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MIAMI-DADE TRANSPORTATION PLANNING ORGANIZATION

CONNECTED AUTONOMOUS VEHICLE
STRATEGIC PLAN

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1.0 Introduction

Connected and automated vehicles (CAV) are emerging and transformative technologies that can reshape the transportation system and urban landscape of Miami-Dade County. They will influence vehicle ownership norms, land development patterns, and travel patterns. While CAV technologies will likely improve safety, increase network efficiency, and reduce congestion, they also pose potential risks and challenges, such as data security and increased miles of travel for single- and even zero-occupancy vehicles.

Vehicles with automated technologies, advanced safety features, and connected capabilities already operate on the local roadway system, and the private sector continues to advance and deploy technologies quickly. It is becoming increasingly important for government agencies to understand the evolving timeline and capabilities of CAV technologies to better plan for how to optimally leverage their benefits and minimize their negative impacts and risks.

The Miami-Dade Transportation Planning Organization (TPO) and Miami-Dade County are planning for and investing in building a more multimodal transportation system. Of particular importance is the SMART Program, which invests in premium transit and supportive transit-oriented communities (TOCs) along six designated rapid transit corridors. CAV technologies will influence those investments and initiatives. Both the TPO and County are seeking to leverage CAV and other travel technologies to support multimodal goals.

The TPO is taking an initiative-taking approach to incorporating CAV technologies into its short-, mid-, and long-term planning processes by developing this CAV Strategic Plan. While CAV is its title, the Plan encompasses all technologies potentially influencing how people travel, ranging from real-time travel communications to internet connectivity that allows people to work and shop from home.

The study process involved those from partner agencies via a Study Advisory Group (SAG) and from the public via a Vision Workshop. The SAG included staff from the Miami-Dade Department of Transportation and Public Works (DTPW), who led the developed a CAV Vision Plan adopted in 2019. The SAG also included representatives from the Florida Department of Transportation, educational institutions, private-sector industry members, and other local governments.

Rapidly emerging technologies make it challenging to know what new technologies will be on the scene and how people will adopt them. Given the uncertainty, the Strategic Plan relied on future scenarios to better understand how new technologies could change travel and support or undermine the goals of the TPO and its partners.

The process yielded two overarching conclusions:

1. Continuing support for the DTPW CAV Vision Statement, the centerpiece of the Miami-Dade CAV Vision Plan, which seeks to leverage CAV technologies in ways that support the county's commitment to a multimodal transportation system.
2. The need to plan for and leverage CAV and related technologies with a holistic and integrated perspective and partnership.

The Miami-Dade TPO is in the unique position of providing a holistic perspective to CAV planning. Such a perspective focuses on complete trips, not portions of trips on any given facility, and the perspectives of differing agencies who own and operate differing network facilities. A complete trip perspective enables the TPO to better understand how CAV and other technologies can be leveraged to optimize multimodal travel across differing segments of the network while segment-oriented perspectives can pain incomplete pictures of travel and can impede the attainment of the County's multimodal goals, such as finding the right balance between roadway levels of service and transit ridership.

The CAV Strategic Plan proposes the creation of a SMART CAV Concept of Integrated Operations (CIO) to orchestrate planning for and operating the Miami-Dade's multimodal network. The centerpiece of the CIO is a partnership among network owners and operators. The first task of the partnership is to define multimodal system performance objectives and measures that help to align those currently used by differing agencies who currently own and operate differing segments of the network. The second task is to develop a plan to guide investment in CAV and other travel technologies in the short, medium, and long-long term. The TPO and partnership will develop pilot projects that explore how CAV and other technologies could impact travel along multimodal corridors and in multimodal centers. These actions will help ensure that agencies and partners in Miami-Dade County are well-positioned to embrace the opportunities and challenges that come with the integrated deployment of CAV technologies.

2.0 CAV and Other Transformative Technologies

This study uses connected and autonomous vehicles (CAV) as an all-encompassing term for technologies related to vehicle communication and automation; however, it is important to note that connected vehicles and autonomous vehicles are distinct. Furthermore, when engaging partners and the public in the conversation of CAV, other related technologies arise, like vehicle electrification, e-commerce, delivery vehicles, and telework, to name a few. The following sections define connected vehicles and autonomous vehicles and provide additional information on examples of other transformative technologies that are either emerging or in the preliminary stages of development and may significantly impact the transportation system.

2.1 Connected Vehicles

Connected Vehicles (CVs) can communicate with one another and the surrounding infrastructure using decades-old over-the-air (OTA) transmission technology and protocols. The advantage of this technology is increased safety and mobility from the real-time exchange of spatial-temporal information between vehicles and between vehicles and the surrounding intelligent infrastructure.

As shown in Figure 1, vehicle-to-vehicle (V2V) networks are made up of OTA communication nodes with cars connected with one another. CVs connect with either roadside infrastructure or pedestrians to build vehicle-to-infrastructure (V2I) or pedestrian-to-pedestrian (V2P) networks. The network type changes to vehicle-to-network (V2N) when the car talks with information technology (IT) networks and data hubs. Vehicle-to-everything (V2X) is a term that encompasses all these sorts of communication by connecting vehicles to a variety of recipients. Dedicated short-range communications (DSRC) technology and cellular vehicle-to-everything (C-V2X) communication technologies are the two OTA data transfer technologies currently employed in V2X systems. CV safety and mobility applications overcome the physical limitations and distraction errors of humans behind the wheel and have the potential to dramatically reduce the number of fatalities and serious injuries caused by accidents on our roads and highways.

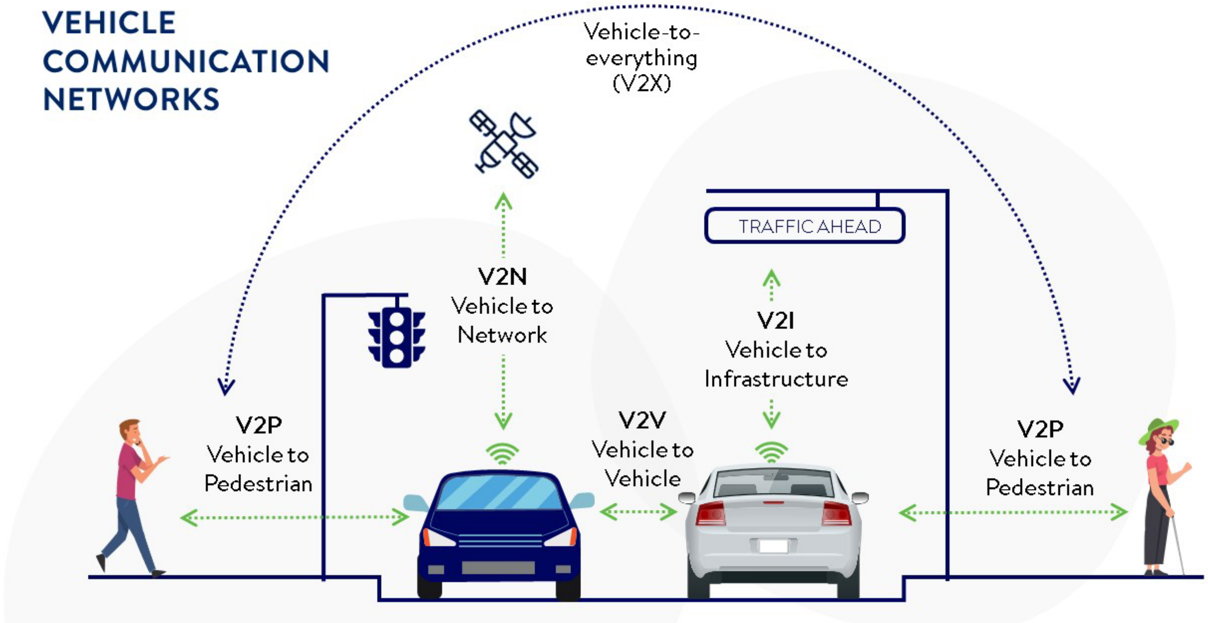


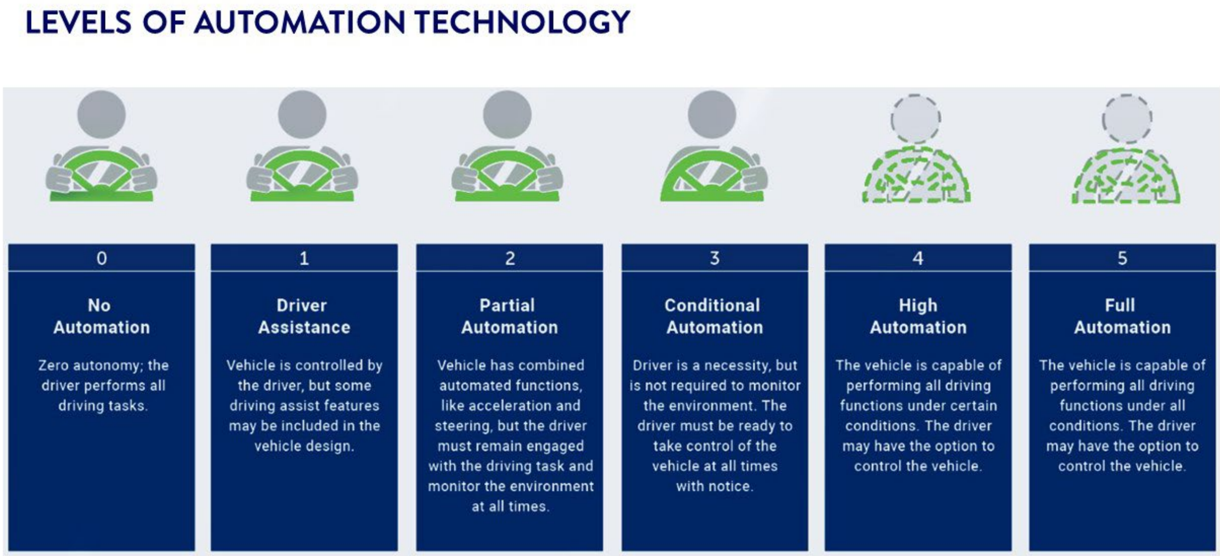
Figure 1 Connected Network Vehicle Ecosystem

2.2 Automated Vehicles

According to the USDOT, "automated vehicles are vehicles in which some aspects of a safety-critical control function (e.g., steering, throttle, or braking) occurs without direct driver input."[1] Therefore, automated vehicles are characterized by distinct levels of automation. The Society of Automotive Engineers (SAE International) established the taxonomy and defined each of the five distinct levels of autonomy, as described in Figure 2.

The full range of driving automation features spans from Level 0 to Level 5, where the level is determined by the driving conditions in which the features are employed. Level 4 and 5 capabilities are the levels of autonomy considered in many AV analyses and serve as a threshold upon which significant changes related to most aspects of personal or freight travel would occur, particularly concerning travel demand.

Figure 2 Levels of Autonomy and Driving Automation System

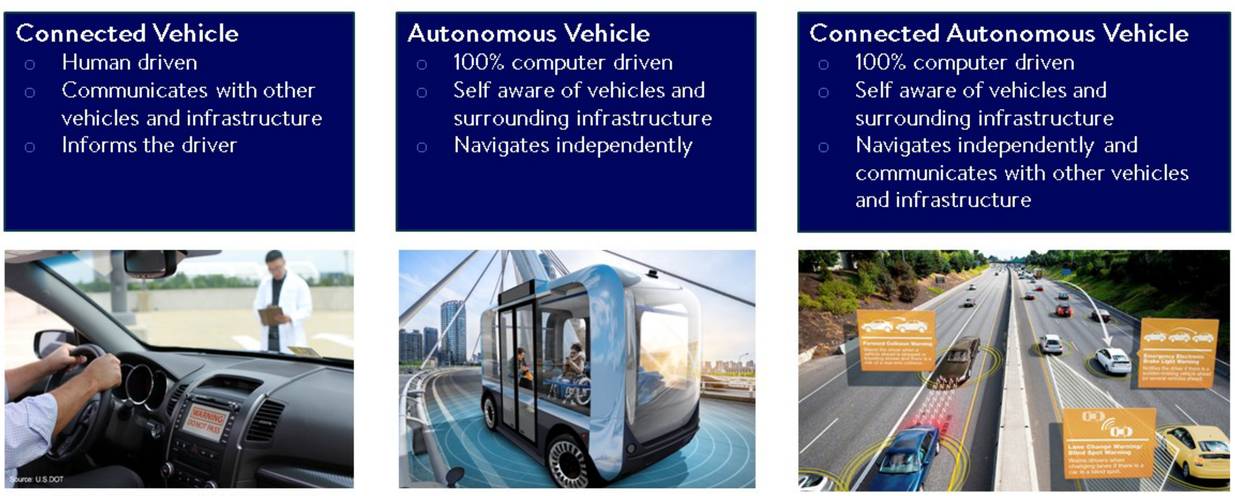


Source: Society of Automotive Engineers (SAE)

2.3 Connected-Automated Vehicles

CAVs leverage automated and connected vehicle technologies to harvest the benefits of advanced in-vehicle sensors with V2V, V2I, and V2X communications. CV connectivity is critical in realizing automated vehicles' full potential benefits and adoption. Figure 3 summarizes the CAV technologies.

Figure 3 CAV Technologies



Source: U.S. Department of Transportation

2.4 Other Transformative Technologies

In addition to CAVs, other emerging technologies are impacting, or will affect, how people move and why they move. The term "emerging" typically refers to technologies still in the initial stages of development and may not yet be widely adopted or significantly impact the transportation system. However, some emerging technologies mentioned below are already available in some capacity and their impact on transportation is becoming increasingly apparent, such as electric vehicles, telework, mobility-as-a-service, and e-commerce. As these technologies continue to develop and become more widespread, their impact on the transportation system will likely become even more significant. Thus, it is essential to continue to identify these emerging technologies so that local government agencies can understand their evolving timeline and capabilities and continue to include them in plans so that agencies are prepared for the transformative impacts of these technologies. The following are a few examples of these transformative technologies:

1. **Electric vehicles (EVs)** are becoming increasingly popular due to their lower emissions and operating costs than traditional gasoline-powered vehicles. As the infrastructure for charging electric vehicles becomes more widespread, EVs have the potential to reduce carbon emissions from transportation significantly. In addition, vehicles with CV or AV technology can also be an EV.
2. **Telework:** Telework refers to working remotely, usually from home, using digital technologies such as video conferencing, email, and instant messaging to communicate with colleagues and complete work tasks. Telework has become more prevalent in recent years due to technological advances and changing attitudes toward work-life balance. Telework can significantly impact transportation, as it reduces the need for people to commute to a central office location. This can help reduce traffic congestion, lower carbon emissions from transportation, and improve the quality of life for workers who may have previously spent several hours commuting daily. Additionally, teleworking can provide workers with more flexibility and autonomy, leading to increased job satisfaction and productivity.
3. **Mobility-as-a-Service (MaaS):** MaaS refers to integrating various modes of transportation, such as public transit, ridesharing, and bike-sharing, into a single platform. Users can use a smartphone app to plan and pay for their transportation needs, with the system optimizing routes and modes based on real-time data. As a result, MaaS could reduce the need for private car ownership and provide more sustainable and efficient transportation options.
4. **E-commerce and autonomous delivery vehicles:** E-commerce is another technology impacting how people move, although it affects transportation indirectly. E-commerce refers to the buying and selling of goods and services online, and it has become increasingly popular in recent years due to the convenience and accessibility it offers to consumers. One way e-commerce impacts transportation is through the delivery of goods, particularly with the increasing demand for fast and efficient delivery services. This means there is an increase in delivery vehicles on the roads, which can contribute to congestion and emissions. While e-commerce may not be a direct transportation technology, it is a significant trend to consider in future mobility, as it has the potential to impact the demand for transportation services and the design of transportation infrastructure. While much of the attention on autonomous vehicles has focused on passenger cars, there is also a growing interest in using autonomous vehicles for deliveries. These vehicles could operate on dedicated delivery routes, reducing congestion and emissions from delivery trucks.
5. **Mobility Analytics:** Advances in data analytics and artificial intelligence could help to optimize transportation systems and improve traffic flow. For example, real-time traffic data could be used to optimize traffic signals, or predictive analytics could be used to anticipate traffic congestion and suggest alternate routes.

6. **Urban Air Mobility (UAM):** UAM refers to using aircraft for short-distance transportation within urban areas. These aircraft would be smaller and more agile than traditional planes, operating from smaller airports or rooftop helipads. As a result, UAM can reduce travel times and significantly ease congestion in urban areas.
7. **Personal Rapid Transit (PRT):** PRT is a form of public transportation that uses small, automated vehicles to transport passengers on demand. Passengers can select their destination; the car will take them directly there without stopping at intermediate stations. As a result, PRT can potentially reduce travel times and provide more personalized transportation options.

3.0 Study Process and Key Findings

A Strategic Advisory Group (SAG) was created at the outset of the study to ensure continued coordination and alignment. The SAG provided insights, feedback, and recommendations on the scenarios and the final strategies. The SAG included representatives from government agencies (such as FDOT, DTPW, RER and other county departments, South Florida Regional Transportation Agency, the Miami-Dade Expressway Authority, Florida Turnpike, City of Miami, and the Town of Key Biscayne), industry experts (including representatives from Florida International University), and representatives from the private sector (including Argo AI, Ford, and Motional).

Furthermore, this study included a workshop to hear from the public and local government agency staff not on the SAG. The workshop focused on learning from participants their ideas and visions for the future of CAVs. The workshop was held via Zoom on August 31, 2022. It included an informative presentation followed by an interactive and collaborative session where facilitators guided participants through exercises and discussions to identify priorities, opportunities, and challenges related to the CAV scenarios presented in the previous section.

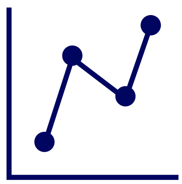
Given the uncertainty over the development and adoption of new travel technologies, the Strategic Plan relied on scenarios to better understand how technologies may change travel patterns and the impact of those changes on the goals of the TPO and its partners. Scenario planning involves developing and analyzing differing outcomes to inform decision-making and planning. The scenarios developed for this effort explored the risks, challenges, and opportunities of existing and possible technologies across all modes of travel. The scenarios were:

1. Trend – minimal development and deployment of travel technologies.
2. Smart roads and vehicles – the private sector and roadway agencies actively develop and deploy CAV technologies. Transit and other technologies are not fully developed and deployed.
3. Smart transit – transit technologies are developed and deployed along with CAV technologies.
4. Smart Infrastructure – technologies and policies optimizing local travel, such as smart parking, are developed and deployed along with transit and CAV technologies.

The following information provides details on each of the four scenarios. It presents the technology story created for each scenario and the expected changes wrought by the technology. Each scenario builds on the previous one, demonstrating a technology adoption and implementation progression over time, with 2050 as a horizon year.

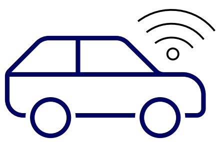
The scenarios were vetted through public workshop. Workshop participants responded to prompts related to each scenario to consider opportunities, challenges, and potential strategies that could emerge. The descriptions below include feedback from the workshop.

3.1 Scenario 1 – Trend



The first scenario assumes minimal development and adoption of technologies beyond what is available today. This scenario does not significantly alter the transportation or land-use landscape. The trend scenario provides a baseline against which other scenarios were compared.

3.2 Scenario 2 – Smart Cars and Roads



The *Smart Cars and Roads s*cenario envisions a future where CAV technology is available and widely used. This scenario assumes Level of Autonomy 4, which provides an elevated level of automation with the fallback expectation that users may need to interact with the vehicle at times. It envisions the active development and deployment of roadside technologies that communicate directly with smart vehicles. The scenario assumes limited deployment of transit and other travel technologies.

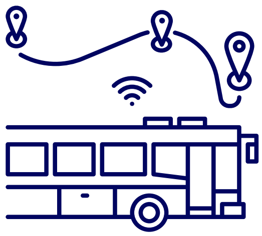
The expected changes of this scenario are increasing use of driverless vehicles and increasing availability of remote parking. The CAV technologies will combine to increase expressway capacities twofold and arterial capacities by up to 50 percent. The scenario's technologies will initially reduce congestion on the major roadway network to promote auto travel, resulting in more vehicle miles traveled (VMT) for both passenger and commercial vehicles. The scenario assumes that decreased congestion will encourage residences and businesses to disperse.

With those changes, transit use will decrease with the greatest reductions in ridership along SMART Program corridors. Bottlenecks will occur in advanced mixed use and job centers, such as downtown Miami, as cars exit from expressways onto local street networks not equipped to manage the increased demand. The bottlenecks will be exacerbated by driverless cars traveling to and from parking areas and picking up and dropping off passengers.

According to workshop participants, the opportunities associated with the *Smart Cars and Roads* scenario are improved accessibility and mobility for some transportation-disadvantaged populations such as the elderly and disabled, improved roadway capacity and travel time reliability, and improved safety from a reduction in vehicle crashes.

The challenges identified by workshop participants included the upfront costs for infrastructure improvements, increases in VMT from more single-occupant vehicles traveling longer distances, decreasing transit ridership, dispersed development patterns, and equity concerns for people without access to the technology-enabled improved mobility.

3.3 Scenario 3 – Smart Transit



The *Smart Transit* scenario incorporates the development and adoption of CAV technologies envisioned in the *Smart Cars and Roads* scenario but also assumes transit agencies are active in developing and deploying transit technologies. These technologies improve transit operations, increase the availability of first and last-mile services, improve the collection and use of real time transit travel information, and streamline fare collection. *Smart Transit* also improves demand-response services, which increase accessibility in low-income neighborhoods outside of areas served by fixed route service. With those improvements, transit becomes more competitive with single-occupant vehicles to help sustain and possibly increase transit ridership.

Workshop participants stated that the opportunities associated with *Smart Transit* include improved multimodal connections, transfers, and better integration of first and last-mile solutions to reduce travel times for complete trips. Other opportunities are the potential for reducing transit operations costs and enhanced safety by reducing conflicts between transit vehicles and other travelers. The savings from reducing operations costs may be passed to transit users through more frequent and widespread transit services.

According to workshop participants, the challenges associated with *Smart Transit* are the potential to increase congestion because of more vehicles being on the road, upfront infrastructure costs, equity concerns, and resistance to adapting to new systems and technologies.

3.4 Scenario 4 – Smart Infrastructure Network

The *Smart Infrastructure Network* scenario incorporates the technologies assumed in the first two scenarios and adds a local network and development pattern dimension, including nodes for modal transfers, off-site parking, and easily accessed high-tech community centers providing connectivity for those wanting to virtually work and shop outside the home. Changes expected to occur due to this scenario include fewer bottlenecks on local streets, efficient parking, increased e-bike and scooter use, and increased virtual connectivity.

According to workshop participants, the opportunities associated with the *Smart Infrastructure Network* scenario include the increasing usage of Intelligent Transportation Systems (ITS) to improve roadway operations, electric vehicle charging, and information systems, and better land use and transportation integration decision-making.

The challenges associated with this scenario are upfront costs, maintenance costs, capital improvement costs, security concerns with technology systems, data sharing, and user privacy.

3.5 Key Findings

Discussions with the SAG and input from the workshop yield two key findings: there is continued support for leveraging technologies to support the County's multimodal transportation system goals; and achieving that vision should inegrate the County's management and operations. The key challenge to integrated management and operations is overcoming the fragmented ownership and operations of the County's multimodal network. Measuring performance through a complete trip perspective can provide the means to coordinate the efforts of differing agencies.

3.5.1 Multimodal Technology

The Miami Dade Department of Transportation and Public Works (DTPW) developed the Connected and Autonomous Vehicle Vision Plan in 2019. The CAV Vision Plan provides a policy direction and implementable actions for CAV and other travel technologies in the County. The CAV Vision Plan includes a vision statement that articulates the County's ideal future conditions for CAV and the transportation system. The Vision statement is as follows:

The vision for connected and automated vehicle technologies in Miami-Dade County is to leverage these technologies to achieve the goals of enhanced safety, reduced reliance on single-occupancy private automobiles, and improved mobility and sustainability of the transportation network across multiple use cases (first/last mile connections, public transit, goods movement, parking, mobility as a service (MaaS) platforms) with an emphasis on supporting public transportation.

The SAG agreed to carry forward the vision statement into this CAV Strategic Plan effort. SAG members agreed that the vision statement still resonates with the overall aspirations and goals for the future. Carrying forward this vision ensures that the TPO's efforts are aligned and consistent with the County's goals and objectives, leading to collaborative and effective planning and implementation of CAV-related initiatives.

3.5.2 Integrated Management and Operations

CAV and other travel technologies can make multimodal networks more efficient, reliable, resilient, and safe. These technologies can achieve such aims through the active management and operations of the transportation system by public agencies working in concert with each other and with private companies.

As noted earlier, one of the key challenges of planning for travel technologies is the uncertainty over when existing technologies will be widely adopted and what new technologies could emerge. A second key challenge is overcoming the fragmented ownership and operations of multimodal networks. This challenge became evident as the SAG reviewed scenarios. For example, the *Smart Roads and Cars* scenario illustrated potential bottlenecks on local street networks that are ill-equipped to accommodate increased traffic exiting from CAV optimized expressways and arterials.

While the uncertainty over future technologies is and will continue to be a challenge, integrated management and operations is something public agencies and private industries can plan for now and implement. The keys to integration are active partnerships and system level goals and performance metrics to guide those partnerships.

3.5.3 System Level Performance Goals and Metric

Roadway agencies active in Miami-Dade County, including FDOT, Florida's Turnpike Enterprise, MDX, Miami-Dade DTPW, and municipalities, are charged with monitoring and improving, as needed, those segments each owns and operates. The performance goals and objectives for those agencies vary. For example, DTPW may be concerned with access to the major road network, while FDOT may be concerned with segment level of service (speed). These varying performance objectives can result in conflicts, such as the expressway to local street bottlenecks highlighted above. Adding to the complexity are transit operators, including DTPW and municipalities, charged with differing performance goals and objectives. Those expectations can conflict with roadway goals. Often, there is not a clear answer as to which set of conflicting performance goals take precedence.

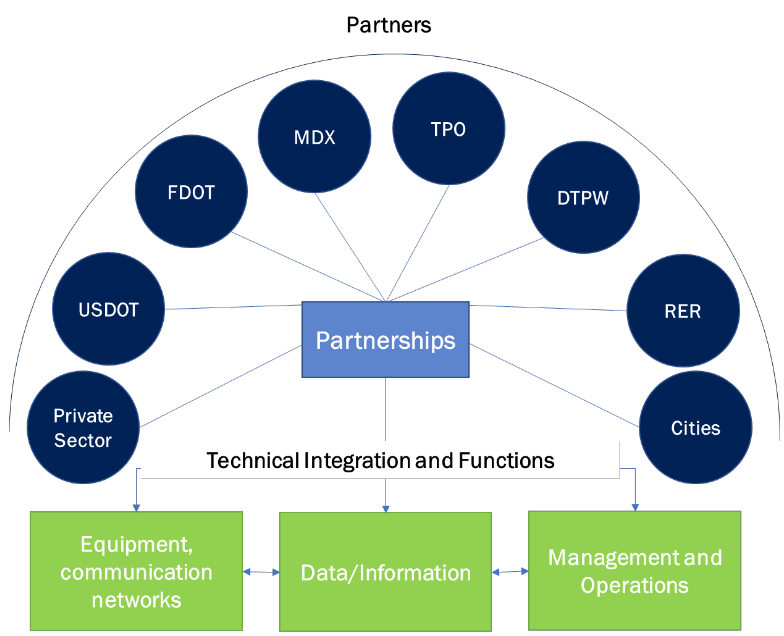
There is another perspective to consider in the planning process, that of travelers who focus on reaching their destinations quickly, affordably, and safely. Before making each trip, they consider available travel mode and path options, regardless of which agency owns and operates differing segments along those paths. This complete trip perspective could be used to help set context for the performance along network segments and reconcile conflicting performance goals. For example, congestion on an arterial segment with transit, walking, and biking supportive land development patterns (either existing or proposed) may be acceptable. Congestion on another arterial segment without such patterns may not be.

4.0 SMART CAV Concept of Integrated Operations

The SMART CAV Concept of Integrated Operations (CIO) is a framework designed to integrate and leverage CAV and other travel technologies. The centerpiece of CIO is a multiagency partnership guided by a multimodal system-level planning framework (Figure 4). The partnership will oversee the integration of equipment, communications, information, and data.

Figure 5 summarizes the recommended CIO strategies. Short-term strategies include creating the SMART CAV Partnership, which in turn will create a SMART CAV Plan that identifies performance goals and measures that guides the SMART CAV Monitoring System. Subsequent strategies focus on pilot projects, conducting periodic updates to the planning framework, developing management and operation plans, and conducting multimodal improvement studies. The short-, mid-, and long-term strategies outlined in this report align with the Plan's key finding.

Figure 4 SMART Technology Partnership



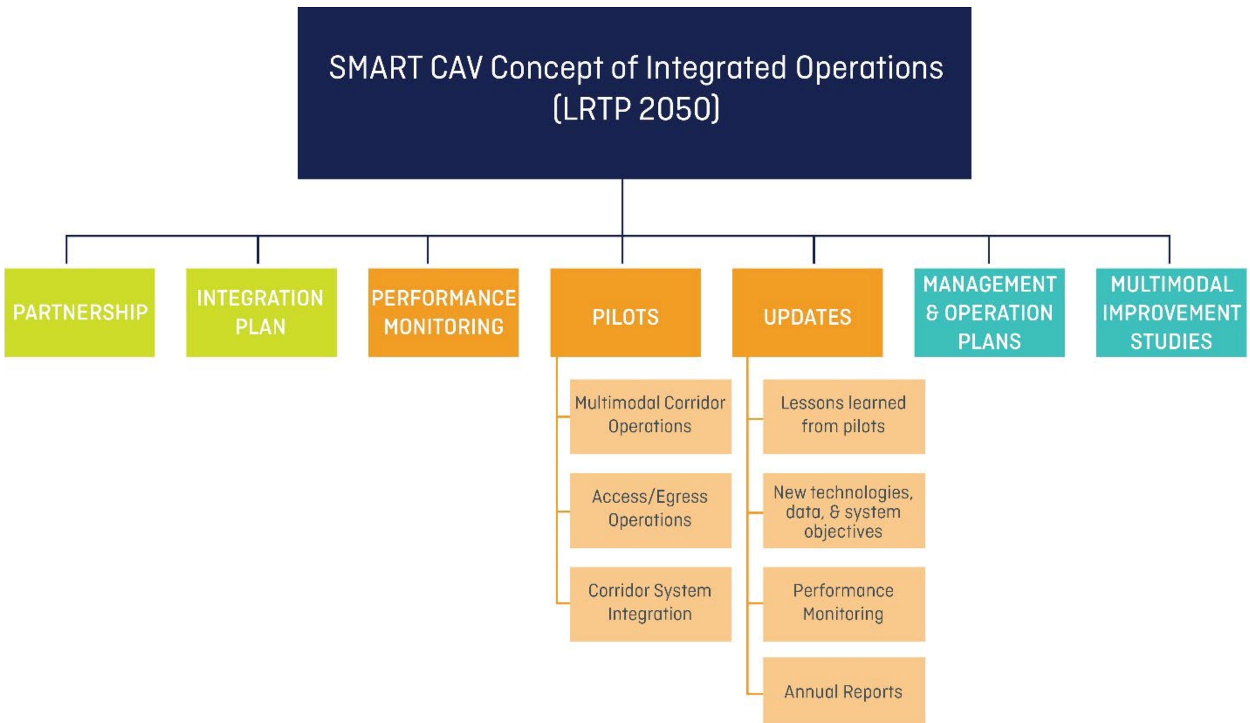
Mid-term strategies are designed to be implemented during the second five-year period. These strategies will focus on scaling up the CIO and implementing technologies. Key mid-term strategies include:

1. Using feedback from system monitoring and pilot studies to refine CIO policies and procedures.
2. Continue monitoring system performance.
3. Conducting pilot studies to evaluate access and egress and to recommend operational improvements in a selected multimodal corridor.

Long-term strategies will take place during the third five-year period. These strategies will focus on ensuring the long-term sustainability and effectiveness of the CAV system. Key long-term strategies include:

1. Continue to refine CIO policies and procedures based on system monitoring and pilot study feedback.
2. Implementing system, corridor, and access and egress technologies based on feedback from the pilot studies.
3. Engaging in ongoing research and development to advance the capabilities of travel technologies and ensure their continued relevance and effectiveness in meeting the needs of users.

Figure 5 Summary of CIO Strategies



4.1 SMART CAV Partnership

The SMART CAV Partnership will create a forum where public agencies and private sector companies can plan for and implement the CIO. The TPO will lead formation of the partnership that will include, at a minimum, the Florida Department of Transportation (FDOT), and the Miami-Dade Expressway Authority (MDX), Department of Transportation and Public Works (DTPW), Department of Regulatory and Economic Resources (RER), private interests, and cities. The partnership will be tasked with developing its mission, goals, and objectives, as well as identifying partner roles and responsibilities.

4.2 SMART CAV Plan

The first order of business for the SMART CAV Partnership is to create the SMART CAV Plan that defines how the CIO can be developed and implemented to support the County's CAV vision. The SMART CAV Plan will define system level goals, objectives, and performance measures. It will outline how data, communications, and technologies will be developed and integrated across modes. The plan will include an inventory of existing operations, data, communications, and information, an exploration of near-term technologies and data, and a more robust list of needed strategies.

4.3 SMART CAV Monitoring System

The SMART CAV Monitoring System will be created shortly after the SMART CAV Plan is completed. It will be designed to provide real-time data and analysis on how well the CIO is meeting goals and objectives. The system could be an augmentation of the TPO's existing congestion management system. The SMART CAV Partnership will oversee the development of baseline data, analysis, and reporting. It will continue to oversee periodic updates of data, analysis, and reporting to track progress toward goals and objectives.

4.4 Pilot Projects

A series of pilot projects are recommended to understand better and put into practice integrated management and operations. Feedback from the projects will help the SMART CAV Partnership in the future planning and deployment of CAV and other travel technologies.

4.4.1 CIO Corridor Pilot Project

A CIO corridor pilot project aims to assess how readily available technologies can be integrated and applied to improve the management, operations, and performance of a selected multimodal corridor. Feedback from the pilot study will be used to recommend mid-term management and operational strategies for multimodal corridors across the county.

Pilot study tasks could include acquiring and summarizing data, reviewing existing performance using the measures developed in the SMART CAV Plan, identifying and testing readily available technologies that can potentially improve performance, and recommending how the lessons learned from the pilot test can be applied elsewhere.

4.4.2 CIO Access/Egress Pilot Project

The objective of a CIO access/egress pilot project is to evaluate how readily available technologies can be integrated and applied to improve access and egress in a selected multimodal area in Miami-Dade County, such as a high intensity, mixed use area surrounding an existing Metro Rail station area. The tasks for such a study could include acquiring data, identifying and testing readily available technologies that can potentially improve performance, and recommending how the lessons learned from the pilot test can be applied elsewhere.

4.4.3 Long-Range Pilot Project

The long-range pilot project is intended to take a longer look into how technologies under development or not widely adopted could improve performance along multimodal corridors. The project's objectives are twofold, to understand better how emerging technologies will impact the County's multimodal goals and identify what can be done in the near term to implement beneficial technologies more readily over the long term.

4.5 Monitoring, Updates, and Studies

As noted above, the SMART CAV Monitoring System will be updated periodically by the SMART CAV Partnership. The schedule of the updates will need to be determined. Feedback from the SMART CAV Monitoring System and the pilot projects will be used to update the SMART CAV Plan and the SMART CAV element of the TPO's Long Range Transportation Plan (LRTP).

Feedback from the CAV Monitoring System and updates to the SMART CAV Plan will help guide the continued development of and enhancements to management and operations of the various agencies who own and operate differing segments of the County's network, including annual performance monitoring reports. The overall goal is to leverage technologies to meet the County's CAV vision. The pilot studies and performance monitoring will provide insights into future multimodal studies, including system-wide plans (such as the LRTP), corridor studies, and local area studies.

Table 1 provides an overview of the recommended SMART CAV Concept of Integrated Operations Strategies.

Table 1 SMART CAV Concept of Integrated Operations Strategies

Strategy	Strategy Objective	Duration/Time Frame	Partners
SMART CAV Partnership	Create partnerships among government and private sector to guide the planning and implementation of system integration.	Short-term	FDOT, MDX, DTPW, RER, private interests, TPO, cities
SMART CAV Plan	Create Plan that identifies how to integrate existing and near-term technologies, operations, data, and information.	Short-term	Smart CAV Concept of Integrated Operations Partnership
SMART CAV Monitoring System	Develop a multimodal monitoring system to track system performance (augmenting the congestion management system).	Short-term	FDOT, MDX, DTPW, private interests, TPO, cities
CIO Corridor Pilot Project	Evaluate multimodal corridor using system performance measures and recommend improvements in mid-term management and operations strategies.	Mid-term	DTPW, TPO

	Access / Egress Pilot Study	Evaluate access / egress performance and recommend operational improvements in selected multimodal corridor (i.e., existing Metro station area).	Mid-term	DTPW, RER, TPO
	Long Range Pilot Project	Develop and evaluate long-term corridor technology scenarios in multimodal corridor.	Mid-term	DTPW, FDOT, RER, TPO
	Plan Updates	Update SMART CAV Plan with new technologies, data, and system objectives.	Mid-term and Long-term	DTPW, RER, TPO
	Performance Monitoring Updates	Update performance monitoring with new technologies, data, and system objectives.	Mid-term	DTPW, RER, TPO
	Annual Performance Monitoring Reports	Generate annual reports to track trends and the performance of improvements.	Short-term, Mid-term, and Long-term	DTPW, RER, TPO
	Management & Operations	Conduct a system integration management and operations plans as needed throughout the county using the lessons learned from the pilot studies.	Mid-term and Long-term	DTPW, RER, TPO
	Multimodal Improvement Studies	Conduct integrated multimodal improvement studies will be conducted in the county using the lessons learned from the pilot studies.	Mid-term and Long-term	DTPW, FDOT, MDX TPO, cities

5.0 Summary

Connected and automated vehicles (CAV) are emerging and transformative technologies that can reshape the transportation system and urban landscape of Miami-Dade County. Those technologies will have an impact on how the Miami-Dade Transportation Planning Organization (TPO) and Miami-Dade County plan for and invest in roads, transit, pedestrian, and biking improvements in the county.

Both the TPO and County are committed to developing a multimodal transportation network. The vision is to leverage CAV technologies in ways that support those multimodal aspirations. To that end, the TPO is taking an initiative-taking approach to incorporating CAV technologies into its short-, mid-, and long-term planning processes by developing this CAV Strategic Plan. While CAV is its title, the Plan encompasses all technologies potentially influencing how people travel, ranging from real-time travel communications to internet connectivity that allows people to work and shop from home.

The study process engaged both a Study Advisory Group (SAG) and the public, who provided feedback on a series of travel technology scenarios. The process yielded two overarching findings:

1. continuing support for the DTPW CAV Vision Statement, the centerpiece of the Miami-Dade CAV Vision Plan, which seeks to leverage CAV technologies in ways that support the county's commitment to a multimodal transportation system,
2. the need to plan for and leverage CAV and related technologies with a holistic and integrated perspective and partnership.

The CAV Strategic Plan recommends the development of a SMART CAV Concept of Integrated Operations (CIO) to orchestrate planning for and operating the Miami-Dade's multimodal network. The centerpiece of the CIO is a partnership among network owners and operators. The first task of the partnership is to define multimodal system performance objectives and measures. The second task is to develop a plan to guide investment in CAV and other travel technologies in the short, medium, and long-long term. The TPO and partnership will develop pilot projects that explore how CAV and other technologies could impact travel along multimodal corridors and in multimodal centers. These actions will help ensure that agencies and partners in Miami-Dade County are well-positioned to embrace the opportunities and challenges that come with the integrated deployment of CAV technologies.