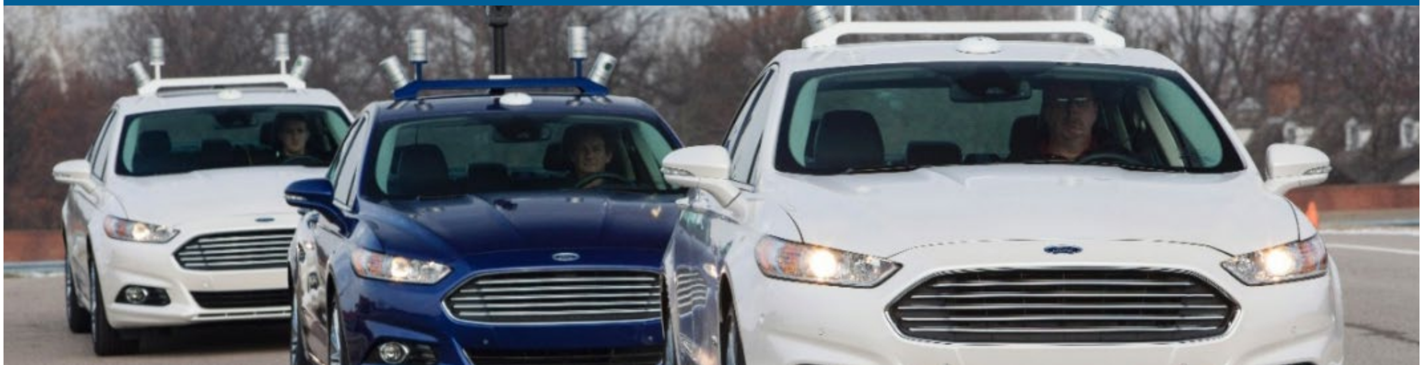
LAND USE TRANSPORTATION ENVIRONMENT PARKS & OPEN SPACES HOUSING

REGIONAL PLANNING NEWS



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STH 60 Northern Reliever Route Feasibility Study

At the request of Washington County, the Southeastern Wisconsin Regional Planning Commission conducted a feasibility study of a northern reliever route to STH 60 between the western limits of the City of Hartford and IH 41. The study was conducted in response to a request from the Hartford Area Development Corporation to the Washington County Board Chairperson, which was prompted by their concerns of increasing traffic volume, congestion, and safety problems on STH 60, and in particular, the effect of increasing truck traffic. The Commission staff worked with staff from concerned and affected local governments, Washington County, and the Wisconsin Department of Transportation (WisDOT) to identify and evaluate potential STH 60 northern reliever routes and improvements to STH 60.

More information on this study is available at: www.sewrpc.org

COMMENTARY ON PLANNING IMPLICATIONS OF DRIVERLESS VEHICLE TECHNOLOGY

Introduction

The development of autonomous vehicles – more commonly known as driverless cars and trucks – is presently receiving increased attention in various segments of the public media. This attention is due in part to recent announcements by firms such as Uber and Ford which indicate that driverless cars will be operational within less than a decade, far sooner than once expected. Because the Commission's latest transportation system plan has a design year of 2050, beyond the date at which driverless vehicles may be expected to be introduced into the regional fleet of cars and trucks, commentary on the status of development of autonomous vehicles and on the implications of that status for regional planning is in order.

Current State of Development of Driverless Vehicle Technology

The concept of driverless cars, and the development of driverless car technology have a history of 50 years or more. The late 1960s and early 1970s saw the development of autonomous vehicle technologies somewhat similar to the present driverless car technology. These earlier versions of the current driverless car technology included two of particular interest, one was then known as personal rapid transit and the other as dual mode. The former envisioned the operation of small, externally controlled, driverless cars at close spacing and at relatively high speeds on dedicated guideways. A demonstration project of this technology was constructed, and still operates, on the University of West Virginia campus located at Morgantown, West Virginia. This demonstration project is considered as the predecessor of people mover systems constructed in the central business districts of some large metropolitan areas such as Detroit, and at some large airports such as Chicago and Atlanta.

Dual mode systems envisioned the operation of individual on-vehicle controlled cars at close spacing and at high speeds on dedicated lanes of existing or proposed freeways. Lateral location within the dedicated lane was to be achieved by use of an electronic link to a wire buried in the center of the dedicated lane. Longitudinal spacing was to be achieved by on-vehicle sensors and automated control of acceleration and braking. The automobiles of the system were envisioned as not only capable of operating in fully automated mode on the dedicated lanes, but also under operator control over the street and highway system for local travel and for access to the dedicated freeway lanes.

It is interesting to note that the Commission in 1971 was an active participant in a coalition created to study the application of the dual mode system in the greater Milwaukee area. The study was supported by a grant from the Urban Mass Transportation Administration of the U.S. Department of Transportation, the predecessor agency to the present Federal Transit Administration. The coalition included the Allis-Chalmers Corporation, the A M

Vehicle-to-Vehicle (V2V) and vehicle-to-external (V2X) communications
Credit: National Highway Traffic Safety Administration

Interconnectivity of Vehicles

The eventual interconnection of vehicles through devices installed in vehicles (or in the case of pedestrians/bicyclists, through portable devices) is intended to improve safety by making a driver aware of upcoming roadway conditions, maneuvers by nearby vehicles (such as a sudden stop), and the presence of pedestrians and bicyclists. Interconnection between vehicles is envisioned to be over relatively short distances. The vehicles could also be connected to infrastructure along the roadway, either providing the driver/vehicle information about an upcoming roadway feature (such as the presence of a red signal light or a construction site) or connecting the vehicle to a master system that uses the vehicle presence and speed to optimize traffic signal timing or transportation management systems (such as ramp signals). With respect to automated vehicles, vehicle connectivity could allow the high-speed platooning of vehicles.

General Corporation (American Motors), Cornell Aeronautical Laboratory, Milwaukee County, and the Commission.[1]

Driverless car technology is also being advanced in an evolutionary manner by the provision of automated features that enhance the safety and convenience of conventional automobiles. These features include automated emergency braking, lateral placement within traffic lanes, assistance in lane changing, and automated parallel parking. The experience being gained in this evolutionary approach may be expected to benefit the development of fully automated vehicles.

The development of driverless vehicles is currently being pursued by a number of "high tech" firms such as Apple and Google, by a number of automobile manufacturers such as Ford, General Motors, and Volvo, and by various combinations of high tech and automobile manufacturing firms. Some of the firms involved in driverless car technology use hybrid or full electric propulsion systems for the automated vehicles, while others use conventional internal combustion engine propulsion. Military applications of driverless truck technology are also being pursued by firms such as the Wisconsin based Oshkosh Corporation. The automation of transit operations has also been long pursued under a number of evolutionary projects, some utilizing technology similar to that of dual mode.

The driverless car technology utilized by the various firms involved is basically similar, consisting of complex on-vehicle video and radar sensors that serve to place and orient the vehicle within the environment, and a computer and attendant software which control the steering, acceleration, and braking of the vehicle in response to the perceived environmental conditions. These on-vehicle sensors and control facilities direct the operation of the vehicle, navigating the vehicle through the street and highway system as an integral part of the traffic stream, responding to signage, obstacles, and roadway conditions. Some forms of the sensor and control equipment also employ global positioning system (GPS) receivers for positioning, and supplementary high precision maps of the lane configurations of multi-lane arterial facilities and of major arterial intersections. Light detection and ranging (LIDAR) sensors may be used with some systems, and communication with other driverless cars and roadway infrastructure may also be provided. The development of the latter, known as connected car technology is being pursued separately from driverless car technology per se by the U.S. Department of Transportation.

The Federal program envisions that all vehicles using the street and highway system would be fitted with equipment that connects the vehicles via wireless technology. New vehicles would be expected to have such equipment factory installed, while older vehicles would be retrofitted with the appropriate transmitting and receiving equipment. The vehicles would not only be in constant communication with one another, but also with infrastructure and would maintain appropriate vehicle spacing, promote proper compliance to signage and signalization particularly at intersections, and respond to emergency conditions. Traffic streams would consist of mixed driver and driverless vehicles. The envisioned enhanced street and highway system would be an element of what have been termed "Smart Cities" which are envisioned as applying digital computer technologies to collect, analyze, and act upon a wide array of data.

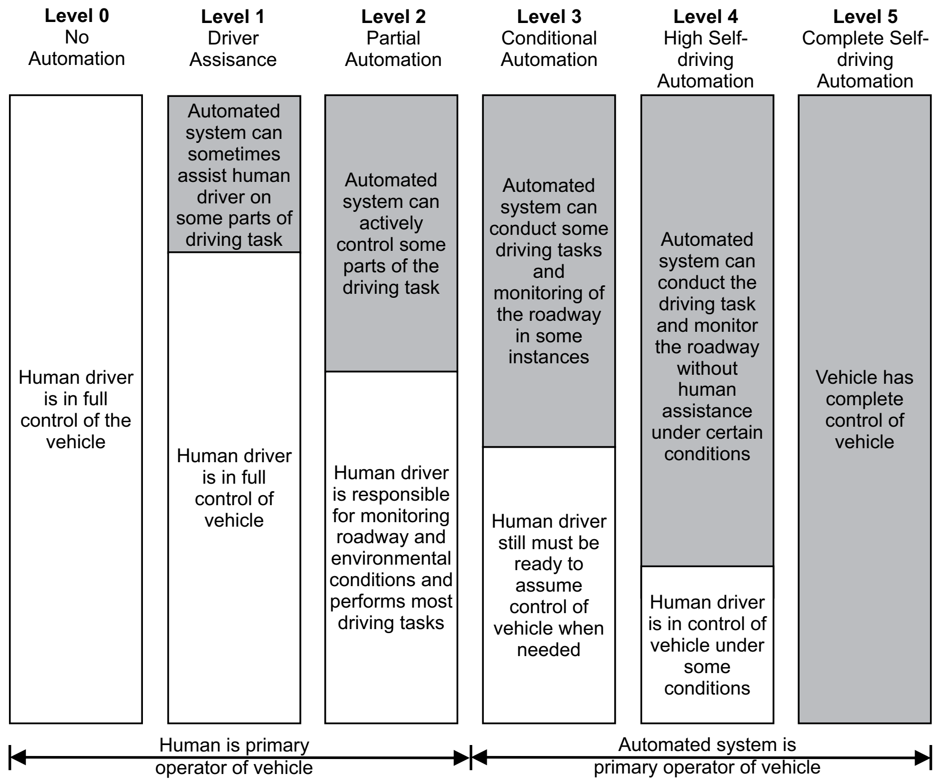
Some of the firms involved in the development of the technology concerned envision advancing the vehicles to be used to the fifth level of automation shown on Figure 1. The vehicles would not be equipped with a steering wheel or pedal brake and acceleration control, and would have an unconventional seating arrangement. Other – perhaps more practical – firms engaged in the development of the technology, envision the use of vehicles that retain a steering wheel and pedal controls, advancing the level of automation to the fourth level depicted on Figure 1. The retention of controls and attendant instrumentation would enhance safety under all operating conditions, facilitate operation under inclement weather conditions and on roadways lacking adequate lane demarcation, and permit off-road operation, and perhaps expedite market acceptance and the introduction of the technology. This latter approach would be clearly evolutionary and would facilitate system planning.

Development of driverless car technology has advanced to a stage where, Uber, for example, recently provided a demonstration of its taxi service utilizing driverless cars. The demonstration was provided in the Pittsburgh, Pennsylvania area.

[1] *See Milwaukee County Dual Mode System Study, Volume 1, Summary Report, Advanced Technology Center, Allis-Chalmers Corporation, December 1971.*

Figure 1

LEVELS OF AUTOMATION



Source: U.S. Department of Transportation and SEWRPC

Many of the current vehicles on the roadway are equipped with some Level 1 automation technology that assist the driver in operating the vehicle, such as cruise control, lane guidance, and basic park assist. Only a few manufacturers have vehicles on the road at the start of 2017 that are equipped with technologies at Level 2 automation. Level 2 automation includes automated parking technology and technology that assists in operating the vehicle under congested roadway conditions. Beginning in 2017, more vehicle manufacturers will be introducing more vehicles to the market that are equipped with such technology. Firms are currently developing the next evolutionary stage of development of automated vehicles (Levels 3 and 4 automation), where the automated vehicle controls the operation of the vehicle under certain conditions—such as on a freeway—with monitoring by either the human driver or the automated system. The last stage (Level 5 automation) is envisioned by some firms as the ultimate future of personal vehicle travel—complete control of the vehicle by the automated system without any assistance by the vehicle occupants.

Uncertainties Concerning Application

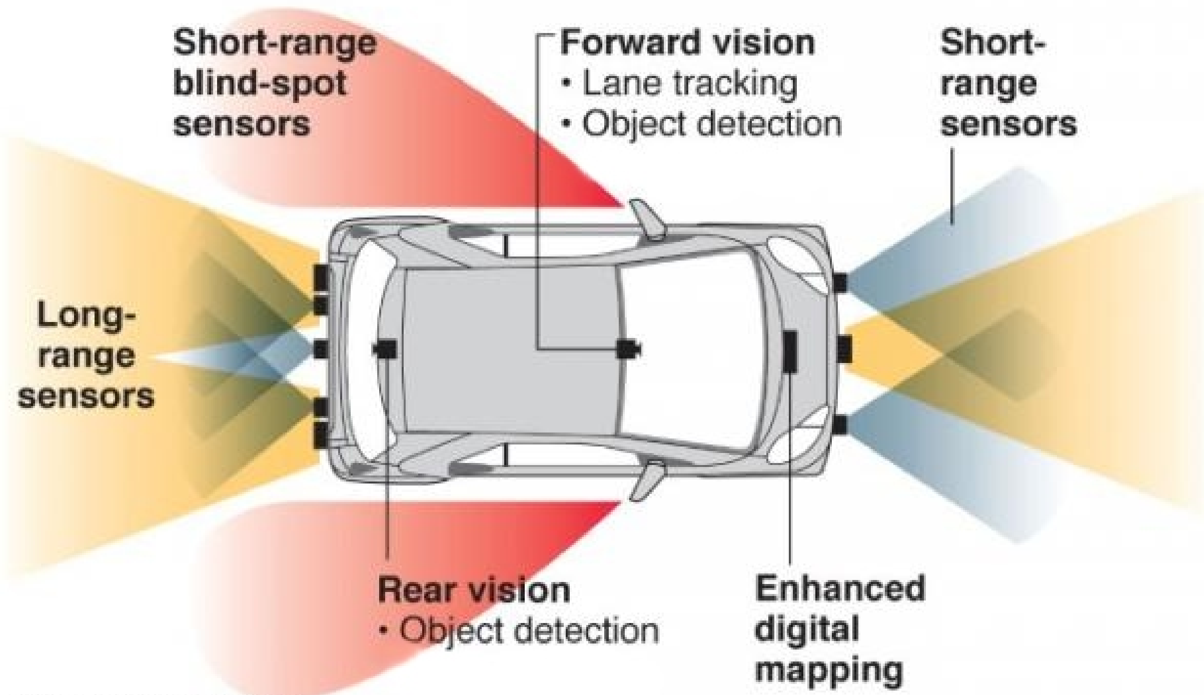
While the recent announcements by some of the firms involved in the development of driverless car technology are optimistic concerning the timing of the application of the technology, major uncertainties still exist concerning the timing of such application. Some of these uncertainties relate to the technology per se, and include, among other challenges, the behavior of driverless vehicles in the presence of parked vehicles, bicyclists, and pedestrians, and the operation of the vehicles under severe weather conditions including particularly heavy snowfalls. Importantly, some of the uncertainties relate to the need for and effects of public regulation. The regulatory issues involved include legal liability for accidents and injuries both on and off vehicle, insurance requirements, restrictions on use including use by children, the aged, and the disabled, restrictions on geographic areas of operation, and police and public works procedures. While resolution of the remaining technological problems may be expected to be successfully addressed by the developers, the resolution of the regulatory issues will require legislation by Federal, state, and local governments and will, therefore, take time.

A particularly important uncertainty concerning the application of driverless car technology relates to market acceptance. To date, two different ways of implementing the technology are being considered by the firms engaged in the development of the technology. Uber apparently envisions implementing the technology by providing a corporately owned and operated fleet of driverless cars for each selected service area – presumably selected metropolitan areas – to provide on-call Uber-operated taxi service. The envisioned service would be similar to that now provided by Uber with the exception of the vehicle ownership and presence of a driver, and should find market acceptance. This approach would abruptly introduce a limited number of driverless cars into the existing street and highway system and attendant traffic streams, and would over time reduce the need for personal ownership and use of conventional vehicles in the service area. This approach would require cooperation between Uber and selected car manufacturers to provide the Uber-owned fleets.

In contrast to this corporate fleet ownership approach, auto manufacturers may choose to implement the technology by offering driverless cars for sale to the public. Market acceptance would initially be uncertain. In any case, the operation of the market would result in the replacement of conventional vehicles relative slowly over time. It is possible that a significant number of potential car owners would prefer to continue to be able to

Figure 2

SENSOR TECHNOLOGY USED TO GUIDE DRIVERLESS VEHICLES



This figure represents one conceptualization of the sensors that could be used for driverless vehicles.

Source: General Motors and SEWRPC

Graphic: Orlando Sentinel

purchase conventional vehicles because they enjoy driving a car. In this respect, it should be noted that manufacturers are still producing cars with standard transmissions even though more efficient automatic transmissions have been available for many decades. Of course, these two approaches to implementation of the driverless car technology are not mutually exclusive. The second approach is seen by some observers as following the first by some years.

Global Implications

The industrial revolution which began in about 1800 occurred in two phases; the first marked by the invention and use of the steam engine and the development of railway systems, this first phase sometimes being known as the railway age. The second phase was marked by the invention and use of the internal combustion engine and the development of modern highway and airway systems; perhaps culminating in the construction of the interstate highway system in the United States. The industrial revolution was greatly disruptive of the then existing ways of conducting businesses and managing industries, of the types and patterns of land use, of human lifestyles, and of environmental quality. The industrial revolution, however, resulted in a massive increase in employment of all types and facilitated a great migration of people from rural to urban areas. The digital age which has now begun may be expected to be as disruptive of all phases of life as was the industrial revolution. Unlike the industrial revolution, however, the digital age – marked by automation of which the driverless car is an example – may not produce, but rather may reduce employment. The widespread use of driverless cars and trucks – as already noted a form of digital automation – may be expected to be disruptive of a number of existing institutions including automobile manufacturers and their suppliers, conventional taxi and trucking businesses, insurance and lending institutions, public mass transit providers, and government at all levels. Long established land use patterns may also experience disruption including changes in the locations and densities of particular uses. These kinds of disruptions and changes may be expected to take place over a relatively long period of time.

Implications for Regional Transportation Planning

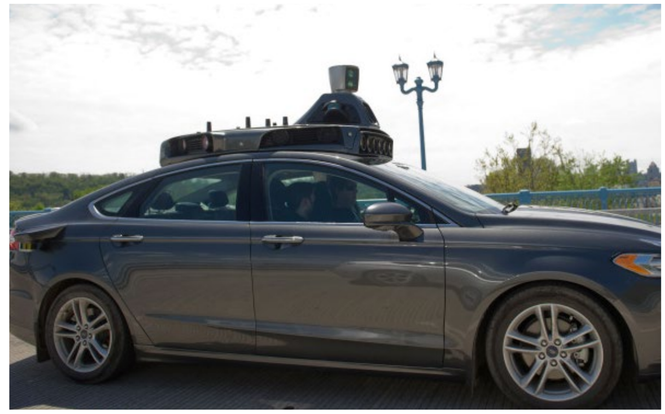
The kinds of socio-economic disruptions that may be expected to accompany the wide-spread use of driverless cars and trucks cannot be addressed by planning at the local and regional levels. The introduction and widespread use of driverless cars and trucks will, however, have implications for local and regional planning efforts. With respect to transportation planning, these implications relate to the characteristics and extent of the existing street and highway system; the number of vehicles in operation within the Region, trip production and distribution; arterial traffic volumes, and service levels; and related arterial capacities. Also of concern, are the effects on public transit including upon demand responsive services and upon conventional bus, light rail, and commuter rail system utilization.

Any consideration of the potential effects of the use of driverless cars and trucks on the transportation system of the Region must at this time be speculative. Such speculative consideration may be facilitated by knowledge of the character, use, and performance of the existing transportation system.

With respect to the characteristics and extent of the existing street and highway system within the Region, Commission data indicate that there are presently approximately 12,500 center line miles and 27,000 lane miles of public streets and highways within the Region. Of this total, approximately 3,300 center line miles and 9,000 lane miles consist of arterial as opposed to collector and land access facilities. Of this arterial mileage, approximately 270 center line miles and 1,300 lane miles consist of freeway as opposed to standard arterial facilities. Concerns about the effects of the operation of driverless vehicles on the existing street and highway system need to be focused on the arterial facilities. With respect to such factors as horizontal and vertical alignment, roadway pavement and lane widths and configurations, lighting, signage and signalization, the existing arterial system is clearly able to accommodate the operation of driverless vehicles. The operation of driverless vehicles may require enhanced center line and lane demarcation on arterial facilities particularly at freeway-to-freeway, freeway-to-standard arterial, and standard arterial street intersections. The operation of driverless vehicles may also require the preparation of detailed maps of the lane configurations at complicated arterial intersections. It has been suggested that post-mounted, programmed digital transmitters could be provided at complex intersections to aid driverless vehicles in navigating through the intersections.

The capacity of the facilities comprising the existing arterial system currently range from approximately 800 vehicles per lane per hour for standard arterials to approximately 2,200 vehicles per lane per hour for freeway facilities. It has been suggested that driverless vehicles would reduce congestion by increasing lane capacity. However, such capacity increase can only be provided if the driverless vehicles are operated on dedicated lanes of freeways where the operation of more closely spaced vehicles can be safely attained at relatively high speeds; or by the universal use of driverless vehicles. Exclusive use by driverless vehicles could increase the capacity of a freeway lane from approximately 2,200 vehicles per hour to perhaps 4,500 vehicles per hour. Any such increase would have to be provided by either eliminating a freeway lane used by conventional vehicles or by constructing an additional lane for dedicated use by driverless vehicles.

With respect to the number of vehicles in operation within the Region, Commission data indicate that there are approximately 1.5 million automobiles and light-duty trucks, 57,000 medium and heavy-duty trucks, 3,900 school buses, 600 taxis, and 580 public transit buses in use within the Region. Ownership of automobiles and light-duty trucks rests predominantly with the Region's households. Ownership of the medium and heavy duty trucks, taxis, and school and transit buses rests largely in the private corporate and local governmental sectors. The use of driverless vehicles may reduce the number of personal



Credit: Jeff Swensen/The Washington Post/Getty Images

use vehicles in an area. Estimates of reduction vary with assumptions of the type of vehicle ownership (private or fleet) and the extent to which ride sharing occurs. Some estimates anticipate no reduction while others anticipate as much as 90 percent, if ridesharing utilizes the full occupancy of a vehicle.

The time span over which the large fleet of conventional personal use vehicles might be replaced by driverless vehicles cannot be known at this time, the factors concerned including the number of driverless vehicles to be provided for fleet taxi service, and the market acceptance of driverless vehicles as replacements of individually owned personal use vehicles. Consequently, traffic streams within the Region may be expected to consist for some time to come as mixes of driverless and conventional vehicles.

With respect to trip production and distribution, Commission data indicate that approximately 6.2 million internal person trips and approximately 410,000 internal-external and through trips are made within the Region on an average weekday. Each of these trips is made for a specific purpose – such as work, shopping, school, medical/dental, and recreation. The use of driverless vehicles will probably not significantly change the number of person trips made per day for these specific purposes. The use of driverless vehicles may, however, increase person trips made by some segments of the population such as by the young, the disabled, and the aged, many of whom may not have had access to personal transportation under the existing system. The distribution of the person trips, that is, the location of the origins and destinations of the person trips – will be determined by the land use pattern. This pattern changes relatively slowly over time. Indeed, the Commission estimates that approximately 90 percent of the planned year 2050 urban land uses within the Region are presently in place.

With respect to arterial traffic volumes, service levels, and related arterial capacities, Commission data indicate that approximately 4.2 million vehicle trips are made within the Region on an average weekday. The overwhelming majority of these trips are made by personal use vehicles. The vehicle trips exhibit sharp peaking, with approximately 20 percent of the trips occurring during the morning and afternoon peak-hours of each day. The peak hourly traffic volumes presently exceed the capacities of significant portions of the arterial system, with 73 center line miles of freeway facility and 201 center line miles of surface arterial facilities operating under congested conditions during the daily peak periods. It is unlikely that the

Figure 3

DRIVERLESS CAR AS DEVELOPED BY FORD MOTOR COMPANY

Note the difference in the sensor technology between that on this Ford vehicle and that used by Uber as shown in Figure 4.
Source: Ford
Graphic: Orlando Sentinel

use of driverless vehicles will serve to reduce this congestion at least until sufficient driverless vehicles are in service to warrant the provision of dedicated freeway lanes for such vehicles. It is possible that the operation of driverless vehicles in mixed traffic with conventional vehicles may increase surface arterial congestion. It is also possible that the use of driverless vehicles may increase the number of vehicle trips and the number of vehicle miles of vehicular travel necessary to serve a given number of person trips, if the mode of operation of the driverless vehicles results, as is likely, in some vehicle trips being made without passengers. Such passengerless operation would occur, for example, when a personally owned driverless vehicle is used to serve a home-to-work trip and the vehicle is returned empty to the home base to be used for another purpose until the return work to home trip is made. Some estimates indicate that the use of driverless vehicles may increase the vehicle miles of travel within a service area from ten to over 90 percent depending upon the mode of operation – fleet taxi versus individual ownership.

The potential effects of the use of driverless vehicles on public transit use must also be speculative at this time. It is possible that the use of driverless vehicles might result in the increased use of commuter railway passenger trains for longer trips, such as trips between Milwaukee and Chicago, and Kenosha and Chicago. The driverless vehicles could serve to conveniently take passengers to and from the railway station stops. It is also likely that the use of driverless vehicles might, to some extent, reduce the use of the public fixed route bus transit systems in the Region. The extent of substitution of driverless vehicle trips for transit trips would depend, in part, upon the relative cost of the trips and the effect of introducing a vehicle transfer in a trip. Demand responsive transit service might be entirely replaced by the use of driverless vehicles.

Implications for Regional Land Use Planning

The implications of the use of autonomous vehicles for regional land use planning, and for land use development must also remain speculative at this time. The Commission adopted regional land use plan has for over 50 years consistently recommended that urban development and redevelopment take place within and contiguously outward from the existing urban centers of the Region in areas that can be readily served by public water supply and sanitary sewerage facilities, that the prime agricultural lands of the Region be maintained in agricultural use, and that the environmental corridors of the Region be maintained in essentially natural open uses. The use of driverless vehicles may promote implementation of the regional land use plan to the extent that driverless vehicle use promotes the redevelopment of surplus parking areas and parking structures in existing urban areas, an increase in urban density, and the development of new forms of urban development such as “age” friendly neighborhoods and communities. The use

Figure 4

ANOTHER EXAMPLE OF SENSOR TECHNOLOGY

Type of sensor technology developed by Uber used to operate driverless cars.
Image: Angelo Merendino/AFP/Getty Images

of driverless vehicles may, however, encourage longer distance commutes within the Region and thereby facilitate undesirable urban sprawl. The introduction and use of driverless vehicles may require the revision of county and local municipal zoning ordinances to address such issues as the potential conversion of surplus garages serving existing residences to other uses.

Commission Position

Presently, there are no definitive data available about the potential impacts of the introduction and use of autonomous vehicles on the transportation system and land use pattern of the Region that would warrant making any changes in the adopted regional transportation system and land use plans. Any assessment of the potential impacts of the introduction and use of such vehicles must be entirely speculative at this time. It may, however, be concluded that, given the massive number of individually owned vehicles presently in use within the Region, replacement of these conventional vehicles by a sufficient number of driverless vehicles to significantly affect the performance of the regional transportation system will require a relatively long period of time.

The public works development process is designed to accommodate changing conditions affecting the facility systems concerned. The process proceeds in orderly phases from system planning to preliminary engineering, to final design, and to facility construction, operation, and maintenance. Moreover, the process is cyclical. Accordingly, the Commission will in 2020 begin preparation of a new regional transportation system plan for the Region. The planning effort will include the conduct of areawide inventories of the arterial street and highway and public transit systems of the Region and of their performance; of the composition of the vehicle fleets then in operation within the Region, of trip production and distribution, and of resulting traffic volumes and congestion levels. The process will include the preparation of alternative system plans and the selection of a new system plan to begin the next cycle of engineering and construction. The mathematical simulation models essential for the quantitative test and analysis of the alternative plans considered, and of the projected performance of the recommended plan, may require recalibration based upon the findings of the new travel inventories. The new inventories involved should provide definitive data on the impacts of the introduction and use of driverless vehicles within the Region to the extent that such use is then in existence, as well as a basis for the projection of such use and the evaluation of attendant impacts to the new plan design year.

VISION 2050

One Region, Focusing on Our Future

Contact us for a copy of the VISION 2050 Summary
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More information can be found at **www.sewrpc.org**.

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VISION 2050 Summary Available

The Commission recently published the *VISION 2050 Summary* report, which provides an overview of the Region's new long-range land use and transportation plan. The summary can be accessed online at vision2050sewis.org/PlanSummary.

Staff is currently preparing a final plan report for VISION 2050, which will be available in early 2017. The most recent draft chapters of that report can be accessed on the SEWRPC website. Once the full three-volume report is published, it will be sent to each local unit of government and affected agency of state government requesting their consideration and endorsement.

SEWRPC Announces New Executive Director

With the retirement of Ken Yunker, the Regional Planning Commission is pleased to announce Mike Hahn as its next Executive Director. Mike's first day as Executive Director will be February 6, 2017. With more than 30 years of experience at the Commission, including serving as its Deputy Director for the last two-and-a-half years, Mike brings a wealth of knowledge and leadership to this important role. He is particularly well-respected in the environmental planning field.

The Commission is also pleased to announce Kevin Muhs as Mike's successor as Deputy Director, also effective February 6. Kevin recently led the development of VISION 2050 and has a remarkable passion for land use and transportation planning.

The Commission would also like to sincerely thank Ken Yunker for his eight years as Executive Director and 40 years of overall service to the Commission. He has worked tirelessly to make the Region a better place and uphold the high-quality standards the Commission has been known for in every one of its planning efforts. The Commission wishes him the best in a well-deserved retirement.

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