonomous Vehicle Legislation Does Near Zilch on Privacy*, OBSERVER, *archived at* https://perma.cc/4BTM-9URB (discussing proposed legislation that could allow autonomous vehicle makers to keep their trade secrets out of the public eye).
[59] *See* Tannert, *supra* note 58 (noting that Google has filed hundreds of patents since its self-driving car project began in 2009).
[60] *See* U.S. Patent No. 9,272,708 (filed Sept. 30, 2013).
[61] *See* Alice Corp. Pty. Ltd. v. CLS Bank Int'l, et al., 134 S. Ct. 2347, 2360 (2014) (holding that petitioner's system was patent-ineligible because it added nothing substantial to an abstract idea).
[62] *See* Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1294 (2012) (applying a framework where the court first identifies the abstract idea, then decides whether the claim adds "significantly more" to that idea).
[63] *See* Inventions Patentable, 35 U.S.C. § 101 (1952) (listing subject matter which is patentable).
[64] *See Alice Corp. Pty. Ltd.*, 134 S. Ct. at 2359-60 (applying the *Mayo* two-step analysis).

ware did nothing more than apply the abstract idea of an intermediated settlement, the Court held that the asserted claim lacked the inventive concept necessary to overcome the judicially created exception to statutory patentability of abstract ideas and was therefore invalid.[65] The *Alice* Court further commented that an abstract idea might be patentable if it constitutes an improvement to another technology or technical field.[66] However courts have often found that mere automation of a task that could be performed by a human is not patentable, for instance in the *Benson*, *Bancorp*, and *Cybersource* cases.[67] Because self-driving car software can be viewed (1) as an improvement to automotive technology; (2) as a system or method that implements the abstract idea of an automated vehicle using a standard microprocessor; or (3) as mere automation of the task of driving a car routinely performed by hundreds of millions of people every day by using ordinary computer equipment, the extent of patentability of such software is unclear.[68] The fact that thousands of U.S. patents have already issued on technologies such as Adaptive Cruise Control, Anti-Collision Systems, and Vehicle Steering Systems would seem to signal the willingness of the USPTO to allow claims of appropriate scope.[69]

But even if the subject matter is patentable, corporations may prefer to maintain their algorithms and sensor systems as trade secrets to secure the competitive advantage of being first to market and/or

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[65] *See id.* at 2359 (requiring that the petitioner's system perform more than a simple recitation of "intermediated settlement" as performed by traditional computers).
[66] *See id.* at 2359-60 (describing further the Court's reasoning for denying the petitioner's patent).
[67] *See* Gottschalk v. Benson, 409 U.S. 63, 67 (1972) (stating occurrences in nature, mental processes, and abstract concepts, even when recently discovered, are not patentable); Bancorp Services v. Sun Life, 687 F.3d 1266, 1279 (Fed. Cir. 2012) (discussing that solely using a computer to expedite a mental process does not make that process patent-eligible); Cybersource Corp. v. Retail Decisions, Inc., 654 F.3d 1366, 1372 (Fed. Cir. 2011) (explaining that one cannot patent "human intelligence in and of itself").
[68] *See Legal Issues Raised by the Driverless Vehicle Revolution,* QUINN, EMANUEL, URQUHART & SULLIVAN, LLP (Dec. 2015), *archived at* https://perma.cc/RKK9-JQHS (discussing schools of thought relating to driverless vehicles and how they are revolutionizing the industrial world).
[69] *See* Rahul Vijh, *Autonomous Cars – Patents and Perspectives*, IP WATCHDOG (Apr. 7, 2016), *archived at* https://perma.cc/EV5X-9HU2 (discussing Toyota, Robert Bosch, Nissan, Volkswagen-Porsche, Daimler, Mitsubishi, and Panasonic and their current and pending patents).

offering superior product features.[70] Other companies might decide not to enforce their patent rights on the theory that a rising tide lifts all boats.[71] With the advent of self-driving cars, however, the legacy free market model collides with public safety concerns that have led the federal auto safety regulators to set machinery in motion to ensure proper testing and regulation of the new technology.[72] Automotive corporations will be called upon to share test data and coded algorithms so that the safety of the new products can be independently verified.[73] A federal safety registration or certification program will likely be necessary.[74] A combination of patent and trade secret protection with regulation of safety-related features comports with the historical automotive industry model.[75]

There are viable and arguably superior alternatives to relying solely on the federal government to ensure public safety.[76] In the automotive industry those alternatives align public interests more

[70] *See* Andrew A. Schwartz, *The Corporate Preference for Trade Secret*, 74 OHIO ST. L. J. 623, 627 (2012) (differentiating the use of trade secrets and patents to protect company's intellectual property).
[71] *See* Ashlee Vance, *Why Elon Musk Just Opened Tesla's Patents to His Biggest Rivals*, BLOOMBERG (June 12, 2014), *archived at* https://perma.cc/5ZQQ-G7FV (providing an example on how Tesla released their patents to help the progression of the automotive industry).
[72] *See* Lowy & Pritchard, *supra* note 3 (acknowledging that vehicle safety has typically been controlled by states, but noting, however, that federal law could control computer-driven cars); *see also* U.S. DEPARTMENT OF TRANSPORTATION, *supra* note 4 (noting the National Highway Traffic Safety Administration's goal to create a consistent national policy for autonomous vehicles).
[73] *See* Scott Kirsner, *For the Sake of Safe Self-Driving Cars, Companies Need to Share Data*, BOSTON GLOBE (Mar. 31, 2017), *archived at* https://perma.cc/8GGL-BLHA (stating the benefits of automotive companies sharing data to aid in safer roadways for autonomous vehicles).
[74] *See* Aarian Marshall, *Congress Unites (GASP) to Spread Self-Driving Cars Across America*, WIRED (Sept. 6, 2017), *archived at* https://perma.cc/3M69-77BV (announcing that Congress has created a bill, called the SELF DRIVE Act, which states the federal regulations for autonomous vehicles).
[75] *See* Timothy K. Kroninger, *Why Should Automotive Industry Care About Intellectual Property? IP Part 1*, NAT'L L. REV. (July 14, 2016), *archived at* https://perma.cc/88KZ-2WAX (explaining how the automotive industry is now relying to intellectual property to help shape new safety standards).
[76] *See* Alan Ohnsman, *Push For Self-Driving Car Rules Overlooks Lack of Federal Expertise In AI Tech*, FORBES (July 19, 2017), *archived at* https://perma.cc/DPG3-NCCJ (suggesting that there is a gray area as to what group is in the best position to regulate the safety of self-driving vehicles).

closely with corporate interests than, for instance, in the financial industry.[77] An unstable financial system can at least temporarily be shrouded in fraudulent security ratings and obscure derivative funds.[78] The automotive industry, on the other hand, would be immediately crippled if official traffic statistics reflected a poor safety record for self-driven cars.[79]

Despite (or perhaps because of) the recent international Volkswagen diesel emissions scandal,[80] reputable and self-interested corporations should recognize that a good faith effort to produce safe self-driven vehicles is essential for their very survival.[81] Automotive corporations may also perceive mutual benefit in collaborating on the testing and standardization of algorithms, sensor systems, and vehicle-to-vehicle communication protocols prerequisite to widespread implementation of self-driving vehicles.[82]

To that end, an industry standardization body and/or patent pool consortium could be formed.[83] Such strategies have proven effective in other ubiquitous international markets requiring compati-

[77] *See id.* (commenting that state laws, while being an alternative, focus more on the safety of public highways, whereas corporations may not be concerned with safety precautions).
[78] *See id.* (highlighting the potential costs to both the consumers and taxpayers when both human and computer drivers begin to share the road).
[79] *See* Phil LeBeau, *Crash Data for Self-Driving Cars May Not Tell Whole Story*, CNBC (Oct. 29, 2015), *archived at* https://perma.cc/5YHZ-D7FT (outlining self-driving cars crash data statistics).
[80] *See* Jack Ewing & Hiroko Tabuchi, *Volkswagen Scandal Reaches All the Way to the Top, Lawsuits Say*, N.Y. TIMES (July 19, 2016), *archived at* https://perma.cc/299B-34UM (depicting that the 11 million Volkswagen vehicles worldwide with software to cheat emission tests).
[81] *See* Ryan Beene, *Government Autonomous Car Regulations Are Out: Here's What it All Means*, AUTO WEEK (Sept. 20, 2016), *archived at* https://perma.cc/29JM-69RA (highlighting regulatory safety assessment for autonomous vehicles).
[82] *See* Bin Zan et al., *Key Agreement Algorithms for Vehicular Communication Networks Based on Reciprocity and Diversity Theorems*, IEEE, 1 (2013) (suggesting that source communication channels in vehicular communication networks needs to be studied further).
[83] *See* Reiko Aoki & Sadao Nagaoka, *The Consortium Standard and Patent Pools*, HITOTSUBASHI UNIV. RESEARCH UNIT, May 2004 at 1 (emphasizing that consortium standardization has become essential in the information and communication technology areas).

bility or interoperability between equipment made by different manufacturers.[84] A prominent example is in telecommunications, where cellular phone technology is generally well standardized through the 3rd Generation Partnership Project (3GPP).[85] 3GPP is a relatively effective international organization with national partner organizations.[86] Those organizations arose organically out of the acute industry need for telecommunications standards.[87] The historical trend has been for the development of incompatible regional systems that have subsequently been standardized for improved interoperability.[88] The telecommunications model is directly analogous to the need to standardize wireless vehicle-to-vehicle communications, and translates generally to the need for standardization of autonomous vehicle technology.[89] The automotive industry has an advantageous opportunity to pursue the more efficient path of collaborative standardization from the outset.[90]

Whenever such an industry organization is formed, there arises a concomitant risk of collusion.[91] In the automotive industry, the risk of collusive antitrust behavior must be balanced against the safety risks to which the public might be subjected in the alternative.[92] As with any industry consortium, whether it ultimately strikes a Coasian or Faustian bargain will depend on the ethical inclinations of the parties thereto as well as the rules and regulations by which it

[84] *See id.* (explaining that collaborative standardization is essential to successful innovation).
[85] *See About 3GPP*, 3GPP (Sept. 15, 2017), *archived at* https://perma.cc/YX2H-H4QV (outlining the objective of 3rd Generation Partnership Project to unite organizational partners and provide their members with a secure environment).
[86] *See id.* (describing 3GPP and its partnerships with international telecommunications organizations).
[87] *See id.* (commenting that the original scope of 3GPP has expanded since its creation in 1998).
[88] *See id.* (explaining the historical standardization of mobile systems from 1G to 4G).
[89] *See* Tannert, *supra* note 58 (examining the need for an industry-wide effort to create a standardized network among vehicle manufacturers).
[90] *See* Tannert, *supra* note 58 (arguing that companies would benefit from working together because the best technologies would be shared throughout the industry).
[91] *See* World Intellectual Property Organization (WIPO), *Patent Pools and Antitrust*, WORLD INTELL. PROP. ORG. 1, 11 (2004) (cautioning that sharing sensitive information in patent pools may lead to collusion among companies).
[92] *See id.* at 12 (overviewing the pros and cons of patent pools).

is governed.[93] Given that the telecommunications industry was permitted to proceed with standardization, *a fortiori*[94] the autonomous vehicle industry should be afforded at least the same license to collaborate with reasonable governmental oversight.[95] Relevant intellectual property such as a standard-essential patent is typically required to be made available license under fair, reasonable, and non-discriminatory (FRAND) licensing terms.[96]

Because self-driving vehicle safety is the interest of the automotive industry as a whole, the automotive industry should be allowed to determine its own testing, vehicle-to-vehicle communication, algorithm-sensor system, and other relevant standards to the greatest extent possible.[97] The sharing of test data among manufacturers would greatly accelerate development at least because collisions among self-driving cars are expected to be rare events.[98] As a result, aggregation of test data could lead far sooner to statistically significant results than the alternative of testing by each individual corporation.[99] The enhanced knowledge network[100] created by the

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[93] *See id.* at 9-10 (acknowledging that a company's ability to bargain for low transactions costs is dependent upon the rules and regulations of that particular industry).

[94] *See* Bryan A. Garner, BLACK'S LAW DICTIONARY (4th ed. 2011) (defining *a fortiori* as, "by even greater force of logic; even more so").

[95] *See* Sadahiko Kano, *Technical Innovations, Standardization and Regional comparison – a Case Study in Mobile Communications*, 24 TELECOMM. POL'Y 305, 319-20 (2000) (summarizing the importance in the relationship between technical innovations and standardization).

[96] *See* Jeffery I. D. Lewis, *What is "FRAND" all about? The Licensing of Patents Essential to an Accepted Standard*, CARDOZO SCH. OF L. (June 11, 2014), *archived at* https://perma.cc/NC9Z-LKZ7 (explaining an adopted standard in patent licensing).

[97] *See* Jeremy Hsu, *When It Comes to Safety, Autonomous Cars are Still "Teen Drivers"*, SCIENTIFIC AMERICAN (Jan. 18, 2017), *archived at* https://perma.cc/8M8H-GAZN (assessing the developments in autonomous vehicle safety testing).

[98] *See* Kirsner, *supra* note 73, at 3 (highlighting the benefits of using some kind of database for manufactures to deposit unique strategies to make their vehicles safer).

[99] *See* Jeff Plungis, *Should Developers of Driverless Cars Share Test Data?*, CONSUMER REP. (Dec. 8, 2016), *archived at* https://perma.cc/BS22-XT6B (advocating for automotive manufacturers to share safety data to speed the development of autonomous vehicles).

[100] *See* Orly Lobel, *The New Cognitive Property: Human Capital Law and the Reach of Intellectual Property*, 93 TEX. L. REV. 789, 792 (2015) (expounding on the successfulness of economies that have employed knowledge networks).

consortium would embody great potential spur technology development.[101]

The automotive industry would be well advised to anticipate the advantages of international standardization, as opposed to the regional standardization that took place in the telecommunications industry.[102] Not only would international standardization facilitate the export of safe and efficient self-driving vehicles outside of the country of origin, but also it is arguably necessary wherever it is possible to drive a vehicle across international borders (i.e. everywhere but Antarctica, Australia, and on many islands).[103] There would have to be a provision for updating the vehicle navigation systems with the applicable rules of the road in real time when crossing borders.[104] For instance it will be necessary to prevent an autonomous car from driving on the wrong side of the road after being transported to or from the UK through the Chunnel.[105] As with the United States, any impetus that self-driving cars may provide for standardization of traffic rules and conventions across international borders can be regarded as yet another benefit of their adoption.[106]

Industry self-interest should drive proper testing and standardization, which inherently involves devising a scheme for sharing the

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[101] *See id.* (discussing how legal regimes have relied on cognitive commons, and mobility protection).

[102] *See* 3GPP, *supra* note 85 (describing the 3GPP international telecommunications standardization project).

[103] *See* Pete Bigelow, *Self-Driving Cars Cross International Borders, Raising More Questions Than They Answer*, CAR AND DRIVER (Aug. 3, 2017), *archived at* https://perma.cc/R6LA-XCW9 (discussing the difficulty of enforcing of autonomous vehicle laws and standards both in the U.S. and internationally).

[104] *See* Bradley Berman, *Whoever Owns the Maps Owns the Future of Self-Driving Cars*, POPULAR MECHANICS (July 1, 2016), *archived at* https://perma.cc/Y6JC-93BN (asserting the importance real-time data processing for autonomous automobile safety).

[105] *See* Ferne Arfin, *Eurotunnel – Driving "Le Shuttle" Through the Channel Tunnel*, TRIPSAVVY (Sept. 10, 2017), *archived at* https://perma.cc/HEZ3-5SEE (addressing people's concerns of driving on the wrong side of the road when driving on European roads). *See also* Chris Baraniuk, The Channel Tunnel That Was Never Built, BBC (Aug. 23, 2017), archived at https://perma.cc/JZ4S-4UZB (stating that concerns of crashes in a possible second Chunnel is becoming a smaller factor as autonomous vehicles help avoid these accidents).

[106] *See* Tim Bajarin, *If Google, Uber and Others Want Self-Driving Cars, They Need to Work on Regulations Together*, RECODE (Mar. 13, 2017), *archived at* https://perma.cc/M72G-2LSN (highlighting the importance of manufacturers' role in the development of autonomous automobile regulations).

necessary patents and trade secrets.[107] Intellectual property issues relating to copyright stem from different considerations and will be discussed in Section VI.[108]

IV. Severe Impact: Liability Reconsidered

A. Mixed Vehicle Technologies

Even under the best of circumstances, self-driving vehicles will inevitably be involved in accidents causing damage or personal injury.[109] The ideal of nominally identical self-driving cars that are optimally maintained and equipped with complete information about the roads, traffic, and each other, piloted by flawless algorithms, and traveling roads with no defects or hazards in dry sunny conditions, is unattainable.[110] Previous authors have considered liability rules and insurance schemes that might be implemented to accommodate self-driven vehicles in routine collisions.[111] For accidents involving self-driven vehicles, it has been suggested that manufacturers should bear the liability, perhaps through a mutual or government administered insurance fund.[112] This paper discusses strategies for more extraordinary situations.

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[107] *See* Tannert, *supra* 58 (emphasizing threat of patent litigation to autonomous vehicle innovation).
[108] *See infra* Part VI.
[109] *See* Mike Ramsey, *Self-Driving Cars Could Cut Down on Accidents, Study Says*, WALL STREET J. (Mar. 5, 2015), *archived at* https://perma.cc/7NBP-TXMZ (pointing to a study which shows that 90 percent of car accidents could be eliminated through the use of autonomous vehicles).
[110] *See* Simon Parkin, *Learning to Trust A Self-Driving Car*, THE NEW YORKER (July 15, 2016), *archived at* https://perma.cc/EGF8-3YJU (reminding the reader of the imperfection of any driver, be it man or machine).
[111] *See Background on: Self-Driving Cars and Insurance*, INS. INFO. INST. (July 1, 2016), *archived at* https://perma.cc/57D8-R2BK (commenting on what the future of insurance schemes and liability coverage could entail).
[112] *See* Caitlin Brock, *Where We're Going, We Don't Need Drivers: The Legal Issues and Liability Implications of Automated Vehicle Technology*, 83 UMKC L. REV. 769, 782 (2015) (discussing the difficulty in where to place liability where autonomous vehicles are involved in accidents); Andrew P. Garza, *"Look Ma, No Hands!": Wrinkles and Wrecks in the Age of Autonomous Vehicles*, 46 NEW ENG. L. REV. 581, 591 (2012) (analyzing self-driving car accidents in light of products liability law); LeValley, *supra* note 21, at 12 (distinguishing design defects from manufacturing defects in regards to products liability law); Carrie Schroll, *Splitting*

The coexistence, at least in the short term, of autonomous vehicles, semi-autonomous vehicles, and human-driven vehicles will complicate accident liability fault analysis, particularly in collisions involving multiple cars of diverse technologies.[113] From the perspective of the self-driven vehicle, assuming that proper standards and vehicle-to-vehicle communications systems are in place the behavior of another self-driven vehicle should be highly predictable.[114] The behavior of a human-driven vehicle will be the least predictable, with the semi-autonomous vehicle occupying middle ground.[115] In a scenario where legacy liability laws govern human-driven vehicles and common carrier liability dominates self-driven vehicles, it remains unclear what law applies when a self-driven vehicle collides with a human-driven vehicle.[116] Conversion of carpool lanes to self-driving vehicle lanes to segregate the new and legacy technologies could minimize such occurrences, and would probably improve public safety overall.[117]

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the Bill: Creating a National Car Insurance Fund to Pay for Accidents in Autonomous Vehicles, 109 NW. U.L. REV. 803, 822 (2015) (suggesting a new national insurance fund as the best solution to self-driving car liability due to the difficulty of determining which party is solely liable)

[113] *See* Brock, *supra* note 112, at 787 (stating that legal liability is the greatest challenge for automated vehicle manufacturers to overcome); *see also* Megan Cassidy, *Who is Liable if a Self-Driving Car Crashes? Tesla Mishap Raises Issues*, USA TODAY (Apr. 3, 2017), *archived at* https://perma.cc/H8SX-R7KX (discussing levels of automation and impacts on legal liability in a collision involving different parties).

[114] *See* Anne E. Boustead & Karlyn D. Stanley, *The Legal and Policy Road Ahead: An Analysis of Public Comments in NHTSA's Vehicle-to-Vehicle Advance Notice of Proposed Rulemaking*, 16 MINN. J.L. SCI. & TECH. 693, 695-96 (2015) (explaining the benefits of vehicle-to-vehicle communication including the reduction of collisions).

[115] *See* Harry Surden & Mary-Anne Williams, *Technological Opacity, Predictability, and Self-Driving Cars*, 38 CARDOZO L. REV. 121, 125 (2016) (noting the paradox of the predictability between autonomous vehicles and human drivers).

[116] *See* Marcus Woo, *When Driverless Cars Crash, Who Pays?*, INSIDE SCI. (June 22, 2017), *archived at* https://perma.cc/HWB7-4LXT (discussing the challenges associated with determining who pays for an accident in an "altered liability landscape").

[117] *See* Charlie Sorrel, *Should Highway Carpool Lanes Be Dedicated to Driverless Cars Instead?*, FAST COMPANY (Sept. 26, 2016), *archived at* https://perma.cc/K8WL-SABU (arguing the depleting usefulness of carpool lanes and how they would be better suited for autonomous-driving lanes); *see also* Kevin C. Desouza, *Can Self-Driving Cars Share the Road With Old-School Vehicles?*, SLATE (Jun. 21, 2016), *archived at* https://perma.cc/GUG4-3UHG (discussing how

The automotive industry may lobby to assign fault to the human driver in all accidents involving mixed vehicle technologies on the basis that no human driver possesses judgment and driving ability on par with that of a lighting fast and highly refined sensor-algorithm system.[118] They will point to the formidable body of test data that earned their self-driving vehicles a governmental safety registration or certification.[119] Data demonstrating the statistically superior safety record of self-driven vehicles on the road using a metric such as accidents per miles travelled should become available.[120] The automotive industry will very likely use all of the available data in an attempt to eschew liability in any accident where human error is a possible cause.[121]

The legacy insurance industry, which will probably be in decline as accident rates decrease due to safer self-driven vehicles,[122] will attempt to argue that the algorithm-sensor systems are inadequate to anticipate unusual driving situations that may arise, or lack the capacity to exercise judgment in accord with ethical values.[123] For instance a self-driven car might choose to rear end a stationary

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self-driving cars and human driven cars are equivalent in terms of safety, and how the current artificial intelligence programs have been considered to match human intelligence in relation to driving).

[118]*See* Ryan Felton, *This Is What Happens When Robot Cars And Human-Driven Cars Mix*, JALOPNIK (Mar. 27, 2017), *archived at* https://perma.cc/T8GU-L5NZ (stating that over 90 percent of car crashes are due to human error); *see also* Hosanagar *supra* note 11 (noting improvements of self-driving vehicle algorithms).

[119] *See* Cecilia Kang, *The 15-Point Checklist for Self-Driving Cars*, N.Y. TIMES (Sept. 20, 2016), *archived at* https://perma.cc/WL4P-FEXD (outlining 15safety expectations to become required by the U.S. federal government in regards to self-driving cars).

[120] *See* Cyrus Farivar, *Google self-driving car gets rear-ended in 13th accident since 2009*, ARS TECHNICA (June 5, 2015), *archived at* https://perma.cc/ASS9-9PU2 (citing reports by Google that in 1.8 million miles, their self-driving car has been involved in 13 accidents).

[121] *See Id.* (attributing the fault of an accident to a human driven car); *see also* Felton, *supra* note 118 (attributing human error as one of the most consistent causes of car accidents); *see also* Desouza, *supra* note 117 (describing how automated cars will have greater safety measures than their human-driven counterparts).

[122] *See* McMahon, *supra* note 9 (arguing that the car insurance industry will likely decline due to fewer car accidents caused by autonomous vehicles).

[123] *See* Patrick Lin, *No, Self-Driving Cars Won't Kill the Insurance Industry*, FORBES (Apr. 25, 2016), *archived at* https://perma.cc/QT7H-YCGM (providing examples of potential sensor malfunctions in autonomous vehicles that will not have human instincts to avoid causing crashes).

vehicle occupied by a distracted driver at a green light, or even strike a jaywalking pregnant woman pushing a stroller, if the alternative would be to swerve into the oncoming lane or otherwise subject the driver to possible risk of injury in an evasive maneuver.[124] Hypothetical ethical dilemmas specific to harm minimization strategies for autonomous vehicles are the subject of several recent articles.[125] However most of the contemplated scenarios are highly unlikely and ultimately do not present the autonomous vehicle with a dilemma distinct from that facing a human driver.[126]

In the end, liability claims stemming from accidents involving diverse vehicles with a mix of self-driving and legacy technologies may have to be resolved in courts based on the peculiar facts of each case.[127] While the parties may enter the litigations on nominally equal footing, the large body of data and superior resources potentially at the disposal of the automotive industry seem likely to place the *de facto* burden of deflecting liability on the human driver.[128]

A. Driver Distraction and Impairment

Proponents of autonomous vehicle technology tout the advantage of its obviating effect on driver distraction or impairment, for

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[124] *See id.* (explaining that "even with perfect software and hardware, accidents will happen as a matter of physics").

[125] *See* Jean-Francois Bonnefon et al., *The Social Dilemma Of Autonomous Vehicles*, 352 SCIENCE 1573, 1573 (June 24, 2016) (analyzing the possible decisions that self-driving cars will have to choose between saving passengers or pedestrians); Will Knight, *How to Help Self-Driving Cars Make Ethical Decisions*, MIT TECH. R. (July 29, 2015), *archived at* https://perma.cc/HTQ6-KMEK (discussing the ethical hypothetical of a child running into a road that a self-driving car would have to handle);

[126] *See* Olivia Goldhill, *The guide psychologists gave carmakers to convince us it's safe to buy self-driving cars*, QUARTZ (Sept. 16, 2017), *archived at* https://perma.cc/A5R3-4W2G (explaining that self-driving vehicles will face the same ethical dilemmas as humans face in collisions).

[127] *See* Steven Seidenberg, *Who's To Blame When Self-Driving Cars Crash?*, ABA JOURNAL (July 2017), *archived at* https://perma.cc/L5FG-TA4V (listing the possible defendants in cases involving autonomous vehicle car accidents).

[128] *See* Rothenberg Law Firm LLP, *Is Human Error to Blame For Self-Driving Car Accidents?*, INJURYLAWYER.COM (June 16, 2017), *archived at* https://perma.cc/PE8X-RKHP (citing a recent CNBC report which describes several ways that self-driving cars better avoid accidents than humans).

instance due to cell phone use, application of makeup, shaving, fatigue, or intoxication.[129] In stark contrast with the current state of affairs, a self-driving car, we are told, could leave its occupants free to engage those or other activities without posing a safety risk to themselves or others.[130] And to a great extent these claims ring true.[131] Possible exceptions arise when a person fails to properly or prudently instruct the vehicle as to its time, place or manner of operation.[132]

For instance an intoxicated person might exercise questionable judgment in programming a vehicle to drive to a liquor store late at night in freezing rain conditions.[133] While it may be possible for an algorithm to determine that the driving conditions are unsafe and at least suggest returning to the point of departure, there would almost have to be an override for emergency situations.[134] If an intoxicated person were to make very poor decisions that resulted in an accident where the accident clearly could have been avoided by exercising better judgment, there should be a provision for finding liability.[135] Apart from such exigent circumstances, however, the mitigation of driver distraction or impairment risk by self-driven vehicles is likely to be nearly complete.[136]

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[129] *See* John Irwin, *Distracted Driving Defies Global Enforcement Efforts,* AUTOMOTIVE NEWS (Feb. 20, 2017), *archived at* https://perma.cc/9QJR-HCRP (stating that fully autonomous vehicles could banish distracted driving).

[130] *See* Kevin Roose, *As Self-Driving Cars Near, Washington Plays Catch-Up*, N.Y. TIMES (July 21, 2017), *archived at* https://perma.cc/SJL9-BKR4 (discussing some benefits to self-driving cars, such as "fewer traffic deaths, easier commutes, and the ability to safely use a phone while driving").

[131] *See Top 20 Pros and Cons Associated With Self-Driving Cars*, AUTO INS. CENTER (Sept. 21, 2017), *archived at* https://perma.cc/Q4PP-ARA7 (comparing safety benefits to potential dangers of self-driving cars).

[132] *See id.* (noting that although a self-driving car's software controls all of the cars operations, the driver would still be required to have knowledge of how to operate or instruct the vehicle safely).

[133] *See id.* (offering examples of how self-driving car technology can fail and leave the driver in dangerous situations).

[134] *See* Wong, *supra* note 23 (highlighting the potential errors and risks self-driving cars' weather algorithms could face).

[135] *See* Christopher Coble, *Can You Get a DUI in a Self-Driving Car?*, FIND LAW (July 11, 2016), *archived at* https://perma.cc/FN8N-PKKU (recognizing that drivers may still be liable for their improper involvement in operating a self-driving car).

[136] *See* Gil Press, *The End of Distracted Driving: The Next Car You Own Maybe Your Last*, FORBES (Apr. 28, 2017), *archived at* https://perma.cc/4FV3-GTCA (ana-

Paradoxically some risks may actually be increased in semi-autonomous vehicles due to the creation of precisely the circumstances that allow a driver/occupant's mind to wander.[137] An occupant could miss a cue to take over the wheel in a construction zone, for instance, resulting in a collision.[138] As such, legacy liability rules should generally apply whenever an occupant was or ought to have been driving a vehicle, and carrier liability should cover situations where the vehicle was driving itself.[139] Where there are multiple occupants it may be necessary to designate a responsible driver/occupant.[140]

C. Mechanical and Firmware Maintenance

Another potential for liability arises out of the need to maintain various aspects of a self-driving car.[141] For instance, a tire could fail because it was tread bare and 20,000 miles overdue for replacement.[142] A vehicle could get into a collision because the law governing right of way in roundabouts was changed and the responsible

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lyzing studies indicating that drivers spend too much time using their electronic devices while driving, which increases the chances of a collision, and that autonomous vehicles would help lower the chances of such a collision).

[137] *See* Jamie Condliffe, *Semi-Autonomous Cars Could Increase Distracted-Driving Deaths*, MIT TECH. REV. (Sept. 21, 2016), *archived at* https://perma.cc/B2FP-28P9 (describing potential reliability issues of drivers in driverless cars).

[138] *See* Jack Karsten, *Semi-autonomous vehicles must watch the road and the driver*, BROOKINGS (Jan. 30, 2017), *archived at* https://perma.cc/9JCZ-4DGE (providing a brief synopsis of the National Highway Traffic Safety Administration's findings on the risks of semi-autonomous vehicles and driver inattention).

[139] *See* LeValley, *supra* note 21, at 26 (concluding that autonomous vehicle liability should be assessed under the same standards as a products liability action); *see also* Nicole Bogart, *Who is responsible when a self-driving car crashes? Insurance companies aren't sure yet*, GLOBAL NEWS (Feb. 24, 2017), *archived at* https://perma.cc/LF2Y-VBPE (assessing various liability concerns in the autonomous vehicle industry).

[140] *See* Ian C. Graig, *Defining moment as regulators question 'driver' of self-driving car*, AUTOMOTIVE MEGATRENDS MAGAZINE (Oct. 11, 2016), *archived at* https://perma.cc/3B44-JKJM (noting the likely confusion in the designated definition of a vehicle's 'driver' as the self-driving automobile industry evolves).

[141] *See* Sasha Kucharczyk, *How Will Maintenance Change With The Autonomous Vehicle?* READWRITE (Apr. 18, 2017), *archived at* https://perma.cc/Y5TN-ML5V (expressing the need for a secondary system that specifically concerns diagnostics in self-driving car).

[142] *See* Micah Maidenberg, *Waymo and Avis Reach Deal Over Self-Driving Cars' Maintenance*, N.Y. TIMES (June 26, 2017), *archived at* https://perma.cc/7SKA-

party failed to update firmware to incorporate the new rules of the road.[143] A vehicle might fail to report for a safety recall related, for example, to airbag deployment, resulting in significantly increased risk of bodily harm or even the death of an occupant.[144] In any of those instances the responsible party could be liable for any resulting damages.[145]

Perhaps self-driving cars will automatically check for and download firmware upgrades in the same way that cell phones do.[146] Maybe they will go out for fuel or schedule battery charging when needed, and independently visit repair shops at required intervals and times that are also convenient for the owner or client.[147] The issue as to who is responsible for properly maintaining and updating the vehicle is inextricably intertwined with the model for vehicle ownership, which is the subject of the next section.[148]

TW8X (noting a recent business agreement to address the low-tech needs of the autonomous vehicle industry); *contra* Fleet Owner Staff, *Goodyear Rolls Out Autonomous Vehicle Tire*, FLEETOWNER (July 11, 2017), *archived at* https://perma.cc/YUN7-ZSXU (reporting on recent advancements in tire technology for autonomous vehicles that would allow the vehicles to address and resolve tire-related issues "before they happen").

[143] *See* Neal E. Boudette, *5 Things That Give Self-Driving Cars Headaches*, N.Y. TIMES (June 6, 2016), *archived at* https://perma.cc/9MVC-WLHG (explaining how autonomous vehicles, such as Google's, rely upon three-dimensional maps which may become out of date with changes in roadways).

[144] *See* Condliffe, *supra* note 137 (providing an incident in which an semi-autonomous automobile failed to detect a semi-trailer across the roads before impact).

[145] *See* Tony Kerr, *What will the impacts of autonomous vehicles be?*, LINKEDIN (July 9, 2017), *archived at* https://perma.cc/3E4P-RAKC (anticipating that failures in vehicle maintenance could lead to increased mechanics' liability in traffic accidents).

[146] *See* Alex Brisbourne, *Tesla's Over-the-Air Fix: Best Example Yet of the Internet of Things?*, WIRED (Feb. 2014), *archived at* https://perma.cc/LR4S-QEWC (discussing how Tesla's "over the air" software update creates a new precedent for what constitutes an automotive recall).

[147] *See* Lewis Duiguid, *With Race to Build Driverless Cars, Where Will we Go for Repairs?*, GOVTECH (May 27, 2016), *archived at* https://perma.cc/HPB2-74DA (highlighting the changing nature of automotive repair with the emergence of self-driving vehicles).

[148] *See* Tim Higgins, *The End of Car Ownership*, WALL STREET J. (June 20, 2017), *archived at* https://perma.cc/MR7Y-PC5C (predicting that autonomous vehicles could be maintained by the car dealer or somebody like the dealer).

V. Fresh Pavement: Automotive Industry Transformation

The advent of self-driving cars could mark the end of the road for the traditional vehicle ownership paradigm.[149] Rather than each household privately owning more than one car as is the norm in the United States,[150] it may be far more efficient to maintain central fleets of cars available for dispatch on a moment's notice.[151] Instead of tying up significant resources in vehicles that are parked in garages or parking lots most of the time, cars could report to passenger/clients on an as-needed basis.[152] Residential garage space could be converted to living space, and parking lots and structures could either be replaced with open space or put to more economically beneficial uses.[153] Vehicles could be efficiently maintained at the central fleet facility, thereby relieving ordinary people of that burden and any liability associated therewith.[154]

From a business standpoint, the self-driving car revolution opens up the possibility of transitioning to a service-based model

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[149] *See id.* (suggesting that most people will not own cars in the coming years).
[150] *See* ADELLA SANTOS ET AL., U.S. DEP'T. OF TRANSP. FED. HIGHWAY ADMIN., SUMMARY OF TRAVEL TRENDS: 2009 NAT'L HOUSEHOLD TRAVEL SURV. 34 (Jun. 2011) (pointing to the statistics for households and vehicle ownership).
[151] *See* Darrell Etherington, *Avis Signs on to Manage Waymo's Self-Driving Vehicle Fleet in Phoenix*, TECHCRUNCH (June 26, 2017), *archived at* https://perma.cc/WK32-ZUPV (citing a recent agreement between rental car company, Avis and self-driving car company, Waymo, to form an autonomous vehicle fleet in Phoenix, Arizona); *see also* Alex Davies, *Lyft is Launching a Fleet of Self-Driving Cars in San Francisco*, WIRED (Sept. 7, 2017), *archived at* https://perma.cc/ZN8Q-5WAW (announcing the launch of Lyft's self-driving car fleet).
[152] *See* Kempner, *supra* note 30, at 2 (predicting that self-driving cars may lead to unused parking lots that will ultimately be repurposed).
[153] *See* Roger Vincent, *When car ownership fades, this parking garage will be ready for its next life*, L. A. TIMES (Apr. 16, 2016), *archived at* https://perma.cc/QC5F-6J4S (describing the future of parking garages as self-driving cars whittle down car ownership).
[154] *See* Alan Ohnsman, *Alphabet's Waymo Taps Avis for Self-Driving Car Maintenance Services*, FORBES (June 26, 2017), *archived at* https://perma.cc/2JW8-NQA3 (announcing services included in Waymo's self-driving vehicle fleet).

where either an intermediary like Lyft[155] or Uber[156] or the automobile manufacturers and dealerships themselves could market service contracts.[157] In fact, General Motors has already invested $500 million in Lyft[158] and subsequently attempted to increase its 11 percent stake in the company with a takeover bid.[159] Self-driving car service contracts could be based on a fixed schedule (for instance to and from work or school), on-demand, or a hybrid model with tiered pricing depending on factors such as peak demand times and locations and how much lead time is provided.[160] The contract could include no-fault insurance at minimal cost, perhaps from a mutual insurance pool maintained by the automotive industry, which would collectively absorb accident liability.[161] Holding the automotive industry as a whole financially responsible for insuring against accident liability would provide another strong incentive for the development of safe standardized autonomous vehicle navigation algorithms.[162]

Further efficiencies in both transportation cost and travel time could be gained from offering clients financial incentives to carpool

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[155] *See* Brian Fung, *Lyft Will Launch Self-Driving Car Rides by the End of This Year*, WASH. POST (July 21, 2017), *archived at* https://perma.cc/RP4F-WL46 (explaining Lyft's increasing role in the world of autonomous cars alongside automakers and one competitor, Uber).

[156] *See id.* (noting Uber's involvement as well in the autonomous car industry).

[157] *See* Higgins, *supra* note 148 (highlighting possible adaptations car manufacturers and dealerships are considering in response to self-driving cars).

[158] *See* Mike Isaac, *General Motors, Gazing at Future, Invests $500 Million in Lyft*, N.Y. TIMES (Jan. 4, 2016), *archived at* https://perma.cc/BP5W-QHQ7 (discussing General Motor's large investment in Lyft and their partnership to develop a network of self-driving cars).

[159] *See* David Kiley, *Why GM Wants to Take Over Lyft and Why Lyft is Saying No*, FORBES (Aug. 16, 2016), *archived at* https://perma.cc/DLR6-EZ68 (explaining G.M.'s reasoning for wanting to acquire a large stake in Lyft's ride-hailing services).

[160] *See* Patrick M. Bosch et al., *Cost-Based Analysis of Autonomous Vehicle Serv*. 3-9 (Inst. for Transp. Plan. Sys., 2017) (detailing the different cost structures that a self-driving car service could employ).

[161] *See* Schroll, *supra* note 112, at 823 (proposing a national insurance fund for autonomous vehicle accident liability).

[162] *See* Brian Fung, *The Biggest Question About Driverless Cars that No One Seems to Have an Answer to*, BUSINESS INSIDER (Feb. 17, 2017), *archived at* https://perma.cc/T39G-DGU7 (suggesting various policy implications that could result with the widespread adoption of autonomous cars)*; see also* David Gutman, *Whose Fault is an Autonomous Vehicle Crash?*, FUTURESTRUCTURE (June 19, 2017), *archived at* https://perma.cc/QS8F-E8HQ (describing the potential of greater safety regulations resulting from crash liability).

to work, school, concerts or major sporting events.[163] Data from social media or other sources could be used to assign friends, acquaintances, or statistically compatible riders to driverless vehicle carpools when practical.[164] Optimized carpooling will reduce the number of vehicles on the road and consequently their collective impact on the environment.[165] In addition, decreased frequency and severity of collisions could allow for lighter cars with smaller individual environmental footprints due to lower fuel or energy requirements.[166]

Clearly self-driving car services could offer improved safety, newfound independence, enhanced quality of life, and greater dignity to people who cannot drive such as minors, the elderly, and blind or otherwise disabled persons.[167] Self-driving cars could also be cost-effective for delivering goods, for instance from restaurants[168] or online retailers.[169]

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[163] *See* Robert Hahn & Robert Metcalfe, *The Ridesharing Revolution: Economic Survey and Synthesis*, OXFORD U. PRESS, Jan. 10, 2017 at 12-13 (explaining how ride sharing will evolve with autonomous vehicles).

[164] *See* Joe Clark, *Uber Patents Feature for Mining Riders' Social Media Data*, COMPUTER BUS. REV. (Feb. 3, 2017), *archived at* https://perma.cc/BX5S-T2UT (alluding to social-media-data fed ride sharing applications and its potential impact).

[165] *See* Hahn & Metcalfe, *supra* note 163, at 4-5 (discussing the potential for a reduction in emissions and greenhouse gasses by carpooling through ridesharing).

[166] *See* Antonio Villareal, *Lighter Cars, More Efficient Cars*, TEX. A&M U. ENGINEERING (2010), *archived at* https://perma.cc/QJ49-4KSE (detailing how lighter cars made of enhanced products, like aluminum, reduce a vehicle's environmental footprint); *Avoiding Crashes with Self-Driving Cars*, CONSUMER REPORTS (Feb. 2014), *archived at* https://perma.cc/92D3-ULFV (suggesting advanced safety systems will reduce car accidents); *New Crash Tests Demonstrate the Influence of Vehicle Size and Weight on Safety in Crashes; Results are Relevant to Fuel Economy Policies*, INS. INST. FOR HIGHWAY SAFETY & HIGHWAY LOSS DATA INSTITUTE (Apr. 14, 2009), *archived at* https://perma.cc/TDW6-JZWT (explaining how human-driven cars require heavier materials because the heavy materials offer more protection in crashes).

[167] *See* Dana M. Mele, *The Quasi-Autonomous Car as an Assistive Device for Blind Drivers: Overcoming Liability and Regulatory Barriers*, 28 SYRACUSE SCI. & TECH. L. 26, 28 (2013) (describing how self-driving cars "will contribute to goals of independence" for individuals with disabilities).

[168] *See* Paul Lienert, *Ford teams with Domino's on Self-driving pizza delivery test*, REUTERS TECH. NEWS (Aug, 28, 2017), *archived at* https://perma.cc/JE99-N2RX (discussing the use of Ford's autonomous and electric vehicles to deliver Domino's pizza).

[169] *See* Dave Sullivan, *Why Amazon Is Forging Into Self-Driving Vehicles*, FORBES (Apr. 28, 2017), *archived at* https://perma.cc/SYN9-5L52 (analyzing Amazon's interest in autonomous vehicles to cut delivery costs).

The radical changes in the relationship between people and motor vehicles are not entirely without legal pitfalls.[170] For instance, criminals may seek to evade the law by using self-driving cars to commit crimes anonymously.[171] Some might strive to minimize risk exposure by sending unoccupied vehicles to deliver contraband or transport minors across state or international borders for illegal purposes.[172] Others might be inclined to replace suicide bombers with kamikaze vehicles.[173] Still others might use hacking or sabotage to take control of a vehicle[174] for the purpose of kidnapping, murder or assassination.[175] Such possibilities underline the need for strong industry collaboration on, and governmental regulation of, robust security features.[176] For example the use of biometric data to verify clients' and occupants' identities could be one component of an overall strategy to mitigate security risks.[177] Fortunately, the high degree of

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[170] *See* Leo King, *FBI: Driverless Cars Could Be Perfect for Police… But Also for Getaway Criminals*, FORBES (July 18, 2014), *archived at* https://perma.cc/83VX-QPNF (suggesting that self-driving vehicles could help criminals avoid capture by law enforcement).

[171] *See id.* (presenting that autonomous vehicles could provide criminals with the opportunity of fast getaways).

[172] *See* Frank Douma & Sarah Aue Palodichuk, *Criminal Liability Issues Created by Autonomous Vehicles*, 52 SANTA CLARA L. REV. 1157, 1165-66 (2012) (theorizing the potential use of autonomous vehicles to deliver drugs, or for other felonious purposes).

[173] *See id.* (highlighting the potential use of autonomous vehicles as weapons of terrorism).

[174] *See* Simson Garfinkel, *Hackers Are the Real Obstacle for Self-Driving Vehicles*, MIT TECHNOLOGY REVIEW (Aug. 22, 2017) *archived at* https://perma.cc/4UKC-YYDL (theorizing the possibility that autonomous vehicles could be hacked for malicious or felonious purposes); Fred Kaplan, *Losing Control of the Vehicle: You should be at least a little scared of car hacking*, SLATE (Aug. 18, 2015), *archived at* https://perma.cc/5WSG-RYVQ (discussing the potential harm of hacking for autonomous vehicles).

[175] *See* King, *supra* note 170 (citing that criminals could be able to conduct illegal tasks from the safety of autonomous vehicles, such as shooting, because both hands would be free).

[176] *See* Morgan Chalfant, *Cyber Official: Feds, Companies Need Better Dialogue on Security of Self-Driving Cars*, THE HILL (Apr. 25, 2017), *archived at* https://perma.cc/3SZL-PTQX (emphasizing that the government should to team up with the private sectors to ensure security standards are in place for autonomous vehicles).

[177] *See* Dr. Salil Prabhakar, *Why Biometrics Are the Key to Driver Authentication in Connected Cars*, VENTURE BEAT (Feb. 7, 2017), *archived at*

complexity of autonomous vehicle navigation systems will inherently increase the difficulty of hacking such systems relative to current vehicle computer control systems.[178]

Privacy considerations arise whenever computerized systems, such as automated vehicle navigations systems, gather extensive data detailing the behaviors of private parties.[179] Allstate already has a patent entitled "Driving analysis using vehicle-to-vehicle communication" which states, "Driver scores may be calculated or adjusted based on the determined driving behaviors of vehicle drivers, and also may be calculated or adjusted based on other the [sic] driver scores of nearby vehicles."[180] Other data of interest to parties ranging from commercial entities to employers to divorce courts could potentially be exposed.[181] Regulations will be needed to balance individual privacy against public safety and other legitimate concerns.[182]

VI. Beyond Stoplight Cameras: Law Enforcement and Security

Autonomous vehicles could offer vital benefits to law enforcement and security patrols.[183] The capabilities of self-driving po-

https://perma.cc/Y46G-UTA4 (asserting that biometric technology can enhance vehicle security).

[178] *See* Ryan Whitwam, *Driverless Car Researchers Develop Plan to Prevent Hacking on the Highway*, EXTREME TECH (Nov. 12, 2014), *archived at* https://perma.cc/E4PZ-H2ZH (suggesting that encrypted signal authentication and new smart algorithms will help to strengthen security of self-driving car's navigation systems).

[179] *See* John R. Quain, *Cars Suck Up Data About You. Where Does It All Go?,* N. Y. TIMES (July 27, 2017), *archived at* https://perma.cc/3HV2-G8SX (explaining some of the various forms of data that modern-day vehicles can now collect).

[180] U.S. Patent No. 9,147,353 (filed May 29, 2013) (patenting a driver analysis computer system that processes driver scores based on driver actions through vehicle communications).

[181] *See* Pete Bigelow, *For self-driving cars, privacy may be bigger concern than safety*, AUTOBLOG (May 12, 2015), *archived at* https://perma.cc/52AG-8HV2 (warning consumers about the increasing volume of data collected by companies, including automakers).

[182] *See id.* (indicating the need for increased legislation concerning consumer protection with data harvesting in automated vehicles).

[183] *See* Swapna Krishna, *Dubai Will Police Streets With Autonomous Patrol Car*, ENGADGET (June 29, 2017), *archived at* https://perma.cc/VBR3-CVA5 (reporting the implementation of a fleet of autonomous police cars on the streets of Dubai).

lice cars could be enhanced to enable remote monitoring of neighborhoods or situations where dangerous or criminal activity is most likely to occur.[184] In an era of coexisting autonomous and legacy vehicle technologies, for instance, self-driving cars could patrol roadways during times when, and in areas where, drunk driving is most probable.[185] Occupied or unoccupied self-driving traffic patrol cars could be programmed with suspect identification algorithms.[186] The algorithms could be purely based on processing sensor data to determine observable aspects of other vehicles or detect criminal behavior while ignoring physical characteristics of the occupants.[187] Suspect identification algorithms could improve effectiveness and reduce litigation costs by virtually eliminating racial or gender bias in traffic law enforcement.[188] Sensor systems could use biometric data to identify suspected terrorists and individuals with outstanding arrest warrants.[189]

Many public safety and private security patrols could eventually be replaced by unoccupied autonomous vehicles transmitting camera feeds to a central facility that would dispatch officers or security guards only when needed.[190] Automating those functions would

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[184] *See* Jeff Glucker, *Self-driving police cars to patrol Dubai streets?*, MOTOR AUTHORITY (July 3, 2017), *archived at* https://perma.cc/R7LC-URET (describing some of the practical uses of the fleet of autonomous police cars that will be used to monitor criminal activity in Dubai).

[185] *See id.* (listing the wide-variety of anticipated uses for Dubai's new fleet of autonomous police cars); *see also* Patrick Sisson, *How Will Driverless Cars Change Street Policing?*, CURBED (Feb. 10, 2017), *archived at* https://perma.cc/BHX8-3QST (discussing how autonomous cars may reduce drunk driving rates and change police interactions with drivers).

[186] *See* Krishna, *supra* note 183 (surmising the use of biometric software to scan for criminals in Dubai's new, autonomous police cars).

[187] *See* Glucker, *supra* note 184 (describing the thermal imaging, laser scanners, and HD scanners which would allow an autonomous police vehicle to patrol an area).

[188] *See* Orin Kerr (@OrinKerr), TWITTER (June 12, 2017), *archived at* https://perma.cc/R8F8-ZUUE (implying that self-driving cars will eliminate pretextual traffic stops based upon implicit bias).

[189] *See* Krishna, *supra* note 183 (suggesting that self-driving police cars will employ technology that allows them to "identify criminals and undesirables" via laser scanners and thermal cameras).

[190] *See* Hamza Shaban, *Meet the Newest Recruits of Dubai's Police Force: Robocars with Facial-Recognition Tech*, WASH. POST (June 30, 2017), *archived at* https://perma.cc/F5G2-UXEN (commenting on how a real police officer can still physically control the autonomous police vehicle).

improve safety for security and law enforcement personnel and should result in significant economic savings from reduced labor requirements.[191] While some will initially take umbrage at the notion of mobile security cameras roaming highways and neighborhoods, a great many more may appreciate the resultant enhancement in public safety, tax savings and uniformity of enforcement criteria.[192]

The act of recording surveillance video from unoccupied self-driven vehicles raises copyright issues.[193] The United States Copyright Act protects original works of authorship fixed in any tangible medium including "motion pictures and other audiovisual works".[194] Whether a recording from a prepositioned security device qualifies as an original work of authorship remains an open legal question in the United States.[195] There is a strong argument that, unless a human is directly controlling what the recording device captures, surveillance videos lack even the minimal level of originality and creativity required for copyright.[196]

Private investigation services or even private individuals may attempt to use surveillance video recordings made from unoccupied vehicles to monitor others in an analogous manner.[197] The law should discourage such invasions of privacy.[198] Prosecution pursuant

[191] *See id.* (stating that autonomous police vehicles are not meant to replace human officers, but aim for safer streets without using excessive police patrol resources).
[192] *See* Ali Al Shouk, *Dubai Police to Deploy Robotic Patrols*, GULF NEWS (June 27, 2017), *archived at* https://perma.cc/ZN2F-27CU (discussing the immense safety benefits associated with self-driving police vehicles which can patrol the streets 24/7).
[193] *See* David Navetta, *The Privacy Implications of Autonomous Vehicles*, DATA PROTECTION REPORT (July 17, 2017), *archived at* https://perma.cc/66S9-YBWU (inferring potential privacy violations gathered from the sensory data in autonomous vehicles).
[194] *See* Subject Matter of Copyright, 17 U.S.C. § 102 (1990) (categorizing the types of works which copyright law applies to).
[195] *See* Feist Publications, Inc., v. Rural Telephone Service Co., 499 U.S. 340, 349 (1991) (on the originality definition by juxtaposing it to copyright law).
[196] *See id.* at 348 (opining that in order to meet the constitutional minimum for copyright protection, there must be an original arrangement of facts).
[197] *See Unmanned Surveillance Vehicle*, PHOTOFAX, INC. (Sept. 29, 2017) *archived at* https://perma.cc/RM34-5STQ (providing an example of a private investigation service that can be purchased which utilizes autonomous vehicles).
[198] *See* David Navetta, *supra* note 193 (discussing how congress and state legislatures have taken steps to protect privacy interests of individuals).

to privacy laws should apply directly to the person directing surveillance in those instances.[199] But as with self-driving car transportation services, the advantages of unoccupied law enforcement and security vehicles seem likely to vastly outweigh the risks.[200]

VII. Conclusion

This paper envisions the future of the embryonic autonomous vehicle revolution. Its effects on the law, regulation, the automobile industry and related service sectors, and society at large will be transformative. Designers and manufacturers will be both required and motivated to form an international industry consortium and forego some intellectual property rights in order to develop and standardize the sensor-algorithm and vehicle-to-vehicle communication systems that will enable safe and widespread implementation. Safety considerations include providing secure systems that are immune from malicious hacking or sabotage. The automotive industry will also likely be obliged to form an insurance pool to assume no-fault liability for collisions between self-driving cars. Federal auto safety regulators will bear a significant role in monitoring and enforcing compliance with standards.

The historical model of individual automobile ownership will likely fall by the wayside in favor of more efficient centralized transportation services from fleets providing appropriate vehicles to clients as needed. Clients will thereby be relieved of the burden of fueling, maintaining, and storing vehicles that are chosen for ownership based on compromises between competing needs. Service providers will bear contractual obligation for proper mechanical and firmware maintenance as well as legal liability for any damages resulting from failure to meet that obligation. Significant residential space and real estate acreage will be liberated because it will no longer be necessary to store idle vehicles wherever their owners happen to be.

Self-driving cars are expected to be a boon to law enforcement and security. Legal issues stemming from racial or other biases

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[199] *See id.* (outlining California legislation requiring customer consent prior to manufacturer surveillance of voice-recognition features in smart technologies).

[200] *See* Jay L. Zagorsky, *Cops May Feel Biggest Impact from Driverless Car Revolution*, THE CONVERSATION (Mar. 16, 2015) *archived at* https://perma.cc/ZKX9-HQBT (identifying positive impacts autonomous cars will have on law enforcement).

in law enforcement will largely be mitigated by occupied or unoccupied patrol vehicles using algorithms to identify traffic violators or criminal activity based on criteria independent of the characteristics of the occupants of the vehicle. Police and security guard labor could be far more efficiently leveraged by dispatching live personnel only when video streams from unoccupied patrol vehicles indicate the need. If properly implemented, self-driving vehicles will enhance safety, efficiency, convenience, the environment, and justice for the benefit of society as a whole.