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October 25, 2016

VIA EMAIL (vturner@wilsonturnerkosmo.com)
Vickie E. Turner
Wilson Turner Kosmo LLP
550 West C Street Suite 1050
San Diego, CA 92101

RE: NBA CLW Panel: Driverless Cars

Dear Ms. Turner:

Please find enclosed a copy of my paper regarding driverless cars (autonomous vehicles) for the NBA CLW Panel. Please do not hesitate to contact me if you have any questions or need anything else.

Best regards,

Cathy Hampton

Cathy Hampton
City Attorney

Encl.

AUTONOMOUS VEHICLES AT AIRPORTS AND ITS POTENTIAL IMPACT

Introduction

In a rapidly ever-changing world, autonomous technology is at the forefront of innovation. Specifically, the futuristic idea of autonomous vehicles ("**AVs**") is becoming today's reality, which presents local governments with special challenges to integrate this technology in, sometimes antiquated, codes of law and regulation. One of the most challenging aspects of integrating AVs into the daily norms of society is the implementation of AVs on government owned airport property. Accordingly, the analysis below identifies potential impacts of autonomous vehicles on airports, which include: (1) potential for new security threats, (2) traffic reduction, (3) environmental impacts, (4) safety, (5) demand for domestic flights, (6) parking needs, (7) opportunities to re-purpose existing parking facilities, (8) opportunities for new ways to transport people and things, (9) potential utilization of AVs to transport passengers to and from airports to downtown districts, (10) rental car facilities, (11) taxi operations, (12) TNC operations, and (13) opportunities for AVs to work in tandem with existing operations at airports. This analysis is not exhaustive of the plethora of issues airports will face in implementing the use of AVs at airports, including but not limited to ethical concerns and overall economic impacts of potentially reduced revenue for future airport development.

A. Potential For New Security Threats

AVs present the possibility for new types of security threats for airports. In general, AVs provide opportunities for computer hackers, disgruntled employees, terrorist organizations, and/or hostile nations to target AVs and cause collisions, traffic disruptions or other security threats.[1] AVs are potentially subject to cybersecurity threats because the various electrical components in a car, known as electronic control units ("**ECUs**"), are connected through an internal network.[2] If hackers can gain access to a vulnerable, peripheral ECU, like a car's Bluetooth, they could then potentially take control of safety critical ECUs like the AV's brakes or engine.[3] Additionally, AVs do not rely on information provided to the particular vehicle alone, but require vehicle-to-vehicle ("**V2C**") and vehicle-to-infrastructure ("**V2I**") communication to allow co-operative communication between AVs.[4] Through the introduction of V2I and V2C communication, the electronic systems that guide and control most vehicle functions are not independent of each other but are communicating openly and wirelessly.[5] Because each AV represents an access point into such systems, it has been projected that it may be infeasible to create a system that is completely secure.[6]

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[1] Daniel J. Fagnant, Kara Kockelman, "Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations," Trans. Res. A-Pol. 77, 177 (2015).

[2] Rob Toews, "The Biggest Threat Facing Connected Autonomous Vehicles is Cybersecurity," TechCrunch (August 25, 2016), *available at* https://techcrunch.com/2016/08/25/the-biggest-threat-facing-connected-autonomous-vehicles-is-cybersecurity/.

[3] *Id.*

[4] Asad Khaliq, "Electric and Autonomous Vehicle Security Concerns" (November 9, 2015), *available at* http://large.stanford.edu/courses/2015/ph240/khaliq1/.

[5] *Id.*

[6] Daniel J. Fagnant, Kara Kockelman, "Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations," Trans. Res. A-Pol. 77, 177 (2015).

"We are a long way from securing the non-autonomous vehicles, let alone the autonomous ones," said Stefan Savage, a computer science professor at the University of California, San Diego.[7] The extra computers, sensors, and improved Internet connectivity required to make a car drive itself increase the possible weak points, he said.[8] "The attack surface for these things is even worse," said Savage.[9] In order for an AV to have the ability to understand its environment and drive itself even part of the time, more computers, sensors, and other components must be included,[10] which will expand the possible entry points for attackers and the range of actions they can take. [11] For example, self-driving cars rely on laser scanners and other sensors, which could be used to send false data.[12]

Cybersecurity threats are not an abstract concern, as the potential danger was demonstrated last year when two hackers, as part of a research initiative, remotely took control of a Jeep Cherokee and cut its transmission on the highway.[13] As a result of the hack, Chrysler recalled 1.4 million vehicles.[14] Car companies like Tesla, Fiat, Chrysler and GM have reacted to such concerns by implementing "bug bounty" programs to reward individuals that find and report security flaws in their cars' software, to attempt to secure their systems against vulnerabilities.[15]

Of particular concern for airports is the potential to utilize AVs as a remotely guided weapon and the possibility that AVs could be used to transport weapons like bombs.[16] As shown by the tragic terrorist attack in Nice, France on July 14, 2016, carried out by driving a 19-ton cargo truck into a crowd, killing 84 people, the threat of using AVs in such attacks is gravely serious.[17] Autonomous trucks are already being utilized in multiple industries across the globe, with a projected potential to reach the 20,000-unit annual sales mark in the United States by 2025.[18]

As seen by airports through air traffic control systems, the United States has shown that it is possible to create, maintain and secure large, critical, national infrastructure systems, and the National Institute of Standards and Technology is currently developing a framework to improve

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[7] Tom Simonite, "Your Future Self-Driving Car Will Be Way More Hackable," MIT Technology Review (January 26, 2016), *available at* https://www.technologyreview.com/s/546086/your-future-self-driving-car-will-be-way-more-hackable/.
[8] *Id.*
[9] *Id.*
[10] *Id.*
[11] *Id.*
[12] *Id.*
[13] Rob Toews, "The Biggest Threat Facing Connected Autonomous Vehicles is Cybersecurity," TechCrunch (August 25, 2016), *available at* https://techcrunch.com/2016/08/25/the-biggest-threat-facing-connected-autonomous-vehicles-is-cybersecurity/.
[14] *Id.*
[15] *Id.*
[16] Mark Harris, "FBI Warns Driverless Cars Could be Used as 'Lethal Weapons'," The Guardian (July 16, 2015), *available at* https://www.theguardian.com/technology/2014/jul/16/google-fbi-driverless-cars-leathal-weapons-autonomous.
[17] Daniel Bukszpan, "Could Autonomous Trucks Be the Next Weapon for Terrorists?" CNBC (July 21, 2016), *available at* http://www.cnbc.com/2016/07/21/could-autonomous-trucks-be-the-next-weapon-for-terrorists.html.
[18] *Id.*

critical infrastructure cybersecurity.[19] It has been proposed that recommendations that stem from this framework could be used in AV technologies.[20] Additionally, multiple levels of security for the protection of automotive cybersecurity systems have been suggested,[21] but the ability to protect the systems and the measures necessary to do so will likely require future research and evaluation.[22]

B. Traffic Reduction and Potential Impact on Dwell Times

AVs could potentially create benefits for traffic capacity, as AVs have the ability to follow behind another AV more closely while maintaining higher speeds than cars driven by people, called "platooning." While theoretical estimates suggest increases as high as four or five times the present vehicle capacity, more intermediate estimates propose two times current capacity.[23] Beyond capacity increases, traffic stability could also improve, as interruptions in traffic flow caused by braking would not be as disruptive.[24]

AVs might reduce the number of vehicles necessary to meet transportation needs.[25] For example, an Organization for Economic Cooperation and Development study modelling the use of self-driving cars in Lisbon found that shared "taxibots" could reduce the number of cars needed by 80-90%.[26] Similarly, research by Dan Fagnant of the University of Utah, using traffic data from Austin, Texas, concluded that an autonomous taxi with dynamic ridesharing could replace ten private vehicles.[27] These predictions are consistent with the finding that one extra car in a car-sharing service typically takes 9-13 cars off the road.[28] Some extreme estimates predict that AVs could reduce urban vehicle numbers by as much as 90%.[29]

AVs may also be coordinated using systems that provide each vehicle with a reliable and predictable path from origin to destination, which could practically eliminate the need to allocate

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[19] Daniel J. Fagnant, Kara Kockelman, "Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations," Trans. Res. A-Pol. 77, 177 (2015).
[20] *Id.*
[21] *See, e.g.*, Rob Toews, "The Biggest Threat Facing Connected Autonomous Vehicles is Cybersecurity," TechCrunch (August 25, 2016), *available at* https://techcrunch.com/2016/08/25/the-biggest-threat-facing-connected-autonomous-vehicles-is-cybersecurity/; Mani Amoozadeh, Arun Raghuramu, Chen-Nee Chuah, Dipak Ghosal, H. Michael Zhang, Jeff Rowe, Karl Levitt, "Security Vulnerabilities of Connected Vehicles Streams and their Impact on Cooperative Driving," *available at* https://pdfs.semanticscholar.org/0965/69cb26b8bdefb9de914d8ca68670096e335f.pdf.
[22] Rob Toews, "The Biggest Threat Facing Connected Autonomous Vehicles is Cybersecurity," TechCrunch (August 25, 2016), *available at* https://techcrunch.com/2016/08/25/the-biggest-threat-facing-connected-autonomous-vehicles-is-cybersecurity/.
[23] Joseph L. Schofer and Hani S. Mahmassani, "Mobility 2050, A Vision for Transportation Infrastructure," Prepared for The Association of Equipment Manufacturers By The Transportation Center Northwestern University Evanston, Illinois at 53 (May 2016), *available at* https://www.aem.org/AEM/media/docs/IV2050/AEM-MobilityReport-051616C.pdf.
[24] *Id.*
[25] "If Autonomous Vehicles Rule the World," The Economist (July 1, 2015), *available at* http://worldif.economist.com/article/12123/horseless-driverless.
[26] *Id.*
[27] *Id.*
[28] *Id.*
[29] *Id.*

extra time for trips to account for variability of travel times.[30] Reduced traffic with more predictable patterns could impact airport passenger behavior, as traffic unpredictability is currently a major motivator for passengers to arrive at the airport early.[31] This may make it more difficult for airports to maximize dwell time available for shopping, eating and drinking, which could impact airport revenues.[32] Decreased traffic congestion as a result of AVs is not a foregone conclusion, however, as double digit increases in travel by people in the age groups of over 65 and from 16 to 24, have also been projected.[33] This could cause an estimated additional 2 trillion miles traveled by those two groups by 2050.[34] As long as conventional cars occupy the roads, the optimum conditions for AVs to operate efficiently will be more difficult to obtain.[35]

One possible option to consider for infrastructure supporting both traditional vehicles and AVs is the use of dedicated lanes for AVs.[36] Managed lanes provide opportunities to accommodate self-driving vehicles, which will give AVs the ability to capitalize on the advantages of platooning.[37] Dedicated lanes could also be an incentive to encourage adoption by consumers of AV technology.[38] Creating dedicated lanes would involve costs for the governmental entities responsible for such improvements.[39]

C. Possible Environmental Impacts

Whether AV use will ultimately help or hinder the environment is uncertain. Research by the National Renewable Energy Laboratory and the University of Maryland found that AVs could provide around 15% in fuel savings by maintaining optimal speed and avoiding excessive

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[30] Andrew Somers & Kamal Weeratunga "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 7 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[31] "Driverless Cars and Robot Restaurants: Is This the Airport of the Future?" Stuff.co (October 19, 2015), *available at* http://www.stuff.co.nz/travel/news/73148122/Driverless-cars-and-robot-restaurants-Is-this-the-airport-of-the-future.

[32] *Id.*; *see also id.* ("Removing that [traffic] unpredictability which is why people get to the airport early … that scares the bejesus out of me . . . That is going to have some really dramatic impacts on dwell times. And if you don't need airport car parking, we are going to have to find new sources of income.") (quoting Mr. Bill Matz, director of The Strategic Airport Planning Group).

[33] Joan Lowny, "Will Robot Cars Drive Traffic Congestion Off a Cliff?" Tampa Bay Times (May 16, 2016), *available at* http://cars.tampabay.com/news/business/autos/will-robot-cars-drive-traffic-congestion-off-a-cliff/2277626.

[34] *Id.*

[35] *Id.*

[36] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 32 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[37] Ram M. Pendyala and Chandra R. Bhat, "Activity-Travel Behavior Impacts of Driverless Cars," 93rd Annual Meeting of the Transportation Research Board at 26 (January 12, 2014), *available at* http://www.caee.utexas.edu/prof/bhat/RESEARCH/AV/AutonomousVehicles_ActivityTravelImpacts_PendyalaBhat.pdf.

[38] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 33 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[39] *Id.*

stop-and-go or idling.[40] It has been estimated by a Goldman Sachs research note that AVs could help fuel efficiency in the U.S. by more than 30% due to smoother traffic flows and lower accident-related congestion.[41] Platooning also reduces aerodynamic drag, which creates better fuel efficiency.[42] A 2013 study by the North American Council for Freight Efficiency concluded that trucks can reduce fuel consumption by 10% while platooning.[43] These benefits are in addition to the possibility that AVs will reduce the number of vehicles on the road, as discussed above.

However, benefits to the environment due to AVs are not a guarantee. According to the Department of Energy, AVs could reduce energy consumption in transportation by as much as 90% or increase it by more than 200%.[44] The largest potential drawback from AVs for the environment has been said to be that AVs could cause a dramatic increase in the total number of miles traveled in cars in the United States.[45] Beyond the potential for additional categories of passengers on the road, as referenced above, AVs make car travel easy and may encourage people to take additional trips that they might not take if they had to drive themselves.[46] Commuters might not mind living farther away from work if they could be productive while in the car.[47] In cities like New York where parking is expensive, it has been proposed that it could plausibly be cheaper to send a car driving around the block constantly, instead of paying for an expensive parking space.[48] So, while AVs have the potential to reduce energy consumption, how AVs ultimately impact the environment is yet to be determined.[49]

D. Safety Improvements

AVs are anticipated to benefit roadway safety. It is estimated that over 90 percent of traffic accidents involve human error.[50] By removing human error, AVs have the potential to drastically reduce the frequency of traffic accidents.[51] As major causes of traffic accidents like alcohol consumption, speeding, or driver distractions like text messages are not applicable to

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[40] Jason Bordoff, "How Driverless Cars Could End Up Harming the Environment," The Wall Street Journal (April 27, 2016), *available at* http://blogs.wsj.com/experts/2016/04/27/how-driverless-cars-might-actually-harm-the-environment/.

[41] *Id.*

[42] *Id.*

[43] *Id.*

[44] Justin Worland, "Self-Driving Cars Could Help Save the Environment—Or Ruin It. It Depends on Us," TIME (September 8, 2016), *available at* http://time.com/4476614/self-driving-cars-environment/.

[45] *Id.*

[46] *Id.*

[47] *Id.*

[48] *Id.*

[49] **Zia Wadud, "Will Self-Driving Cars Reduce Energy Use and Make Travel Better for the Environment?" The Conversation (February 26, 2016), *available at* http://theconversation.com/will-self-driving-cars-reduce-energy-use-and-make-travel-better-for-the-environment-55363 (noting both positive and negative impacts and finding that reduced energy use is not the *per se* direct result of AVs).**

[50] Alain L. Kornhauser "Impact of Driverless Cars on the Future of Airports," Passenger Terminal Conference at 11 (April 2013), *available at* http://orfe.princeton.edu/~alaink/Presentations/Kornhauser_PassengerTerminalConf'13_GenevaFinal_031813.pdf.

[51] *Id.*; Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 7 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

AVs, roadway safety is expected to improve.[52] One study by the Eno Centre for Transportation, a non-profit group, estimates that if 90% of cars on American roads were AVs, the number of accidents would fall from 5.5 million per year to 1.3 million, and road deaths from 32,400 to 11,300.[53] Improvements in driver safety could positively impact disruptions at airports caused by traffic accidents, as it could reduce the number of accidents occurring on airport property.

E. Impact on Domestic Flights

It is possible that AVs could lower the demand for domestic flights, particularly for short distances. AVs eliminate the time it takes to arrive at the airport, check in and pass through security, while maintaining the "in travel" productivity of flying.[54] Passengers may opt to travel by AV instead of flying, as people could sleep or prepare for a meeting the next day while on the road.[55] For example, a business traveler who would normally fly out the night before and check into a hotel for a business meeting may just decide to drive.[56] Additionally, with the anticipated higher highway speed limits and more comfortable vehicle designs, AVs could provide a cheaper, faster and more comfortable alternative to flying.[57]

As a result of these perceived passenger conveniences, it has been proposed that AVs could result in a substantial reduction in air travel of less than 500 km, particularly in North America, with the only viable short-distance flights being hub-spoke feeder flights.[58] A strategist for Audi has boldly predicted that "We can disrupt the entire business of domestic flights," said Sven Schuwirth, Vice President of Brand Strategy and Digital Business, "I think that vision is probably 20 years from now."[59]

F. Parking Implications

Parking is a significant revenue generator for airports, and AVs could have a disruptive impact on this traditional source of revenues. It has been suggested that AVs would not require

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[52] "If Autonomous Vehicles Rule the World," The Economist (July 1, 2015), *available at* http://worldif.economist.com/article/12123/horseless-driverless.

[53] *Id.*

[54] Nick Vivion, "The Breakthrough Magic of Driverless Cars Isn't Urban. It's Regional!" Sabre (September 7, 2016), *available at* https://www.sabre.com/insights/the-breakthrough-magic-of-driverless-cars-isnt-urban-its-regional/.

[55] Marcus Fairs, "Driverless Cars Could Spell the End for Domestic Flights, Says Audi Strategist," Dezeen Magazine (November 25, 2015), *available at* http://www.dezeen.com/2015/11/25/self-driving-driverless-cars-disrupt-airline-hotel-industries-sleeping-interview-audi-senior-strategist-sven-schuwirth/.

[56] Gabe Zaldivar, "How Driverless Cars Could Mean Huge Losses For Airlines and Hotels," Travel Pulse (December 7, 2015), *available at* http://www.travelpulse.com/news/business-travel/how-driverless-cars-could-mean-huge-losses-for-airlines-and-hotels.html.

[57] Kevin LaRoche, Robert Love, "Autonomous Vehicles – Revolutionizing Our World," Borden Ladner Gerais LLP at 19 (2016), *available at* http://www.blg.com/en/NewsAndPublications/Documents/Autonomous-Vehicles2016.pdf

[58] Alain L. Kornhauser, "Impact of Driverless Cars on the Future of Airports," Passenger Terminal Conference at 19 (April 2013), *available at* http://orfe.princeton.edu/~alaink/Presentations/Kornhauser_PassengerTerminalConf'13_GenevaFinal_031813.pdf.

[59] Marcus Fairs, "Driverless Cars Could Spell the End for Domestic Flights, Says Audi Strategist," Dezeen Magazine (November 25, 2015), *available at* http://www.dezeen.com/2015/11/25/self-driving-driverless-cars-disrupt-airline-hotel-industries-sleeping-interview-audi-senior-strategist-sven-schuwirth/.

airport parking, because AVs can return home or leave to collect a new passenger.[60] When a passenger is finished with a car, it would not be left idle, and instead the AV would drive itself to its next customer, according to real-time consumer demand and travel hotspots.[61] Some people project that with AVs, there will also be no need for park-and-ride at public transport terminals.[62] Experts have been quoted as anticipating dramatic impacts on parking as currently utilized:

> Dr. Kara Kockelman, University of Texas at Austin: "It really depends on how many people let go of personal vehicle ownership. I think we'd lose 50 percent of parking demand. If everyone did it, you could get rid of 7 out of 8 cars on the road, so you'd need an eighth of the spots."[63]
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> "The biggest impact is going to be on parking. We aren't going to need it, definitely not in the places we have it now," Alain L. Kornhauser, a researcher in autonomous vehicles at Princeton University. "Having parking wedded or close to where people spend time, that's going to be a thing of the past. If I go to a football game, my car doesn't need to stay with me. If I'm at the office, it doesn't need to be there. The current shopping centre with the sea of parking around it, that's dead."[64]

As an alternative projection, AVs may not eliminate the need for airport parking altogether, but instead change how cars are parked at airports. With AVs, parking could be transformed by vehicles parking themselves.[65] After dropping off passengers, vehicles could drive themselves to a multi-story parking garage, where an automated mechanical system would stack vehicles close together with no need to leave space to open doors.[66] AVs could be parked nose to tail or side by side to save space, or could even be stacked on top of each other in an automated parking lot that dispatches the vehicle at the front of the line when it's needed, autonomously driving straight to pick up a passenger.[67] This will eliminate congestion caused by

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[60] "Driverless Cars and Robot Restaurants: Is This the Airport of the Future?" Stuff.co (October 19, 2015), *available at* http://www.stuff.co.nz/travel/news/73148122/Driverless-cars-and-robot-restaurants-Is-this-the-airport-of-the-future.

[61] Josef Hargrave, "Connectivity / Driverless Cars to End Parking Problems" (February 14, 2013), *available at* http://thoughts.arup.com/post/details/273/driverless-cars-to-end-parking-problems.

[62] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 11 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF

[63] Patrick Sisson, "How Driverless Cars Can Reshape Our Cities," Curbed (February 25, 2016), *available at* http://www.curbed.com/2016/2/25/11114222/how-driverless-cars-can-reshape-our-cities.

[64] *Id.*

[65] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 11 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[66] *Id.*

[67] Josef Hargrave, "Connectivity / Driverless Cars to End Parking Problems" (February 14, 2013), *available at* http://thoughts.arup.com/post/details/273/driverless-cars-to-end-parking-problems.

drivers cruising around looking for parking,[68] and provide opportunities for airports to develop parking garage efficiency for storing and retrieving AVs.[69]

G. Opportunities to Re-Purpose and Re-Imagine the Use of Space

If AVs dramatically reduce the need for parking spaces, airports will have the opportunity to repurpose real estate currently dedicated to parking. The potential reduction in the total number of vehicles, together with lower parking requirements for vehicles, may release valuable land currently occupied for parking, to be used for other purposes.[70] There may also be surplus land due to a reduction in lane widths and the number of lanes, which could then be used to provide better amenities for other road users such as cyclists and pedestrians.[71] AVs could create a more pedestrian-dominated environment, where vehicles would need to take a more subsidiary role, increasing the amount of space open for public use, including space for other kinds of alternate transportation.[72] Drop-offs and pick-ups at curbside or designated areas could increase,[73] which could be an important factor to consider for future development of land-side facility design and operation. The reduction of parking needed in direct proximity to airports could provide opportunities for other revenue generating ventures like shops, restaurants or entertainment.

H. Opportunities for Revolutionized Transportation of People and Things at Airports

Airports have been leaders in the use of automation, embracing it in the movement of people in and around airports.[74] AVs present opportunities to expand on automated movement of people, as shown by Heathrow's "pods"—an on-demand fully-automated transport service

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[68] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 11 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[69] Alain L. Kornhauser, "Impact of Driverless Cars on the Future of Airports," Passenger Terminal Conference at 22 (April 2013), *available at* http://orfe.princeton.edu/~alaink/Presentations/Kornhauser_PassengerTerminalConf'13_GenevaFinal_031813.pdf.

[70] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 11 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[71] *Id.*

[72] Peter Dockrill, "Self-driving Cars Could Mean the End of Parking Spaces, and That's Great for Cities," Science Alert (February 29, 2016), *available at* http://www.sciencealert.com/self-driving-cars-could-mean-the-end-of-parking-spaces-and-that-s-great-for-cities.

[73] ACRP Problem Statement: 16-07-06 Recommended Allocation: -- Impact of Autonomous/Driverless Vehicle to Airport Landside Terminal Planning and Design, *available at* http://onlinepubs.trb.org/onlinepubs/acrp/fy2016ps/16-07-06Zhang.pdf.

[74] Alain L. Kornhauser, "Impact of Driverless Cars on the Future of Airports," Passenger Terminal Conference at 3 (April 2013), *available at* http://orfe.princeton.edu/~alaink/Presentations/Kornhauser_PassengerTerminalConf'13_GenevaFinal_031813.pdf.

operating between remote parking lots and Terminal 5, replacing buses.[75] The pods operate on a protected guide-way with a waiting time of under a minute.[76]

AVs also have the potential to move luggage from place to place.[77] Other proposals include using AVs to transport airplanes for engines-off taxiing, with the development of towing vehicles for that will, on command, autonomously navigate to an assigned aircraft, attach itself, tow the aircraft to an assigned location (a runway for departures, a gate for arrivals), autonomously detach itself, and navigate to an assigned location, either a staging area or to service another aircraft.[78] The proposed benefits include the potential for higher precision navigation, decrease in human workload to pilots and controllers through automated decision making, and the economic and environmental benefits that arise from engines-off taxiing.[79]

I. Opportunities to Utilize AVs to Transport People from Airports to Downtown City Districts

AVs provide the prospect of expanded methods for transporting people to and from the airport to downtown city districts. For example, the region of Flanders, a public bus operator and the Brussels airport are working together on a pilot project to introduce automated solutions to transport passengers from and to the airport from the Belgian Capital.[80] The project uses driverless busses, with expected implementation in 2018, with the object to transport 250 passengers per hour and per direction.[81] The automated shuttles are viewed as a complementary service to major existing transport solutions.[82]

Similarly, a feasibility study is being conducted on the "Flying Carpet" project, with aims to facilitate the implementation of autonomous vehicles between Groningen, Netherland's city center and Groningen airport.[83] The goal is to use AVs to transport passengers from their car to the departure and arrival areas.[84] Because the new technology will catch the attention of

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[75] Andrew Somers & Kamal Weeratunga, "Automated Vehicles: Are We Ready?" Internal Report on Potential Implications for Main Roads WA at 10 (2015), *available at* https://www.mainroads.wa.gov.au/Documents/Automated%20Vehicle%20Report.RCN-D15%5E2381741.PDF.

[76] *Id.*

[77] Nick Vivion, "The Breakthrough Magic of Driverless Cars Isn't Urban. It's Regional!" Sabre (September 7, 2016), *available at* https://www.sabre.com/insights/the-breakthrough-magic-of-driverless-cars-isnt-urban-its-regional/.

[78] Robert Morris, et al., "Self-Driving Aircraft Towing Vehicles: A Preliminary Report," Artificial Intelligence for Transportation: Advice, Interactivity and Actor Modeling: Papers from the 2015 AAAI Workshop (2015).

[79] *Id.*

[80] Automated Vehicles at Brussels Airport (April 23, 2015), *available at* http://www.citymobil2.eu/en/News-Events/News/Automated-vehicles-at-Brussels-airport/.

[81] *Id.*

[82] *Id.*

[83] "Autonomous Vehicles – Impacts on Mobility of the Future," Care-North Plus, Carbon Responsible Transport Strategies for the North Sea Area, *available at* http://archive.northsearegion.eu/files/repository/20160113160412_CN+FactSheet_AutonomousTransport.pdf.

[84] *Id.*

passengers, the hope is that it will present a highly desirable opportunity for advertisers.[85] Additionally, the project aims to reduce costs in the long-run by using fewer bus drivers.[86]

J. Rental Car Facilities

There are differing views on the potential implications of AVs on rental car companies. On the one hand, some experts believe that car rental companies may be "early adopters" of the technology, particularly if insurance initiatives are offered.[87] Rental car companies are holding themselves out as being well-equipped to facilitate AV transportation, and according to Chris Brown, editor of Auto Rental News Magainze, "[a]utonomous vehicles will still need to be managed – fleeted, de-fleeted, maintained and moved – and car rental companies are poised to do that, as they already run the largest fleets in U.S. and even the world."[88] If AVs are provided using a "pay-as-you-go system," this plays into car rental's strengths of customer interface and management for the long term.[89] If rental car companies utilize AVs, then offsite parking of vehicles with close to terminal vehicle distribution is a conceivable scenario, with strong implications for terminal pickup and distribution.[90]

Rental car companies may go so far as to adopt a business model which does not require leasing of airport property, because cars can be dispatched from farther away.[91] This could impact airport revenues currently collected from leases between rental car companies and airports. On the other hand, an extreme view has been taken that rental cars will not survive once AVs take hold, particularly in urban markets.[92]

K. Further Erosion of the Taxi Industry

Compounding the impact already felt by the widespread acceptance of TNCs, AVs are expected to further reduce the taxi industry's market share. A Columbia University study concluded that a fleet of 9,000 autonomous vehicles could replace all 13,000 taxis in New

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[85] *Id.*

[86] *Id.*

[87] Alain L. Kornhauser, "Impact of Driverless Cars on the Future of Airports," Passenger Terminal Conference at 24 (April 2013), *available at* http://orfe.princeton.edu/~alaink/Presentations/Kornhauser_PassengerTerminalConf'13_GenevaFinal_031813.pdf.

[88] "How Will Autonomous Vehicles Impact Car Rental? Enterprise Holdings: 'U.S. Car Rental Industry May Very Well Be One of Early Adopters'" Urban Life Institute St. Louis (April 25, 2016), *available at* https://www.enterpriseholdings.com/en/press-archive/2016/04/how-will-autonomous-vehicles-impact-car-rental.html.

[89] *Id.*

[90] Alain L. Kornhauser, "Impact of Driverless Cars on the Future of Airports," Passenger Terminal Conference at 24 (April 2013), *available at* http://orfe.princeton.edu/~alaink/Presentations/Kornhauser_PassengerTerminalConf'13_GenevaFinal_031813.pdf.

[91] ACRP Problem Statement: 16-07-06 Recommended Allocation: -- Impact of Autonomous/Driverless Vehicle to Airport Landside Terminal Planning and Design, *available at* http://onlinepubs.trb.org/onlinepubs/acrp/fy2016ps/16-07-06Zhang.pdf.

[92] Kevin LaRoche, Robert Love, "Autonomous Vehicles – Revolutionizing Our World," Borden Ladner Gerais LLP at 19 (2016), *available at* http://www.blg.com/en/NewsAndPublications/Documents/Autonomous-Vehicles2016.pdf.

York.[93] AVs could result in passengers spending less time waiting, and paying less per mile, because the highest cost for taxi operators is paying drivers.[94] Without a driver, "the cost of taking an Uber anywhere becomes cheaper than owning a vehicle," Travis Kalanick, CEO of Uber, said last year.[95] Uber's first test vehicle has already been seen on the streets of Pittsburgh.[96] These changes could impact current ground transportation operations at airports and the revenues currently collected from taxi operators.

L. Changes in TNC Operations

TNCs appear well-situated and eager for the utilization of AVs. Ride sharing is expected to expand with driverless vehicles, following the platforms developed by companies like Uber and Lyft.[97] AVs would contribute to reducing the cost and uncertainty of ride sharing by increasing the supply pool and enabling rapid dispatch of driverless vehicles.[98] Uber foresees having an entirely driverless fleet by 2030, at which point the service hopes to be so inexpensive and ubiquitous that it will render car ownership obsolete.[99]

M. Transportation Working in Tandem

While AVs could be viewed as detrimental to the demand for flights at airports, others foresee AVs working in conjunction with current forms of transportation. For example, at a recent event in Atlanta hosted by the Urban Land Institute, regarding "Evolving Transportation & the Future of Commercial Real Estate," transportation leaders discussed the topic of AVs. Both Sam Bond, General Manager for Lyft, and Rukiya Thomas, MARTA Chief of Staff, offered a view where AVs compliment current transportation forms, highlighting how MARTA and AVs could work in tandem to improve mobility for everyone.[100] Bond noted that presently, one out of every five Lyft trips in Atlanta originates or ends at a MARTA station.[101] MARTA's Chief of Staff explained a vision where driverless cars could be timed to pick up transit riders at their origin, delivering them to transit stations to coincide with arriving trains, helping to bring a critical mass of riders to mass transit.[102] Similarly, AVs could be timed to pick up and drop off passengers based on flight departure and arrival times, transporting passengers to and from airports more efficiently.

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[93] "If Autonomous Vehicles Rule the World," The Economist (July 1, 2015), *available at* http://worldif.economist.com/article/12123/horseless-driverless.
[94] *Id.*
[95] *Id.*
[96] *Id.*
[97] Joseph L. Schofer and Hani S. Mahmassani, "Mobility 2050, A Vision for Transportation Infrastructure," Prepared for The Association of Equipment Manufacturers By The Transportation Center Northwestern University Evanston, Illinois at 55 (May 2016), *available at* https://www.aem.org/AEM/media/docs/IV2050/AEM-MobilityReport-051616C.pdf.
[98] *Id.*
[99] Kevin LaRoche, Robert Love, "Autonomous Vehicles – Revolutionizing Our World," Borden Ladner Gerais LLP at 4 (2016), *available at* http://www.blg.com/en/NewsAndPublications/Documents/Autonomous-Vehicles2016.pdf
[100] Michael Kahn, "Atlanta's Driverless Future In the Eyes of Experts," Curbed Atlanta (February 22, 2016), *available at* http://atlanta.curbed.com/2016/2/22/11084458/atlanta-selfdriving-cars-uber.
[101] *Id.*
[102] *Id.*

Conclusion

If implemented, AVs have the potential to dramatically change the transportation industry. Although there is the possibility that AVs could have a detrimental impact on airports, many opportunities exist for airports to utilize AVs and seek ways for AVs to work in conjunction with current airport offerings. Local governments must be adaptable to rapidly changing technology and innovation in order to meet the demands and needs of the public.