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INSIGHT: Autonomous Vehicles in the World of Intellectual Property Rights

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Autonomous vehicles are rapidly evolving into one of the most transformative technologies, in part because of innovations in devices and processes historically not associated with the automotive industry, such as improved sensors and cameras, radar and Light Detection and Ranging (LiDAR) technologies, artificial intelligence (AI) algorithms, and communications mechanisms for vehicle connectivity. The use of such technologies in autonomous vehicles has also ushered in numerous technology and ridesharing companies as new market players in the automotive industry, which has long belonged to the traditional car manufacturers and their OEM suppliers.

Autonomous vehicles provide the possibility for effecting groundbreaking social benefits, such as improved road safety and reduced car crash fatalities. As highlighted by the World Economic Forum, autonomous vehicles also have the potential to reduce traffic, decrease pollution, and even transform the way we design our cities. There are also enormous business opportunities. Some experts project that autonomous vehicles will constitute about 10% of all cars on U.S. roads by 2025. By then, Bloomberg projects that the industry would have transformed into a $42 billion market. It is thus no surprise that, according to CB Insights, venture capital and strategic corporate investors invested about $3.4 billion into autonomous vehicles in 2017 alone, and Brookings Institution estimated that over $80 billion has been invested in total. But such unprecedented changes will cause significant disruptions to the automotive industry and raise new legal and ethical issues that must be addressed. IP rights and considerations, in particular, will become one of the key implicated areas, alongside other legal and ethical issues, such as privacy, cyber security, and liability. This article attempts to identify those IP issues and navigate the complex IP landscape within this rapidly-developing sector.

Autonomous Vehicles

Generally, an ''automated vehicle'' refers to a vehicle that includes certain automated functions (e.g., adaptive cruise control), whereas an ''autonomous vehicle'' more specifically refers to one that drives itself in most or all settings. Other terms, such as ''self-driving car,'' ''driverless car,'' ''fully-autonomous vehicle,'' and ''semi-autonomous vehicle'' are also often used to refer to automated and/or autonomous vehicles. For clarity, as well as to emphasize the varying degrees of automation, this article provides the following levels of automation, as defined by the Society of Automotive Engineers International (SAE) and identified by National Highway Traffic Safety Administration (NHTSA) in its Voluntary Guidance for Automated Driving Systems (2017):

- Level 0 – no automation
- Level 1 – driver assistance (e.g., may include some driving assist features)
- Level 2 – partial automation (e.g., includes combined automated functions, but requires driver to remain engaged with driving tasks)
- Level 3 – conditional automation (e.g., driver must be ready to take control of the vehicle upon notice, but is not required to monitor the environment)

- Level 4 – high automation (e.g., vehicle is capable of performing all driving functions under certain conditions)

- Level 5 – full automation (e.g., vehicle is capable of performing all driving functions under all conditions).

The driver may have the option to control the vehicle in Levels 4 and 5. For purposes of this article, an ''autonomous vehicle'' refers to a vehicle that falls within SAE Levels 3-5 (conditional, high, and full automation), which can drive itself in at least some, if not all, circumstances.

The concept of autonomous vehicles is not new. In fact, Carnegie Mellon University demonstrated its first ''autonomous'' vehicle, *Terregator*, in 1984, and cars falling within SAE Levels 1-2, equipped with automated functions like assisted steering, parking, or braking, are already common today. But the rapid technological advancements for highly or fully autonomous vehicles (i.e., SAE Levels 3-5) came recently, driven by better and cheaper sensor technology, unprecedentedly large amounts of data collected from the sensors, and improved AI and machine learning algorithms that process and learn from the data.

Governments recognize the significance of this emerging technology area. In 2016, the United States announced a 10-year, nearly $4 billion investment for real-world pilot projects to help accelerate the development and adoption of safe vehicle automation, as part of the FY17 budget proposal. In 2017, companion bills, H.R. 3388 (''SELF DRIVE Act'') and S. 1885 (''AV START Act''), have been passed and introduced, respectively, by the U.S. House of Representatives and the Senate, which will, among other things, grant NHTSA the exclusive authority to regulate the design, construction, and performance of automated driving systems, and allow 50,000 autonomous vehicles on the road by the second year. Further, at least 30 states have enacted legislation on autonomous vehicles, including laws for facilitating the testing and deployment of autonomous vehicles.

Meanwhile, the private sector is becoming increasingly competitive in the area. More than 260 companies currently contend for venture capital funding, and according to Bloomberg NEF, the amount of private investment in autonomous vehicle companies in the second quarter of 2018 alone was greater than that of the last four years combined. By July 2017, thirteen of the world's 14 largest car manufacturers had announced their plans for introducing autonomous vehicles in the subsequent five or so years, and 12 of the 14 largest technology companies had also revealed their plans for developing the necessary technologies for autonomous vehicles. Together, these companies are spending billions of dollars to develop the underlying technologies for autonomous vehicles.

Underlying Technologies

Autonomous vehicles drive themselves by sensing their surroundings—with data collected from sensors, digital and video cameras, radar and LiDAR technologies, geo-location devices, and other connected cars and infrastructure—and processing such data with software or applications to coordinate their mechanical operations. The increased connectedness of today's vehicles with one another and with the internet also allows them to communicate information on road and traffic conditions, as well as their respective travel speeds and positions, which can be used for providing a safer and more autonomous driving experience. Connectivity of cars can also be used for other beneficial purposes, such as allowing third parties to assess the condition of the vehicle for any repair or maintenance need or to monitor the driver's health or fitness to drive.

The autonomous vehicles' adoption of Internet of Things (IoT) devices will likely accelerate with increasing demands for interconnected autonomous vehicles, which will also likely cause further shifts in automotive design from hardware to software innovations. This will also likely lead to even more instances of traditional car manufacturers and their suppliers working with technology and ridesharing companies. The key technologies implicated include:

- Advanced sensors, digital and video cameras, and image processing algorithms

- Radar technologies for determining various aspects of surrounding objects, such as their distance, angle, and velocity

- LiDAR technologies for sensing road conditions and the vehicle's surroundings

- Connectivity and telecommunication mechanisms, such as dedicated short range communications (DSRC) for vehicles to communicate with others, including vehicle-to-vehicle (V2V) communications and vehicle-to-infrastructure (V2I) communications

- Data analytics, diagnostics, and telematics for analyzing real-time telemetric data, such as vehicle speed and proximity of other cars

- AI, machine learning, and deep learning algorithms for diverse purposes, such as identifying objects as vehicles, pedestrians, or landmarks to help the vehicle adapt to changing circumstances

- Infotainment human-machine interfaces, such as driver monitoring, speech recognition, and natural language interfaces

- Adaptive cruise control (ACC) for controlling the engine, power train, and service brakes, so that the vehicle can follow another vehicle at a pre-selected distance, using data collected from various sources

- Automatic emergency braking (AEB) for detecting objects and automatically applying the brakes to avoid collisions with other objects, using data collected from various sources

- Lateral road lane assistance mechanisms, such as lane departure warning (LDW), lane keeping assist (LKA), and lane centering assist (LCA) technologies, using digital and video cameras to monitor lane markings

Intellectual Property Rights and Considerations

Autonomous vehicle manufacturers, their suppliers, and technology companies seek advantageous positions in the industry by better protecting their technologies with IP. According to an online survey conducted as part of Managing IP's report on *IP and the Automotive Sector*, 95% of industry respondents predicted that IP rights will play an even more important role in the sector. Patents, trade secrets, and copyrights each have their advantages, and appropriate planning and use of IP rights can help a company stay ahead of the curve.

Patents

Patent rights are still used by most companies as their central IP strategy. Traditional car makers are filing more patent applications than ever before, and technology and ridesharing companies are also building robust patent portfolios on automobile technologies, resulting in more than 6,300 issued patents on autonomous driving technologies, according to Bloomberg Law. There are, however, several issues that must be considered.

Patent Subject-Matter Eligibility In the United States, 35 U.S.C. § 101 on patent subject-matter eligibility can be a hurdle for inventions on software, AI, or machine learning used for autonomous driving. Section 101 limits patent-eligible subject matter to a ''process, machine, manufacture, or composition of matter,'' and excludes abstract ideas, laws of nature, and natural phenomena from patentable subject matter. In 2014, this standard became more stringent for ''computer-implemented inventions'' with the Supreme Court's decision in *Alice Corporation v. CLS Bank International*, which established a heightened two-step test: (1) determining whether the invention is directed to a patent-ineligible concept, such as an abstract idea; and (2) determining whether there is any additional inventive step that transforms an abstract idea into something worthy of patent protection. The *Alice* Court held that the patent claims at issue covered abstract ideas without any inventive step because they were directed to a computer-implemented business process that could be performed without a computer.

Although what precisely constitutes an ''abstract idea'' continues to evolve, courts have invalidated subject matter that could be performed through an ''ordinary mental process,'' ''in the human mind,'' or by ''a human using a pen and paper,'' under the *Alice* framework. This creates tension with obtaining patent rights on computer-implemented inventions for autonomous driving, such as AI and machine learning, which often strive to automate or replicate acts performed by human drivers. Despite such tension, the number of issued patents on AI has actually continued to increase even after *Alice*. According to a 2017 report (F. Hidemichi & M. Shunsuke), the average number of annually issued AI patents increased from 250 (2005-2009) to 487 (2010-2014) and rapidly to 1,550 (2015-2016). This is because not all computer-implemented innovations are abstract ideas, and even for those that cover abstract ideas, they can be held patentable if their claimed invention is directed to improving the functioning of the computer itself or an existing technical process. The chances of survival for a patent application on an AI invention thus depend on different factors and can be improved by preparing claim language with sufficient details on how the invention's novel autonomous feature is implemented with different components, so as to improve a certain technical functionality or process.

The status of patent protection for software in the United States is also in flux, and like any other statute, § 101 and its interpretation can be subject to change. David Kappos, a former director of the USPTO, suggested abolishing § 101, and Andrei Iancu, the recently appointed USPTO director, has recently expressed the need for greater clarity in the area of computer-related patents. It is important to monitor how this standard evolves with time.

Standard-Essential Patents (SEPs) The increasing number of different connected devices in autonomous vehicles will require collaboration among various industry players in order to ensure interconnectivity and interoperability. This need is expected to lead to new standards and SEPs, which can raise competition concerns, such as fair, reasonable and non-discriminatory (FRAND) licensing considerations. According to the survey conducted by Managing IP, about 20% of industry respondents explained that they plan to be involved in standard setting, with similar proportions preparing to be involved in patent pools. This trend will likely result in the industry players being faced with whether to participate in the standard-setting process, as well as in more SEP and FRAND licensing issues arising in the context of autonomous vehicles.

More Litigation Even though the traditional automotive industry players have historically been reluctant to sue one another for patent infringement, there has recently been a rise in patent litigation within the industry. Automotive companies and their suppliers were sued in 51 cases in 2008, but were subject to 205 cases in 2013, according to a 2015 article authored by Melinda DeSantis. Further, some expect that there will be even further increased patent litigation activities in the automotive industry as new entrants supply technology in competition with the automobile manufacturers and suppliers, especially for autonomous vehicles that employ various new functionalities that are not provided by the traditional players.

Trade Secrets

Trade secrets are a viable alternative to patent protection for the software-based technology essential to autonomous driving. In fact, for many companies and inventors, trade secret protection may be more attractive than patent protection. This is particularly true in light of the challenges facing software-based patents and patent applications *post*-Alice. Patents require the *quid pro quo* of publicly disclosing the invention in exchange for the protection (and also require the time and expense of applying for and prosecuting the patents until issuance). Trade secret protection, however, can be claimed without ever publicly disclosing the invention and without registration before a government agency, providing a competitive advantage, as long as they remain a secret. Furthermore, the federal Defend Trade Secrets Act allows for recovery of actual losses and for unjust enrichment.

To be best-positioned to protect their trade secrets, companies should take care to protect the confidentiality of their trade secrets. Strategies for doing so include (i) requiring engineers and others with access to the trade secrets sign non-disclosure agreements; (ii) ensuring that trade secret information has limited distribution or availability even within the company; and (iii) having employees departing the company sign statements that they have not taken any confidential information. The company's efforts to limit access to the trade secrets should be carefully documented. Although trade secret protection is attractive for several reasons, if the potential trade secrets are software algorithms that can be reverse-engineered or are otherwise difficult to keep confidential, patent protection is likely the best option as the information may not qualify as a trade secret. There may be more trade secret suits on the horizon as well, as traditional car manufacturers and suppliers acquire start-ups to own key autonomous driving technologies and hire engineers away from their competitors.

Copyrights

Although patents and trade secrets will likely be employed as key IP mechanisms for protecting novel technologies, more copyright issues can be expected to arise from autonomous vehicles. Although copyrights cannot be used to provide IP coverage for a functionality of a proprietary software used in autonomous vehicles, copyrights will provide protections for the underlying source code of the software. Given that open-source software will be used by certain companies, careful considerations must be paid by the users to comply with the open-source licenses, including the notice procedures for using the open-source software. Other forms of IP, such as design rights and trademarks, can also play important roles in differentiating the designs and branding of different autonomous driving technologies.

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