AUTONOMOUS SHUTTLES IN SANTA FE SPRINGS

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By

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Background

Autonomous vehicles and increasing levels of automation will revolutionize the nation's transportation systems. (Ryan J. Harrington, 2018) Ridership, trips, and connections previously requiring a human behind the wheel will now be taken care of by AI. The ability to eliminate the burden of driving allows for greater safety and productivity. Advancements in levels of autonomy and promotion of AV technology by private companies will encourage roads to be shared differently. An emphasis on complete streets will encourage the marriage of Connected Autonomous Vehicles (CAVS) with cyclists, pedestrians, buses, scooters, and more.

Jurisdictions around the country are getting ready for this change researching infrastructure needed to accommodate this future tech. Several AV tests and pilot programs are being spearheaded by municipalities and tech companies to examine how cities can best prepare for the addition of AVs. The integration of cutting-edge AI relieves the burden of driving and opens the door to unlimited possibilities. The adoption of autonomous cars on the road will affect everything from density, parking, and carbon emissions, to personal vehicle ownership. The integration of AV technology encourages a shift towards pursuing mobility as a service, redefining transit as a public good by creating a mobility management system.

What are autonomous Vehicles?

"In the United States, approximately 94 percent of all crashes can be attributed to human error and the cost of crashes is more than $250 billion annually." (Ryan J. Harrington, 2018) Autonomous vehicles are widely anticipated to reduce fatalities on the road and reduce costs. To get an understanding of how an AV vehicle works we must first become familiar with the different levels of automation.

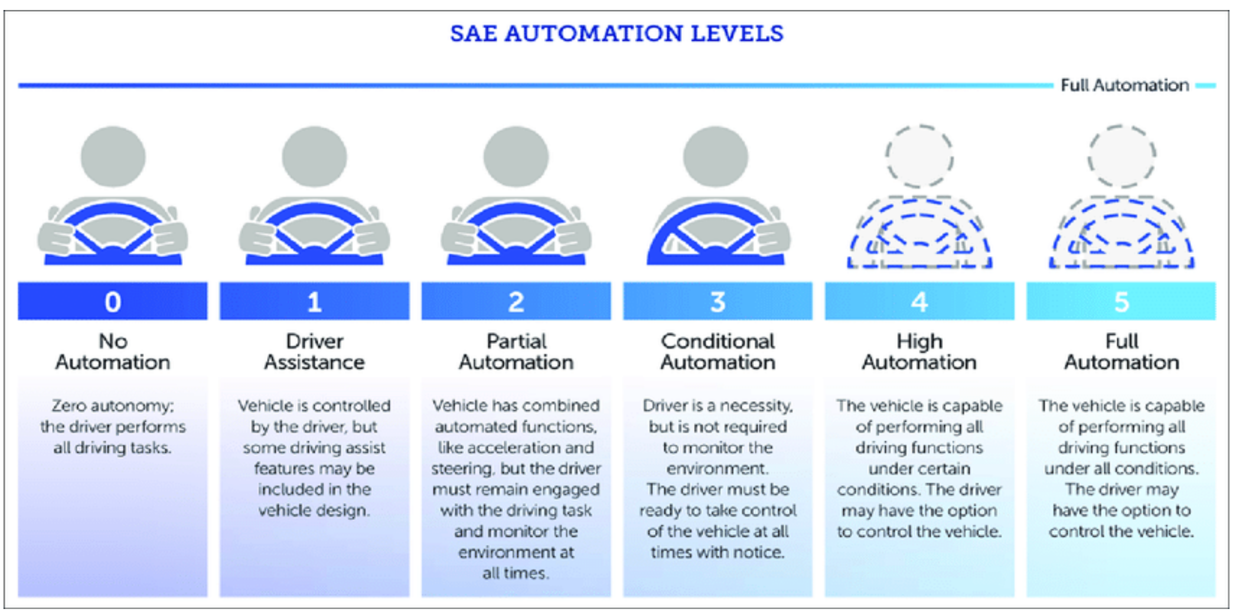


Figure 1-1: Autonomation Levels

At level 0, the driver is responsible for all tasks including changes in acceleration, speeding up and slowing down. At level 1 the vehicle starts to assist the driver with some monitoring of the surrounding environment. At level 2 we begin to see the vehicle assisting in the acceleration and steering of the vehicle. An example of this assistance is adaptive cruise control with a lane keeping system. Starting at level 3, we see the vehicle begin to monitor all parts of the environment using cameras and sensors coined “LiDAR” technology. The driver’s attention is still necessary for safety functions. Levels 4 and 5 see increasing control of the vehicle over all functions with the goal of pursuing a level of autonomy that requires no human attention. Several private companies are testing these highly automated vehicles and are yet to be made available to consumers.

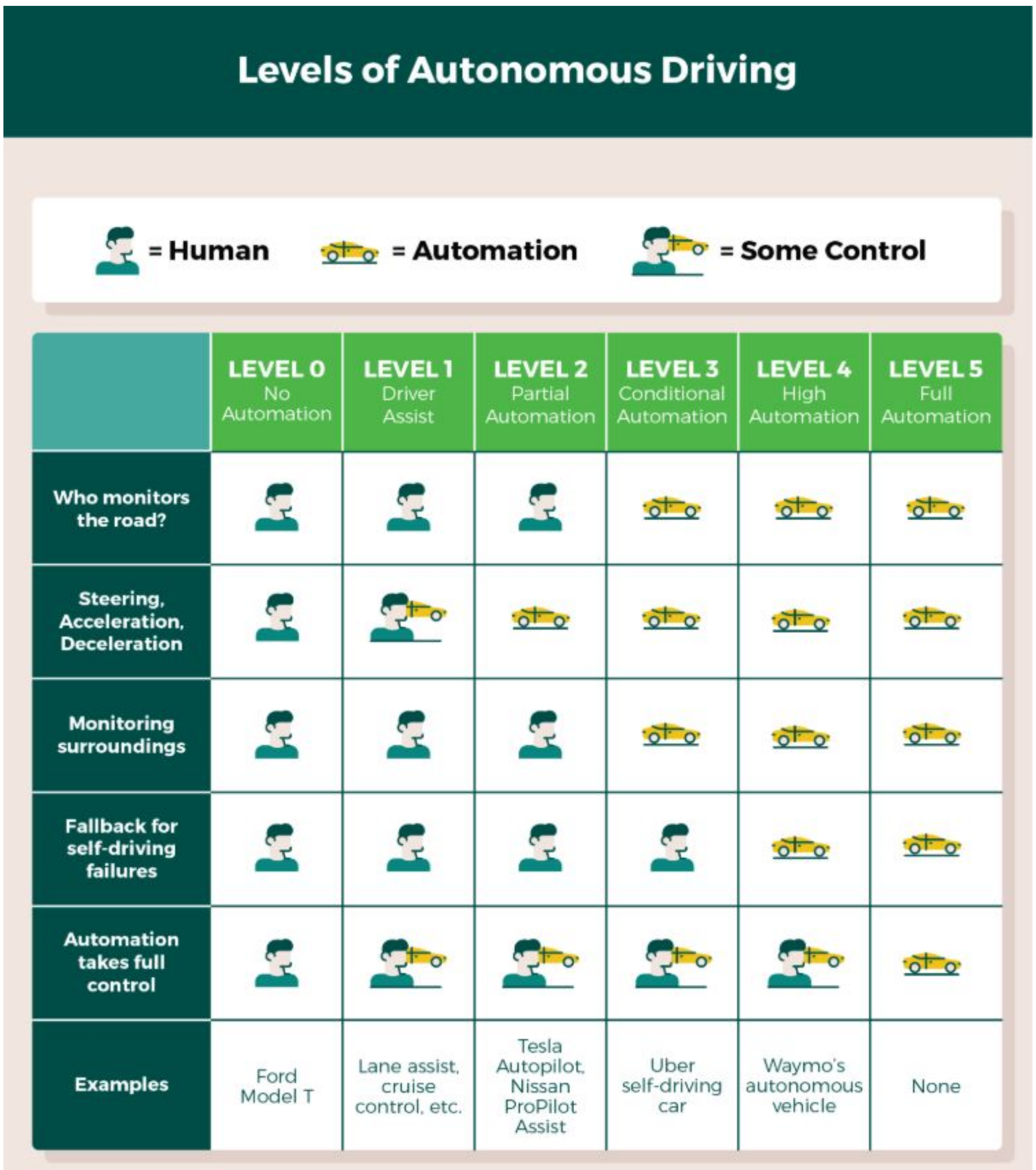


Figure 1-2: Human vs. Automation across Autonomous Levels

How does a self-driving vehicle see?

An ordinary vehicle is equipped with lidar sensors. These sensors are light detection and ranging devices that measure distances using pulses of light to create a three-dimensional map of a place. (Metz, 2018) Once the map is complete the vehicle can use it to navigate the roads autonomously. As the vehicle moves it captures what it “sees” and compares this to what its’ maps shows. In addition to Lidar, a self-driving vehicle utilizes radar and cameras to accurately understand its surroundings. These cameras also help the vehicle intercept traffics lights, street signs, and other road markings. (Davies, 2018) This hardware is what allows AVs to effectively “see” and detect the surrounding road topography and any other man-made features.

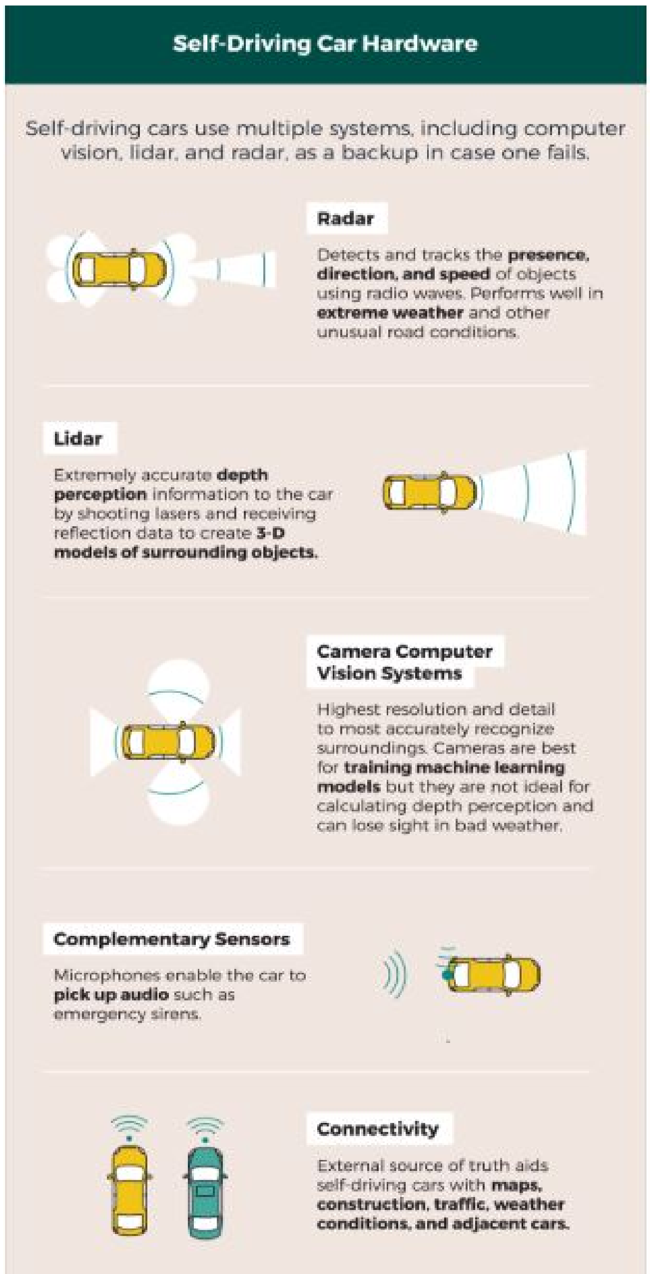


Figure 1-3: Self-Driving Hardware & Technology

What is the definition of an AV shuttle?

According to the Utah Transit Authority, an Autonomous shuttle is an electric vehicle with the capacity for six to twelve passengers. (UDOT, 2018) There are no drivers' seats, steering wheel, or pedals. The shuttles are programmed to follow a pre-determined route while being able to interact with other vehicles and pedestrians in real time. The vehicle itself is equipped with sensors and computing capabilities to perceive surroundings and correct itself upon experiencing any emergencies.

Why is it related to planning?

AV technology will change many of the transportation networks and land use patterns found in cities across the US. Planners and policy makers should familiarize themselves with must information and equip themselves with tools to prepare their streets for AVs. Known factors affected by AVS are discussed in a book, *Disruptive Transport*, by William Riggs. These factors include AV's potential to reduce cost of vehicle travel. The hope is that programs like an electric AV shuttle would incentivize public transit reducing private vehicle emissions and reducing the cost of public transit as a result. In turn, more ridership would result in the elimination of the burden of driving and commuters could use their time more effectively during transit. Less collisions of private vehicles would occur increasing safety on the road as well.

We must remind ourselves of what amenities streets provide to our communities. Aside from transporting people and information, they guarantee accessibility to goods, services, and activities. The quality of linkages and streets is strongly correlated with equity of access and economic exchange. While we tend to think of transportation as purely functional and utilitarian, they are an essential component of community infrastructure and are affected by cultural and artistic preferences. (Riggs, 2019) The AV shuttle represents the next evolution in linkages and transportation. AVs represent the growing field of Smart City technology changing how data is collected with a high promise of impacting policy making. A Smart City uses IoT technology (internet of things) to improve its relationship between the public, bureaucracy, and the private sector. IoT or the Internet of Things describes the ever-evolving process of connecting everyday devices to a cloud. (Burgess, 2018) AV tech is a part of these technologies as IoT can be used to monitor and analyze real time traffic data, optimize streetlights, and ensure public transportation meets user demand. (Rouse, 2019) Jurisdictions adopting AVs will not only strengthen their transit infrastructure but also allow for greater data collection, building up a smart infrastructure network to prepare for this exponential technological phenomenon.

Figure 1-4: A visual description of the Internet of things within a Household

The advent of AVs allows planners the opportunity to rethink street space. This should be done in a way that supports sustainable transportation. There is a potential to reclaim urban space for existing needs and future public purposes regardless of how AVs are fueled or whether they are individually owned, shared, or rented. (Riggs, 2019) Jurisdictions ought to outfit their vehicle fleets with AV technology to capitalize on the benefits of IoT as it is more sustainable transit option with the ability to reduce GHG emissions. Iot will possess the ability for information to be shared seamlessly from private to public spaces. AV shuttles enable that service while onboard public transit.

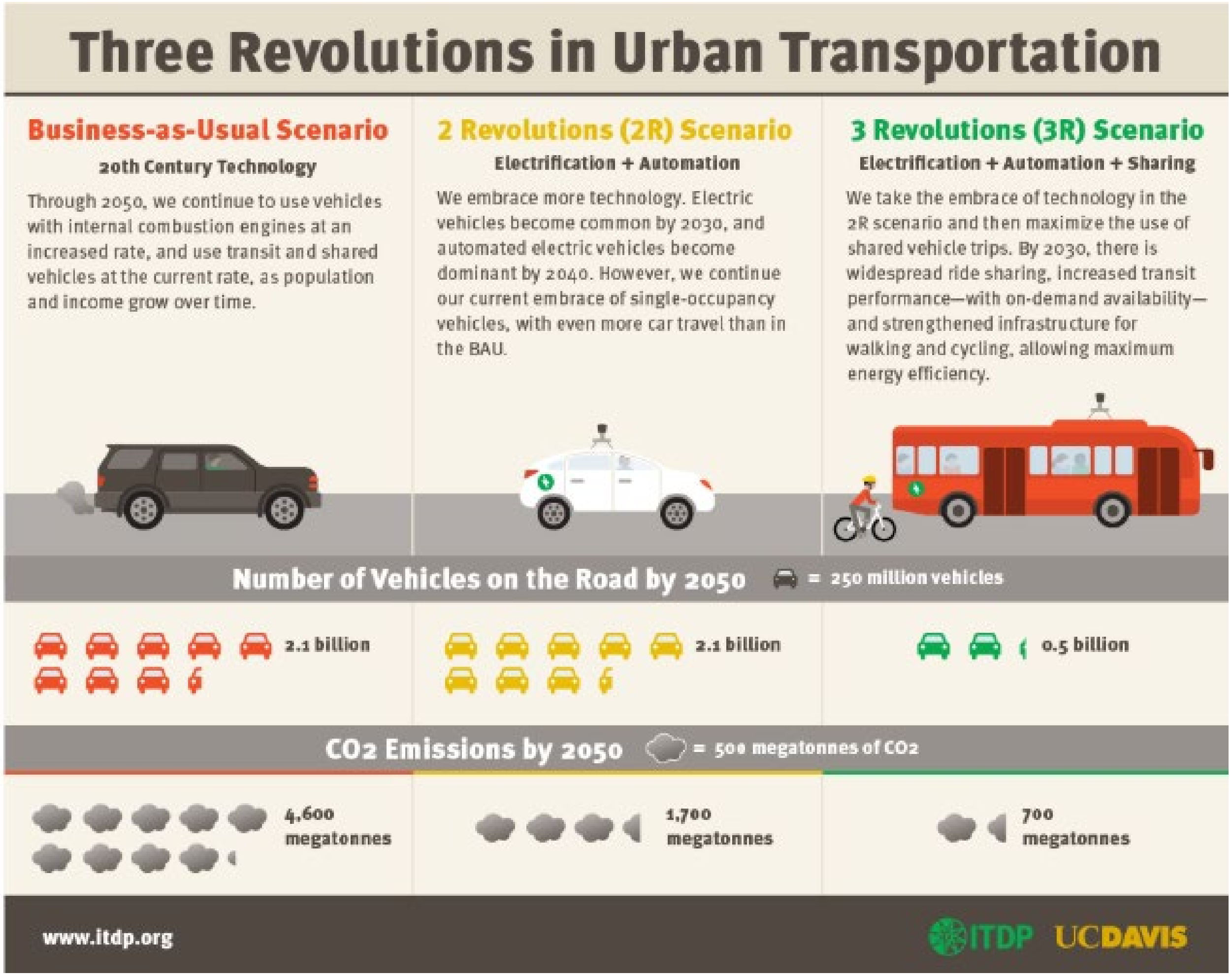


Figure 1-5: Three projected scenarios for AV technology by 2050

AVs possess great potential for change in Urban Transportation, yet it is uncertain of the extent and nature of this transformation in the future. A report produced by the University of California, Davis, and the Institute for Transportation and Development Policy imagined three scenarios involving new AV transportation technology. Scenario 3 is the most sought-after revolution as it will maximize the use of shared vehicle shared trips and increased transit performance. (Lew Fulton, 2017) An ideal AV future combines automation with electrification using a shared system while collaborating with other modes of transportation on the road.

Existing Conditions in Santa Fe Springs

Santa Fe Springs, California is a gateway city in southeast Los Angeles County known for its strong community and culture as well as a high number of industrial zones and strong economy. With a population of just over 17,000 people, 74.3% being Hispanic or Latino, 55.9% of families speak a language other than English at home. (U.S. Census Bureau, 2014-2019) The median household income as of 2018 was $65,518. The Major interstates located near Santa Fe Springs include the 605 and 5 running northwest through the city limits. The nearest light rail is the Green Line which ends at highway 605 near Studebaker Southeast of Santa Fe Springs. The mean travel time to work for workers age 16 years+ was 30.4 minutes. (U.S. Census Bureau, 2014-2019)

Santa Fe Springs benefits from the use of a neighboring Norwalk Transit System. This system comprises a total of five bus routes shared across city limits. Route 1 runs along highway 605 connecting the majority single-family residential neighborhoods to southern Santa Fe Springs (Alondra Blvd). Route 2 runs near highway five within Santa Fe Springs city limits connecting to Paddison Square Shopping Circle. Additionally, Route 3 runs parallel to Route 1 then branching out into the industrial zones of the eastern section of the city. Route 4 cuts horizontally through the city through Metrolink Station to Norwalk Station. Finally, Route 5 runs through the southern section of Santa Fe Springs through industrial zoned land. The adoption of AV shuttle fleets could utilize these existing bus shuttle lines, prioritizing Routes 1 and 3, serving residents within the West Whittier-Los Nietos neighborhoods by connected them in to the industrial and economic areas of the city.

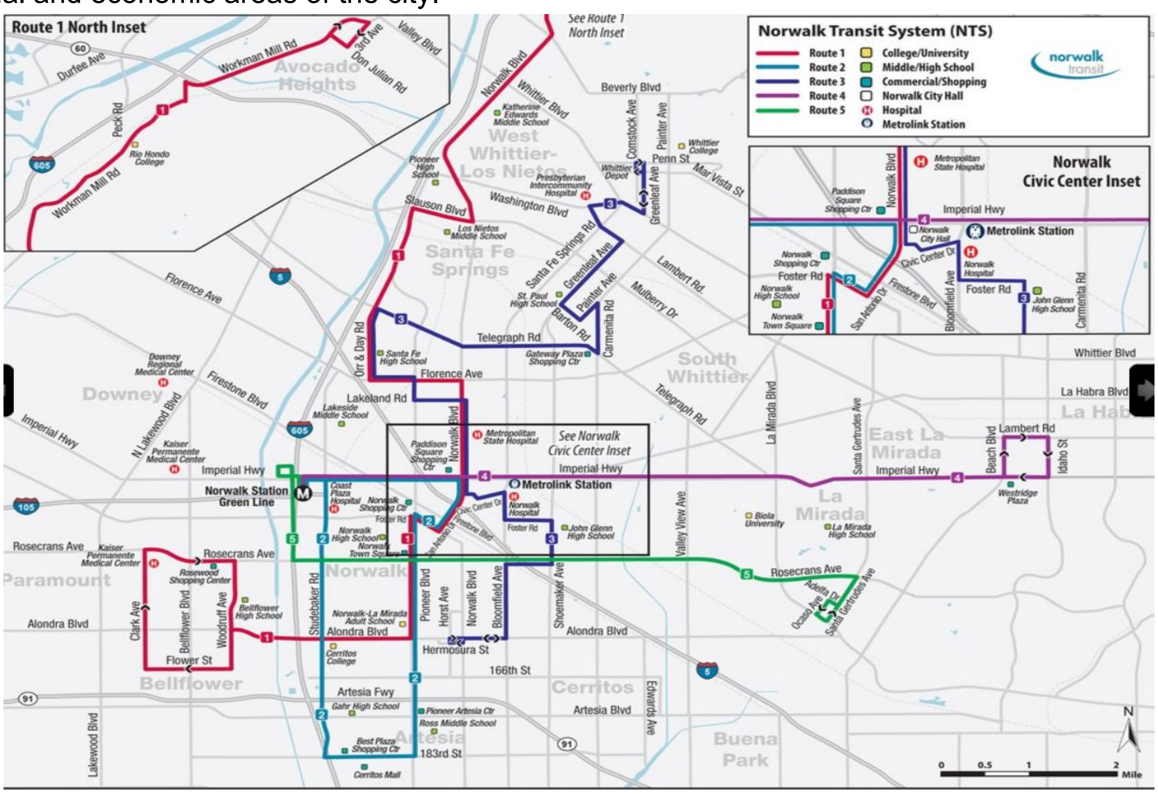


Figure 2-1: Norwalk Transit System Bus Routes

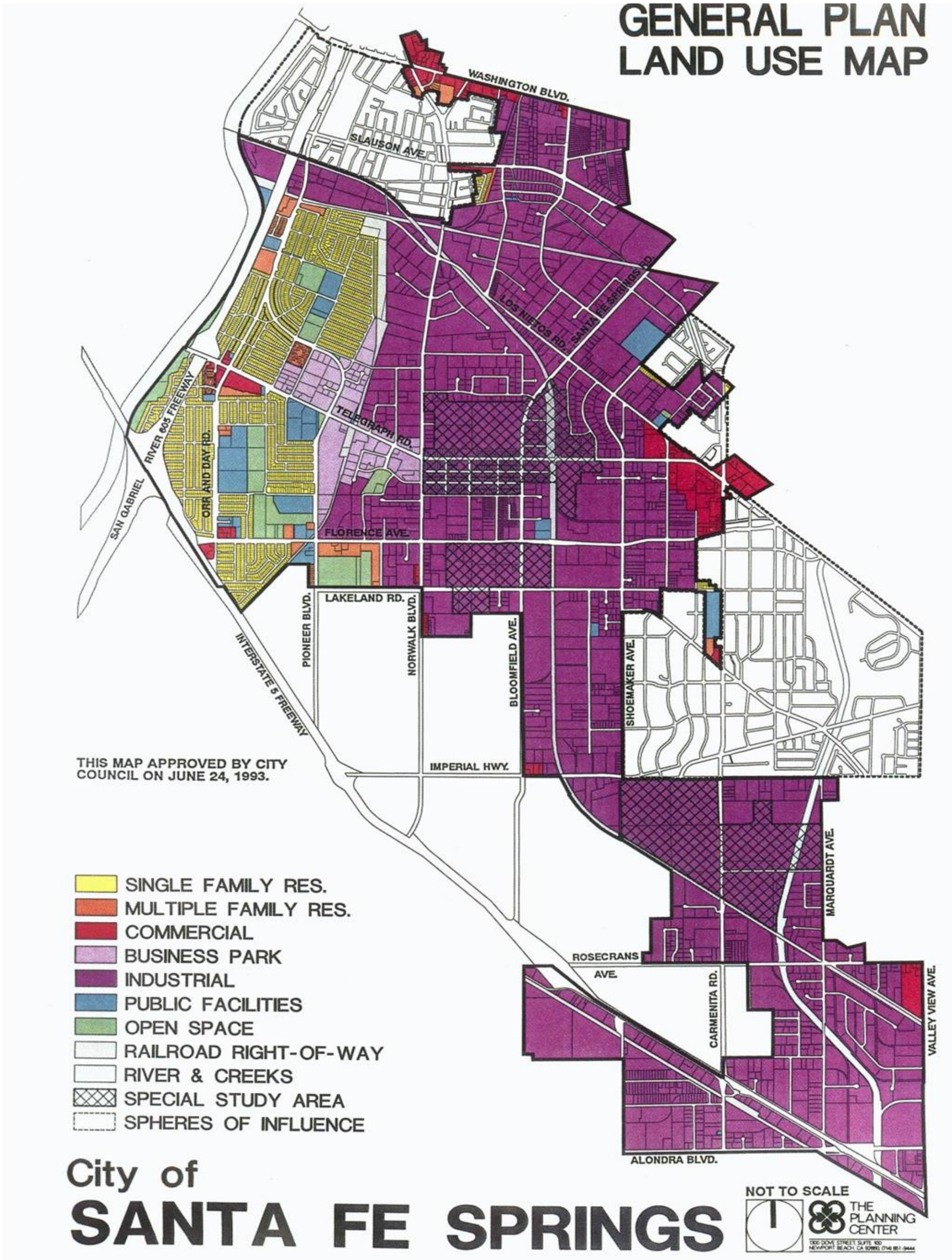


Figure 2-2: City of Santa Fe Springs General Plan Land Use Map

The Land Use Map of Santa Fe Springs shows us the city is overwhelming industrially zoned with no clearly defined downtown area. We see single family residential housing covers the eastern portion of the city. There is a real opportunity for an AV shuttle to service these residential areas to and from jobs in west and southern Santa Fe Springs.

The city of Santa Fe Springs also offers several transportation programs for its residents. These include a transportation for seniors and disabled persons program. The city provides transportation medical and dental for residents 60 years and older and disabled persons. However, reservations are required at least 24 business hours in advance. (Springs, Transportation Services, 2020) These trips are provided to the neighboring cities of Downey, Norwalk, Pico Rivera, and Whittier. Another program the city of Santa Fe Springs offers is an Excursion Program. This is aimed towards assisting youths, seniors, and disabled with transit to educational, cultural, or recreational events in the region. The transit costs are free or subsidized depending on the location. These trips are organized by City of Santa Fe Springs' Recreation Services and are open to the public throughout the year. Lastly, the city offers a Taxi Voucher Program as part of its Special Needs Service which assists seniors 60 years and older and persons with Disabilities. These vouchers are $1 each, and are worth up to $7 in taxi fares. (Springs, Transportation Services, 2020) These programs make up transportation services within the city providing reliable transit service to residents with a focus on the elderly and disabled residents.

A review of Santa Fe Springs's 2013-2014 fiscal year reveals the top three departmental expenditures to be fire, police, and public works. 32% (16.38 million) goes towards fire, 19% (9.89 million) towards police, and 18% (9.21 million) towards public works. (Springs, City Budget and Redevelopment Impacts, 2014) Clearly the city views fire protection and safety as their largest community concern. In 2014, the city spent under 2 million on parks and recreation services, Library and Cultural Services, and 1 million on Family and Human Services.

Project Goals

The objective of this project is to present research material and AV information to develop a foundation for creating short-term, cost effective, and implementable planning solutions in Santa Fe Springs. These recommendations will prepare the city for the eventual adoption of electric AV shuttles on the road. This will require the incorporation of findings from case studies, existing conditions, and outreach to explore the eventual introduction of AVs in the streets of Santa Fe Springs. These recommendations will result in an affordable electric AV shuttle service connecting serving residents within Santa Fe Springs to major employer centers.

Case Studies

In 2018, Neuhasuen Rheinfall, Switzerland became the first city in the world to fully integrate an autonomous shuttle into their regular public transportation system. Neuhausen Rheinfall choose to begin operating an autonomous shuttle made by the France-based AV automobile company NAVYA on March 2018 along their regular service route. Passengers can now take the autonomous shuttle on Route 12 to the Rhine Falls, the largest waterfall (by volume) in Europe, which receives 1.5 million visitors annually. (Comfort, 2018) Autonomous Shuttles had begun to be implemented in cities around the world reimaging how transit affects everyday lives of citizens.

-University of Michigan

In the summer of 2018, the University of Michigan began a public private partnership called Mcity deploying driverless electric shuttles on the U-M Campus. The project focused on user behavior experience and extensive data collection. Two NAVYA shuttles were designed to support data collection, understanding vehicle performance, roadway interactions and passenger attitudes. (Mcity, 2018). Driverless shuttles can only have a future on our roads if they are trusted by the general community. NAVYA is a french company that specializes in the production of autonomous shuttles in cities around the world. Since 2015, the company has solid 160 units in the US, France, Germany, Japan, Switzerland, and Australia. (NAVYA, 2020)

Mcity partnered with several stakeholder organizations within and outside the university including, University of Michigan Office of Research, Ann Arbor Public Schools & First Responders, and National Highway Traffic Safety Administration (NHTSA). Identifying key stakeholders early and engaging with them throughout the implementation process can flag potential obstacles before they slow down progress. (Mcity, 2018)

There were several factors taken into consideration when determining a route for the automated shuttles. It was important to determine an operating speed to shuttles did not cause traffic congestion. The slope of the route did not include any section with a grade of more than 10 percent. (Mcity, 2018). Route design was influenced by the section of stops and proximity to other modes of transit and nearby points of interest. Most shuttles needed to adjust indoor temperature to weather predictions. Ucity adapted an existing shuttle icon design for their signage to make sure road users were aware of the driverless vehicles. Research revealed that "Driverless Vehicle" would be the simplest phrase for other (human) road users to understand.

Figure 3-1: Mcity signage design for AV shuttles

Mcity shuttles also required mapping advanced mapping of the intended route in coordination with local law enforcement to provide escorts during the initial mapping. These factors sum up to what Mcity calls the Operating Design Domain (ODD) which consists of "these dynamic parameters, including weather, roadway and traffic conditions, and construction. (Mcity, 2018) A total of three electric shuttles were purchased from NAVYA, a leading manufacturer of driverless vehicles. MCity tested these products for a year to gather data about weather conditions and lighting. Technical information about the shuttles submitted by NAVYA were combined with parameters to understand critical scenarios on the road. These shuttles were monitored by a Safety Conductor who can take control of the shuttles should an event occur in which the shuttles could not navigate automatically.

Safety Conductors require additional training as they are responsible for overseeing the efficiency of these shuttles while interacting with passengers. They help to reassure riders and ensure safety protocols are followed. In the Mcity program Safety Conductors underwent 2-3 weeks of training and instruction in operation of the shuttles in Manual Use, Driverless Use, and On-Route Training. Conductors were required to attend an orientation session that summarized the technology in use with emphasis on emergency procedures and scenarios.

Mcity created a detailed Operations Plan to ensure day-to-day shuttle operation runs smoothly. Shuttle Conductors worked "approximately four-hour shifts, with three of those hours on-route." "The fourth hour includes breaks, plus time for shuttle startup, shutdown, and shift changeover." (Mcity, 2018)The plan accounted for day-to-day non-emergency issue resolutions, battery and weather constraints, and operating procedures. It outlined energy costs and necessary information to be given on websites and social media. Infrastructure needs included vehicle storage, charging stations, and signage. The goal was to be able to operate the shuttle in a dynamic environment with, "robust procedures and communication in place to facilitate smooth operation for the conductors, passengers, and other road users." (Mcity, 2018)

Data Acquisition should be a focus for any city wanting to adopt AV shuttles. Mcity collected data in shuttle interaction with other road users, behavior of passengers riding the shuttle, and basic vehicle data. Data gathering harnessed tech built into the shuttles by U-M Transportation Research Institute (UMTRI). They installed real-time cloud sharing storage in a data acquisition system (DAS) on each shuttle capable of, "storing up to two-weeks of data on-board in the event of a transmission failure." (Mcity, 2018) Sensors and cameras were installed to study on-road interactions with other vehicles. The collected data was encrypted and streamed to cloud endpoints. After the transmission, data is marked for removal from the shuttle's local storage to protect privacy.

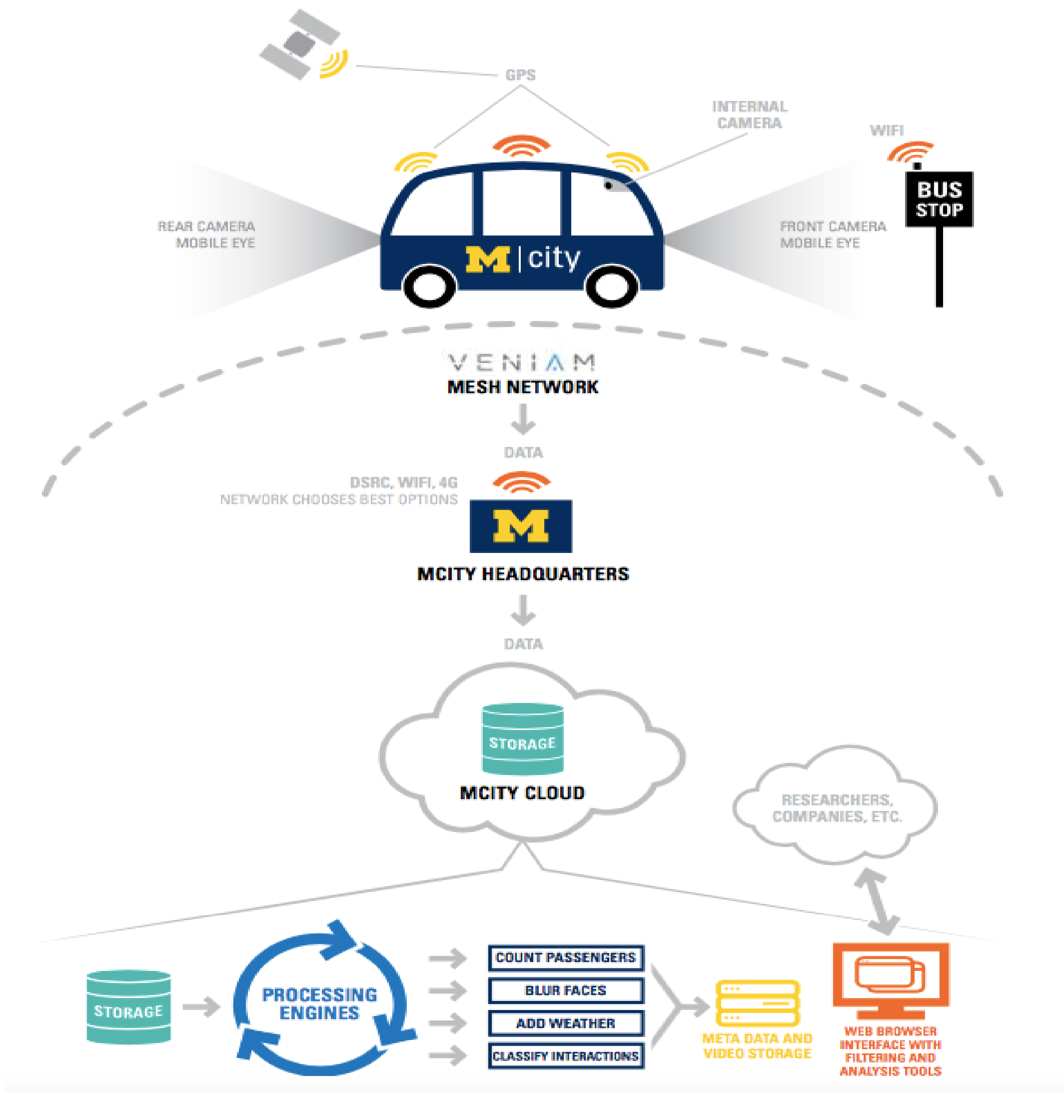


Figure 3-2: Mcity Veniam mesh network used by shuttle to transfer data to Mcity's cloud systems

Mcity recommends to “define desired data needs early,and devise a data collection method that does not interact or interfere with the nearby sensors used by the shuttle for perception and control. This must be done while preserving privacy.” (Mcity, 2018) As AV shuttles are an emerging technology, emergency preparation is crucial to prepare an immediate and effective response to an incident. MCity notes that “All stakeholders must understand their role in an emergency through training and practice.” (Mcity, 2018) A jurisdiction wanting to slowly adopt AVs must explore all legal, regulatory and insurance issues to safely conduct these vehicles.

The following are Mcity recommended implementation lessons:

- Set Specific Project goals
- Engage Stakeholders Early
- Explore Legal, Regulatory, and Insurance Questions

- Identify Operational Environment Constraints
- Conduct Your Own Testing
- Train Safety Conductors Thoroughly
- Anticipate Challenges
- Develop an Incident Response Plan
- Establish Data Needs Early

-AAA Free Self-Driving Shuttle Pilot Program, Las Vegas

The American Automobile Association, AAA, in partnership with the NCNU (North California, Nevada & Utah) launched a free self-driving shuttle in Las Vegas in November of 2017 and concluded the program in 2018. The shuttle operated in the vibrant city of Las Vegas offering a great number of diversities in passengers in a structured environment. The vehicle was limited to 8 passengers and traveled along a 3-5 mile loop in downtown Las Vegas. (Jones, 2018) The shuttle operated for 1,515 hours, with 32,827 riders. (AAA Self Driving Shuttle , 2018-2020) AAA claims that after experiencing ridership on the shuttle, 30% of riders have more positive attitudes towards AV technology and 98% would recommend this technology to their friends and family. The shuttle was built by NAVYA and AAA partnered with the city of Las Vegas, the Regional Transportation Commission of Southern Nevada (RTC) and Keolis North America (Keolis). AAA offered free ridership because the project offered them the opportunity to study AV tech on the road and expose the public to autonomous vehicle technology. The AV shuttle is a free service for Las Vegas visitors and residents, spanning 8 city intersections, 6 traffic lights, 2 stop signs – all without a human behind the wheel. This pilot program is a great example of a successful partnership between a private business and public jurisdiction. (Schlagenhauf, 2018)

Figure 3-3: NAVYA made AV Shuttle utilized by the city of Peoria, Arizona.

-Robo Ride Autonomous Shuttle

Arizona's first shared-ride, autonomous shuttle service on a public street was approved on Feb. 4, 2020 by Peoria City Council. The city of Peoria has partnered with Beep, a Florida-based autonomous mobility solutions company, to initiate a 60-day pilot program. (City of Peoria, 2020) Colloquially named "Robo-Ride", this program was undertaken to discover the feasibility of using autonomous vehicles alongside current mobility options on the road as well as accounting for ridership behavior and adoption patterns. The shuttles themselves have a capacity of 10 passengers and are ADA accessible, as well as being fully electric producing no green-house gas emissions. As they are driverless, an attendant is onboard the vehicle at all times for safety and to ensure the operations go smoothly. Beep provides a command center for the vehicles to communicate with the shuttle attendant in event of an emergency. The vehicle uses a pre-programmed, fixed route with a combination of localization technologies, including advanced sensors and cameras. (City of Peoria, 2020) This service is available to all and is free to ride. Peoria's shuttles were manufactured by NAVYA and operated by BEEP. Peoria took into consideration the accessibility of young children using their vehicles. The shuttles are equipped with emergency kits and seat belts on board along with cameras monitoring the inside of these vehicles as well. Children under the age of 16 are required to be accompanied by an adult. A car seat or booster for children is not an option as the shuttle does not contain car seats or anchors.

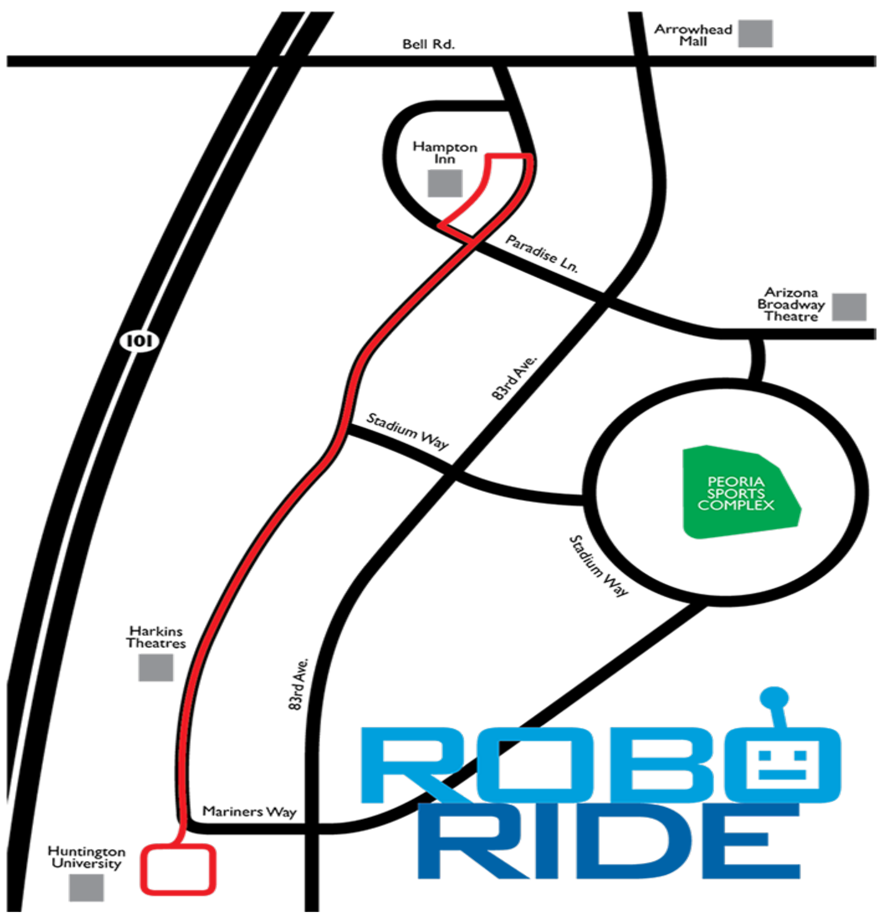


Figure 3-4: Robo Ride Route, City of Peoria

-Autonomous Shuttles and COVID-19

NAVYA designed AV shuttles are being used to ferry COVID-19 tests and medical supplies from a drive-through testing center at the Mayo Clinic in Jacksonville, Florida. (Descant, 2020) The vehicle travels a half-mile with no human operator on board. The project is a partnership between transit company BEEP, NAVYA, the Mayo medical clinic, and the Jacksonville Transit Authority. The shuttles are not operating on public streets and have little to no interaction with other automobiles. These shuttles are providing a climate-controlled environment for medical cargo and test samples. The COVID-19 pandemic has offered up what may be a whole new role for robotics in an effort to reduce human contact. (Descant, 2020)

-Elk Grove California AV Readiness Plan

Elk Grove's AV Readiness Plan suggests policy and recommendations for the integration of connected and autonomous vehicles on the road. The "Connected Vehicle" is one that can communicate wirelessly with its surroundings and other vehicles. Several acronyms are used to describe this communication: "V2X" (vehicle-to-everything) is the umbrella term indicating vehicle-to-anything connections. "V2V" (vehicle-to-vehicle) describes the technology for vehicles to communicate with each other. "V2P" (vehicle-to-pedestrian) describes the technology for vehicles to communicate with pedestrians. "V2B" (vehicle-to-bicycle) describes the technology for vehicles to communicate with bicycles. "V2I" (vehicle-to-infrastructure) describes the technology for vehicles to communicate with roadway. "SAV" (shared autonomous vehicles) describes what an AV shuttle would function as. (City of Elk Grove . Fehr & Peers, 2019)

Elk Grove states changes in driving conditions with the introduction of AVs would include:

- Reduced potential for collisions
- Traffic Flow Benefits
- Eliminated Burden of Driving
- Increased access and travel options
- Reduced travel costs
- Optimized travel routing

-Planning Implications of AVs

- Reduced Parking Demand: Depending on whether the SAVs are privately owned or under a mobility as a service (MAAS) system, parking areas could be located further from activity centers to areas with surplus space and lower values. (City of Elk Grove . Fehr & Peers, 2019)
- Increased curb activity: The increased use of SAVS acting as ubers dropping off passengers would reduce the demand for on-site curb parking but also increase pedestrian and passenger activity at the curb. Parking lots may have to be redesigned to allot for better loading and unloading of passengers similar to an airport or school.

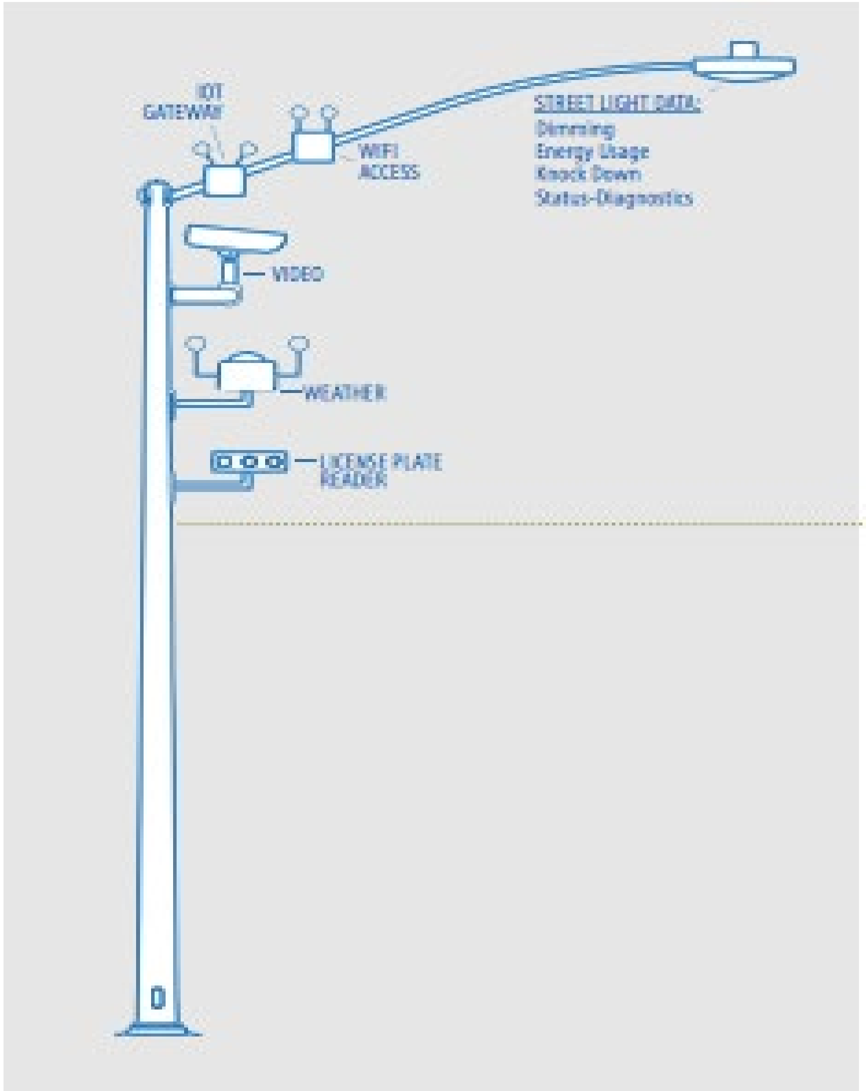
- Potential for Increased Development Density: Parking lots and/or parking structures could be repurposed leading to new commercial opportunities. A reclamation of space.
- Potential for Increased Suburban Development: With AVs reducing the burden of driving combined with possible traffic flow improvements means that AVs could enable additional low-density development further from activity centers.

-Infrastructure and Design Changes

- Recommendations Roadway infrastructure features, such as signs, lights, lane markings, and curb space.
- Roadway striping: Caltrans recommends adopting 6-inch wide markings for edge-lines and new reflective standards as a way to accommodate autonomous vehicle technologies. (City of Elk Grove . Fehr & Peers, 2019)
- Fiber Optic Infrastructure: CAVS will need fiber optic communications network. Identify priority corridors and expand fiber optic system to improve traffic and safety.
- Data management: large amounts of data will need to be managed by a network that can integrate different technologies like traffic signals and weather data and trip/transit data to all function on the same infrastructure. (City of Elk Grove . Fehr & Peers, 2019)
- Smart Street Lighting: Combining different monitoring technologies to provide for a comprehensive data management of systems.

-Recommended Policy Actions for the city of Elk Grove:

- Consider Local community and stakeholder outreach and engagement.
- Monitor regulatory developments at the state and federal level.
- Lobby for data sharing and effective communication protocols for AVs, CVs, and mobility service providers at the state and federal level.
- Apply cost structures to manage effects and encourage desired outcomes.
- Restructure transit service in the City.
- Modify zoning regulations to respond to reduced parking demand, increased land values in established areas, and potential demand for new development at the edge of the City.



Pictured: Traffic Management Center Data Collection
Credit: Fehr & Peers

Figure 3-5: IoT tech incorporated into a streetlight preparing the road for AVS.

Analysis and Outreach Findings

A correspondence between an Assistant Planner from Santa Fe Springs and myself was established to better explore the reality of an AV shuttle in Santa Fe Springs. The planner was excited at the prospect of having an AV shuttle loop connecting transit centers to major employers. The main constraints viewed by the planner were cost effectiveness, insurance, and maintenance. Also cited was the lack of a downtown area and the fact that AV is an emerging technology and the city would need personnel with a strong knowledge of AV technology. The verbatim discussion can be found below:

SFS Planner:

> *"We think it would be awesome if we had an autonomous shuttle that went in a loop from the Norwalk/SFS transportation center to major employers/City Hall and back again, but we don't know if enough people would ride it to justify the cost. We do not think the city's current shuttle operations would benefit from being autonomous since the populations they serves really benefit from a human touch.*
>
> *We agree that it may not make the most practical sense to switch to an autonomous shuttle service at this time. But, we don't think* Santa *Fe Springs would benefit much from autonomous shuttle, unless it was free or practically fee. We currently own our own buses so our current cost is maintenance, gas, insurance and the hourly wage of the driver as we don't believe our drivers are full-time benefitted employees. Switching to an autonomous shuttle would only eliminate the cost of the drivers since maintenance, gas and insurance would still exist.*
>
> *A huge unknown, however, is the cost of maintenance. Because of the technology involved, there might only be only a select number of mechanics that even know how to work on such vehicles thus possibly sending the maintenance costs through the roof. Such added cost could erase any financial benefits of not having to hire a driver. It sounds cool and cutting edge, but we can't imagine it being a huge success here in SFS at this time. Maybe if or when we have a downtown."* (Jimenez, 2020)

The planner from Santa Fe Springs brings up valid concerns about cost during the transition from gas powered buses to AV shuttles. However, the transition to the new electric AV shuttles would not get rid of drivers altogether and instead create new jobs and opportunity for retraining. Routes from residential to industrial zones would be prioritized. Gas costs would be replaced by electric charging systems contributing considerably less to green-house gas emissions. A partnership between Santa Fe Springs and a known AV shuttle tech company would cut down the cost of maintenance to the city overall. As we saw in the case study of Arizona's "Robo-Ride", the AV shuttle tech company successfully managed the cloud service and sensor capabilities of the vehicles. All of the "cutting-edge" technology that makes an AV shuttle "high-tech" is responsibly upkeeped by the AV company. This effectively leaves the regular components of the shuttle up for maintenance by the city. Lastly, the incorporation of an AV shuttle system would bring attention and spotlight to the city, perhaps generating revenue for the eventual development of master-planned downtown.

Recommendations

It is my hope that the following recommendations demonstrate how an AV shuttle program is possible in Santa Fe Springs. These are short-term policies, funding considerations, and infrastructure changes preparing Santa Fe Springs for the introduction of AV shuttles. At the core of these recommendations is an emphasis on partnership and communication with stakeholders to create robust support for an AV shuttle program.

-Funding:

The case studies found depict just how powerful a partnership between AV tech companies and local jurisdictions can be. Companies like NAVYA, BEEP, and AAA are bold and willing to work together to outfit AVs in cities across the US. Proposing a partnership with one of these companies should be the ultimate goal of Santa Fe Springs, but first, the city would need to responsibly budget an AV shuttle program. This would allow the city to keep informed on the state and federal developments in AV legislation and create a local roadmap to implementation. In fact, grants pertaining to AVs have recently been created and successfully awarded by the U.S. Department of Transportation.

In September of 2019, 60 million in Federal grant funding was awarded to select recipients for an Automated Driving Systems (ADS) Demonstration Grant Notice of Funding Opportunity. (UDOT, 2019) Over 73 jurisdictions across the country applied. Because of the attention the grant program received, we can expect to see similar grants in the future that Santa Fe Springs could take advantage of. Additional funding for an AV shuttle program could also come from reallocated departmental expenditure on Fire protection. Future funds would be directed towards necessary infrastructure changes to introduce AV shuttles to the roads of Santa Fe Springs.

-Policies:

- **Update data collection, web capacity, and online resources:**

AV shuttles require organized and robust online infrastructure and web design. Santa Fe Springs should strive to develop web-tech infrastructure that will allow for the monitoring of the gradual introduction of AVs to the streets. The city would benefit from having a transit orientated data management capability to provide information on congestion, safety, and sustainability models. This includes being able to monitor traffic in real-time, traffic projection, and to effortlessly share data with the AV partner company. The data collected will inform the city on the impact and success of AV shuttles as they are slowly introduced to the roads.

- **Empower a group of Local Stakeholders to Expand Transit Issues:**

Building a strong coalition consisting of local stakeholders and business owners is a powerful strategy for community engagement. An AV shuttle program must have the support of a broad group of local stakeholders, including businesses, community leaders, and elected officials. During this period, the city would identify possible riders for these AVs to deciding who and where they'd want routes to go. These groups would prioritize AVs admit any changes in staff, budgets, or elections. Public support is the best way to guarantee implementation is eventually achieved. This public engagement is critical as a strong and long-lasting foundation for implementation of AV shuttles.

- **Create Attractive Transit Stops and Transit Infrastructure**

Beautifying bus stops sends a message to residents of Santa Fe Springs emphasizing the quality of transit. It generates appeal towards public transit, in turn increasing ridership in a positive feedback loop. Attractive bus stops and transit stops enhance the quality of shared

spaces complementing the idealism of an AV shuttle program while promoting the city's transportation system. As we saw with Elk Grove's Case Study, existing light stops and signage could be outfitted with IoT technology to aid AV data collection and way finding. Infrastructure elements to take into consideration for beautification include signage, intersections, and street typology. AV Shuttles will need to co-exist with other transit modes and alternatives within streets. In addition, the creation of outfitted prospects will need the create the affordability in the end of the system.

- **Retrain Personnel**

AV shuttles will need personnel to answer questions and any emergency concerns for the riders on board. Existing transit staff should be prepared and given resources in training with regards to safety, operation of AV vehicles, and technology training. Training of staff members would cover the hardware of AV shuttles, leaving sensors and LIDAR technology to the AV partner.

- **Plan to Retrofit Current Transportation Services with AV shuttles**

Santa Fe Springs already offers a Taxi Voucher Program that could easily be retrofitted with AV shuttles in the future. This would be the perfect opportunity to showcase AVs technology to the public and create positive public perception in the community. The use of these AV shuttles by a demographic population of the elderly and disabled would demonstrate the robustness and effectiveness of the vehicles increasing the transparency of the program. Santa Fe Springs also currently offers an Excursion program to residents free of charge aimed at seniors, youths, and disabled persons. Subsequently, this program could be adapted into a pilot for the AV shuttles to understand possible routes and implementation. I recommend making the AV shuttle program free to residents of Santa Fe Springs and creating a small transit fee for those visiting outside of the city. An AV shuttle system, though utilization by design, would attract some tourism, and the city should not forget to take advantage of this. An AV shuttle in the city would change public image about ridership leading to greater support for transit programs.

Conclusion

AV shuttles will usher in a new era of productivity for riders serving local Santa Fe Spring residents and connecting them to jobs in industrial zones. AV shuttles will reduce greenhouse gas emissions with the incorporation of an all-electric fleet. An AV project will bring regional attention to the city of Santa Fe Springs improving quality of life. Santa Fe Springs has expressed its goal for the creation of a small-scale livable downtown and data from outreach collected on this program could help aid in a downtown project. It is important to reiterate the goal of pursuing a partnership with an AV tech company. It is also important to remember an AV shuttle program will need the broad support of local stakeholders and community groups. A series of engagement strategies to generate public interest must focus on creating a coalition of groups dedicated towards the creation of AV shuttle programs. The city should advertise the benefits of automation. Public perception towards automation is not by default, positive, simply because the technology is new and unknown to the general population. Therefore, it is crucial to communicate the positive impacts which include GHG emissions reduction, commuting benefits,

less accidents, and other positive effects of included case studies. Outreach should be aimed towards households with special attention to schools and colleges in the area. Local businesses should be contacted, and the city should hold public workshops and seminars about the benefits of AV shuttles. AV Shuttles in Santa Fe Springs could be marketed as a healthy alternative to avoiding smog and pollution in the industrial areas of the city. In addition, the people of Santa Fe Springs pride themselves on being active and present in their community. They value transparency in local government and health. In summary, an AV shuttle program spearheaded by local support would allow for Santa Fe Springs residents to participate in city events and improve city image.

Figure 3-6: Las Vegas AAA AV Shuttle on the Road

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