APPENDIX B

APPALACHIAN REGIONAL FREIGHT MOBILITY PLAN

Technical Memorandum

FREIGHT PLANNING BEST PRACTICES AND EMERGING TECHNOLOGIES

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1. Introduction

Freight planning has become a required element of the transportation planning conducted by states, metropolitan areas, and local governments. The Fixing America's Surface Transportation (FAST) Act placed emphasis on sound freight planning at the state and regional levels to strengthen economic competitiveness, reduce congestion, improve safety, and reduce the environmental impact of freight movement. States and regions are also increasingly aware of the impact that efficient freight transportation can have on economic development outcomes.

Trade growth also comes with costs, however. Local governments are increasingly aware of the community impacts of freight growth, which include safety concerns, emissions, and unauthorized truck parking, among other things. Emerging technology applications – which are being increasingly adopted by the freight industry, sometimes in partnership with public agencies – can mitigate some of these issues. Others require innovative public-private partnerships (P3) to deliver infrastructure solutions that benefit both parties.

As home to the Greer Inland Port, BMW North America, and other automotive industry suppliers, freight is important to Upstate South Carolina's economic success. At the same time, continued population and economic growth – and the increased freight volumes that come with them – are contributing to concerns about congestion, safety, and preserving community character. Funding constraints coupled with the difficulty in planning and constructing large infrastructure projects mean that the region may need to look beyond traditional approaches to addressing such issues. It's therefore important to look at best practices from other regional planning efforts, including innovative technology approaches and funding options to help execute critical projects and improve network operations.

This technical memorandum provides an overview of freight planning best practices the ACOG region can use to promote better freight mobility, improve safety, and meet other regional goals. Freight planning best practices can be thought of as innovative techniques that promote efficient goods movement while also optimizing mobility for all users. More specifically, this memo provides best practice case studies of peer regions that have developed innovative solutions to freight challenges. It also describes future technology trends and applications in Connected and Automated Vehicle Technologies, Intelligent Transportation Systems (ITS) strategies and applications, and P3 solutions to truck parking challenges.

The remainder of this document is outlined as follows:

- Peer Regions Review – Summary of three recent regional freight planning/technology efforts with lessons learned for the ACOG region
- Alternative project delivery and public-private partnerships (P3) for emerging technologies – Big picture trends related to connected and autonomous vehicles, electrification, and shared mobility, with potential impacts on how infrastructure is planned and financed

- Future Technology Trends - Discussion on connected/autonomous vehicles, positive train control, and intermodal terminal automation trends that may impact goods movement planning in the ACOG region, with illustrative case studies
- Planning for ITS and Emerging Technologies – Overview of federal ITS planning/deployment guidance and a framework for integrating ITS and emerging transportation technologies into regional planning processes
- Public-Private Partnership (P3) Opportunities – Review of P3 projects that have improved truck parking and intermodal rail in other parts of the country
- Freight Safety and Security – Review of roadway incident management best practices, rail safety, and intermodal facility safety procedures/regulations
- Federal Grant Programs – Summary of key grant programs that are applicable to freight and technology projects, with a selected case study for a rail project that successfully pursued federal funding in the Carolinas

2. Peer Regions Review

This section presents a best practice review of three peer regions that have developed innovative approaches to freight and transportation planning. The following peer regions were selected based on similar freight/general mobility issues, and innovative technology deployments that ACOG may wish to explore:

- **Centralina (Charlotte) Freight Plan –** The Centralina Council of Governments (CCOG) developed a multimodal freight plan in 2016. The CCOG region consists of 14 counties in two states, making intergovernmental coordination crucial for plan development and implementation. The plan also includes best practices in freight and land use planning and truck parking.
- **Will County Community Friendly Freight Mobility Plan –** Will County, IL is on the outskirts of Chicago and has experienced tremendous freight growth driven by new intermodal rail terminals and associated warehouses and distribution centers. While this growth has benefitted the economy, it has also led to safety and livability concerns. The Community Friendly Freight Mobility Plan addresses transportation and land use interaction, community sensitivity to continued growth, and community best practices for assessing and permitting new freight facilities. It also includes an innovative workforce transportation plan to provide mobility for logistics sector employees.
- **Smart Columbus –** As the winner of the 2016 USDOT Smart Cities Challenge, Columbus, OH is developing, testing, and deploying technologies that can improve both freight and passenger mobility. The region is also a model for using partnerships to secure funding, define solutions, and mobilize resources to solve regional problems.

2.1 Centralina Freight Plan

2.1.1 Summary

The Centralina Freight Plan is the freight plan for the Centralina Council of Governments (CCOG) region, which is a bi-state, 14-county region in the Charlotte, North Carolina area. The plan was developed to identify ways to address freight congestion and key bottlenecks, identify links that connect freight mobility to regional economic goals, prioritize improvements to reduce barriers to efficiency, promote effective land use in urban and rural areas to support freight mobility, business development and job growth, and mitigate environmental impacts related to mobility barriers across the region.

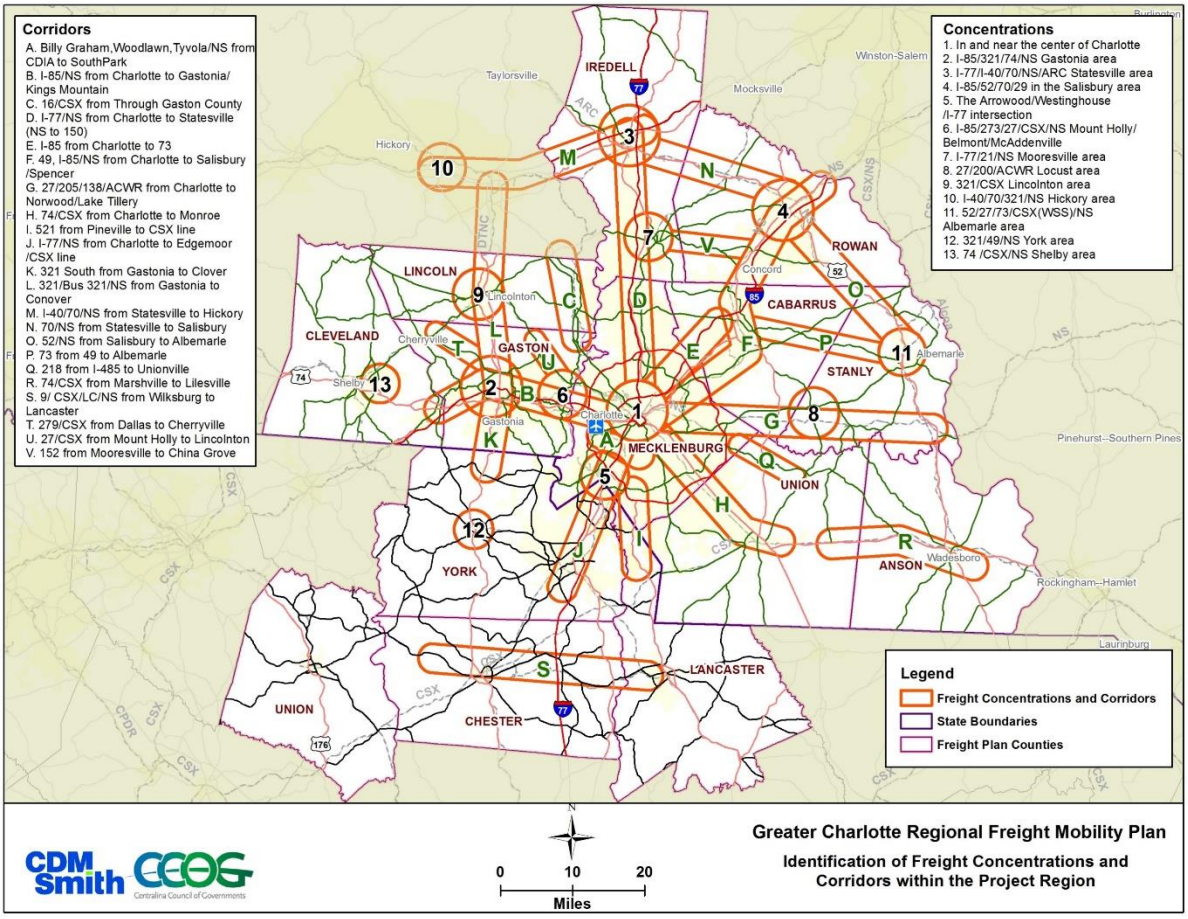
The plan has multiple purposes including being used as a data resource, providing freight related recommendations to be used in state and local land use and transportation plans, and serving as a basis for expanded and sustained regional coordination throughout the CCOG area.

2.1.2 Regional Freight Planning Best Practices

Freight and Land Use

The Freight Land Use Analysis for the Centralina Freight Plan identified and analyzed linear corridors and nodal concentrations areas of freight development (see **Figure 2.1**). Industrial sites were identified and developed into freight corridors or concentrations. The existing opportunities within the identified corridors and concentrations allows for infill or new development to locate near existing developed areas. This increases efficiency in freight movements, minimizes land use conflicts, and creates economies of scale for future freight improvement projects.

Figure 2.1: Mapping Freight Clusters and Corridors in the Centralina Region



Source: Greater Charlotte Regional Freight Mobility Plan

For future freight land use in the CCOG Region, the Centralina Freight Plan referenced the *CONNECT Our Future Place Types and Community Types Technical Memorandum* developed by the CCOG. The memorandum was used to organize and identify future freight-related land uses by their freight-related community types and their subsequent place types.

The Regional Freight Land Use Analysis analyzed multiple levels including the existing freight land use for the entire study area, and existing, underutilized, and potential freight opportunities in the identified corridors and concentrations in the study area. Land impacted by wetlands was also factored in to determine the amount of developable acreage available for infill and/or new freight development.

As an implementation step, the plan suggests local governments should adopt the plan and consider it when making future land use decisions. Having buy-in at the local level will ensure that better land use decisions are made as zoning is controlled at the city and county level. One recommendation was to identify logistics villages to concentrate freight and logistics activity within a defined area, thus minimizing negative impacts of freight movement community-wide.

Agency Coordination and Plan Implementation

Meeting in a Box

The Centralina Freight Plan developed pre-packaged materials for agency staff to host follow-up meetings with community groups, elected officials, or other organizations for use beyond the development of the plan. These materials are called "Meeting in a Box" and allow the CCOG to continue to engage the public on plan implementation.

Outreach Efforts

Outreach efforts for the Centralina Freight Plan consisted of four components: an online survey, a telephone survey, stakeholder meetings, and the CCOG-FHWA Freight Mobility Planning Peer Exchange.

The online survey was conducted using SurveyMonkey to gain feedback from trade organizations such as the North Carolina Trucking Association, South Carolina Trucking Association, the Chamber of Commerce, and other key freight stakeholders in the region. The survey included questions related to the performance and condition of the freight transportation system.

The telephone survey asked representatives of the freight industry to solicit input on trends and barriers that impact freight movement; specific regional freight mobility issues; performance measures; issues of regional coordination; and required resources. These representatives included public planning agencies, economic development professionals, transportation agencies, private sector freight shippers, carriers, and transportation intermediaries. All modes of freight mobility were represented in the outreach efforts including ports, railroad, air cargo, highway, and freight intermediaries.

The Centralina Freight Plan also held stakeholder meetings with three committees:

- **The Coordinating Committee** oversaw technical aspects of the plan which included reviewing and approving the Plan's content, layout, recommendations, and implementation. They reviewed and commented on technical memoranda and the final Plan as the 'front-line' reviewers. Representatives of the Coordinating Committee included CCOG member Metropolitan Planning Organizations (MPO) and Rural Planning Organizations (RPO), representatives from North Carolina and South Carolina Departments of Transportation (NCDOT and SCDOT), and the Federal Highway Administration (FHWA).

- **The Steering Committee** was responsible for the policy related elements of the plan and served as advisors to the Coordinating Committee and reviewed their recommendations and findings. Members of the Steering Committee included representatives from MPOs, RPOs, economic development groups, Chambers of Commerce, Airports, municipal and county governments, colleges and universities, railroads, and more.
- **The Freight Advisory Committee (FAC)** members were identified during the Plan development process. The FAC is comprised of members of the private sector including firms related to trucking, rail, and aviation. The purpose of the FAC is to improve freight operations in the region on an on-going basis and provide the region with a detailed understanding of freight issues that the CCOG and private industry will face in the coming years.

The Planes, Trains, & Semis Peer Exchange was an effort of Centralina Council of Governments and supported by Federal Highway Administration's (FHWA) Regional Models of Cooperation (an initiative of the "Every Day Counts" program), which promotes collaborative processes that bring together entities working on common goals across jurisdictional boundaries. The Peer Exchange supported the Greater Charlotte regional freight mobility planning effort which sought to involve numerous transportation planning organizations, state and local governments, and private sector stakeholders in the Greater Charlotte area in a collaborative effort to develop a regional freight plan. Throughout the process, two peers to the Greater Charlotte Region traveled to Charlotte to present how their regions were using freight planning to strengthen their regional economies and support economic development.

Truck Parking

A truck parking inventory was conducted to determine the capacity and utilization of truck parking facilities in the CCOG region. The inventory of truck parking facilities included public rest areas and private truck stops.

The inventory included the location, parking capacity, and amenities for each facility. Private truck stops were identified using www.truckstops.com and amenities identified through the 2015 National Truck Stop Directory. The inventory of spaces was conducted through field surveys and Google Earth satellite imagery. Public rest areas, welcome centers and visitor centers with truck parking were identified via the North Carolina and South Carolina DOT web sites. Parking capacity and amenity data for public rest areas was gleaned from web research and field surveys.

The demand for these facilities was calculated using a spot count during overnight peak utilization. Field data was collected on two weekday overnight periods. Peak parking demand, utilization, and the capacity or lack thereof was estimated based on the overnight count observations.

Environmental Recommendations

As a part of its General Freight Recommendations, the Centralina Freight Plan included Environmental Sustainability recommendations. These recommendations represent the best practices for environmental sustainability for freight. Recommendations consisted of a policy "toolbox" (**Figure 2.2**) with specific measures to address environmental impacts of goods movement and industrial development. The plan delineates similar toolboxes for freight safety, congestion, quality of life, and encroachment on agricultural lands.

Figure 2.2: Environmental Policy Toolbox for the Centralina Freight Plan

Environmental Issue	Measures to Address
Air Quality	– Partner with industry to minimize air quality impacts from freight – Partner on strong anti-idling regulations and technology – Plan for buffer zones around new/expanding freight developments
Water Quality	– Employ best management practices for avoidance and minimization of impacts to wetlands and for stormwater management – Consider water quality impacts in truck route selection and implement stormwater best management practices in roadway design
Hazardous Materials Transportation	– Regularly review and update route designations with partners – Ensure emergency management plans are reviewed and updated
Encroachment on Sensitive Areas	– Develop a county land use plan and strategy – Focus new freight development in existing identified freight clusters – Review truck routing to minimize impacts to adjacent environmentally sensitive areas

Source: Greater Charlotte Regional Freight Mobility Plan

2.1.3 Applicability to ACOG Region

Multi-Jurisdictional Coordination

Like the CCOG Region, the ACOG Region is comprised of multiple jurisdictions including 6 counties and 3 MPOs. To ensure that each jurisdiction and agency has ongoing participation in the direction of freight mobility in the ACOG region, the ACOG should encourage Freight Advisory Committee meetings to continue once the ACOG Freight Plan is finalized to continue to provide the region with an understanding of the freight issues the ACOG region and private industry will face in the future.

Truck Parking Needs and Considerations

The ACOG Freight Plan has completed a truck parking survey and conducted interviews with truck parking facilities in the region to determine utilization of the truck parking facilities. To get a better understanding of the capacity and utilization of truck parking in the region, ACOG should consider doing a field survey to determine the estimated utilization of truck parking on an average day. The Centralina Freight Plan conducted a truck parking study which included a field survey during peak hours to identify and calculate the capacity and utilization of truck parking facilities in the CCOG region. Using this information, it can be determined which corridors have the highest demand for truck parking, where more truck parking is needed, and what types of facilities are necessary.

2.2 Will County Community Friendly Freight Mobility Plan

2.2.1 Summary

Will County is home to the largest inland port in North America, connecting west coast ports by rail to the Midwest, and is a key node in the Chicago regional freight economy. To ensure future improvements

reduce conflict and support safe, livable communities, Will County and the Will County Center for Economic Development (CED) formed a public-private partnership to develop a Community Friendly Freight Mobility Plan. The plan identifies and provides guidance for local freight policies, programs, and investments while simultaneously creating a mechanism for evaluating and prioritizing freight-related projects, recognizing six areas: safety, mobility, preservation enhancement, workforce, economic competitiveness, and community livability.

2.2.2 Regional Freight Planning Best Practices

Addressing Community Sensitivity to More Freight Movement

Freight and Land Use Interaction

One of the program recommendations of the Will County Community Friendly Freight Mobility Plan is to coordinate transportation and land use planning. Stakeholders from the public and private sector identified a need to coordinate transportation and land use planning to prevent or mitigate conflicts between freight traffic, workers, and residents. The focus is to develop freight growth at existing and planned freight clusters. Recommended tools in the Freight Plan to coordinate freight transportation and land use planning include:

- **Identify Locations and Develop Partnerships to Provide Truck Parking -** Truck parking is a safety issue for the trucking industry. A lack of truck parking forces a driver to choose between driving beyond their available hours-of-service without rest or parking in an undesignated area along the road. This, in addition to growing truck traffic indicates a need for local jurisdictions to identify locations along major freight corridors where public or private truck parking facilities can be developed.

- **Promote Sharing of Best Practices for Freight-Supportive Zoning and Land Use -** Communities with greater capacity to plan for the impacts of a major freight generator can share best practices with communities that lack that capacity. This ensures that practical freight considerations are incorporated into local planning and design efforts like good neighbor development strategies for freight facilities and practices to promote safe movement of freight. To that end, a policy recommendation from the plan was for the County to form partnerships and create a "Freight Resource Center" to identify and disseminate local best practices and advise local governments on freight issues.

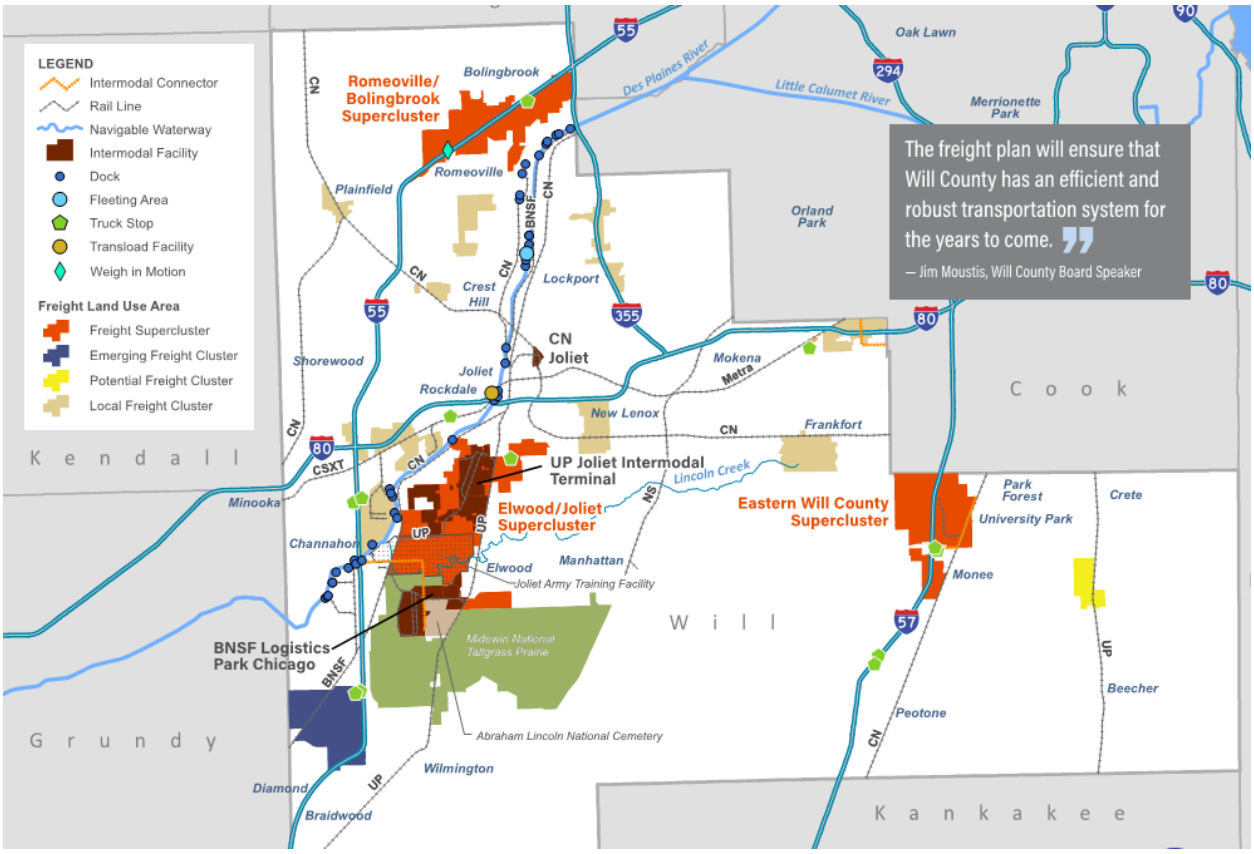
- **Develop a County Land Use Plan in Coordination with Local Communities and Townships -** An integral part of attaining a balance between freight and quality of life is to reduce the impacts of freight uses on agricultural land and other sensitive land uses. The annexation powers of local governments can lead to freight development in areas that encroach on agricultural land or other sensitive land uses and create unplanned travel impacts for County and local roads which can create safety and livability issues. A key plan recommendation was to create a County land use plan and strategy with local governments that engages local communities in strategies and zoning that focuses new freight development on existing and planned freight clusters.

- **Establish Shared Drop-Off Points for Freight in Local Communities -** As online shopping continues to grow, urban freight deliveries are expected to grow apace, which in turn creates congestion in the county. One solution is mandating shared freight drop-off points to be included in new buildings. This allows truck drivers to deliver all parcels for one building rather than delivering to individual buildings.

Cluster Analysis

The Will County Community Friendly Freight Mobility Plan conducted a freight cluster land use analysis to determine where existing and future freight clusters currently exist and where they will develop in the future. The freight cluster analysis evaluated the total land area for the cluster and determined what is presently industrial designated and what is occupied industrial land to determine the future industrial land (or net buildable land). The analysis also estimated the future buildout of the industrial space. In addition, the cluster analysis assessed employment for the cluster, including number of employees in transportation, trade, or utilities fields and those that are in goods-producing fields. Identifying these clusters helped identify where freight and transportation investment is needed. The cluster analysis can also be used to focus new freight development at existing or planned freight clusters to avoid impacts on sensitive areas.

Figure 2.3: Will County Freight Cluster Mapping



Source: Will County Community Friendly Freight Mobility Plan

Consideration for Environmental Groups/Needs

Discussions with stakeholders, environmental groups, and the public helped identify environmental issues that should be addressed while planning for future freight related improvements. There were four main issues concerning environmental impacts of freight activity and potential means of addressing them, as shown in the **Table 2.1**.

Table 2.1: Measures to Address Environmental Impacts of Increased Freight Movement

Issue	Desired Future State Objectives	Measures to Address
Air Quality	• Coordinate transportation planning activities among jurisdictions to ensure that implementation of freight transportation projects and strategies do not negatively impact regional air quality	• Partner with industry to continue to enhance the use of technology to minimize air quality impacts from freight • Partner on strong anti-idling regulations and technology to support anti-idling • Plan for buffer zones around new /expanding freight developments, particularly intermodal sites
Water Quality	• Avoid and minimize water quality impacts related to site selection of freight facilities and truck routing	• Employ best management practices for avoidance and minimization of impacts to wetlands and for storm water management • Consider water quality impacts in truck route selection • Implement storm water best management practices in roadway design
Hazardous Materials Transportation	• Avoid conflicts between hazardous materials routes and residential and environmentally sensitive areas	• Regularly review and update route designations with partners • Ensure emergency management plans are reviewed and updated
Encroachment on Sensitive Areas	• Implement land use strategies to avoid encroachment on environmentally sensitive areas. • Provide resources to help communities better mitigate the impacts of freight	• Development of a county land use plan and strategy • Focus new freight development in existing identified freight clusters • Review truck routing to minimize impacts to adjacent environmentally sensitive areas

Source: Will County Community Friendly Freight Mobility Plan

Managing Growth of an Inland Port

The Will County Community Friendly Freight Mobility Plan developed a checklist for communities considering freight-intensive development. These considerations are intended to assist communities with land use planning, site design practices, operational procedures and transportation planning in supporting large distribution facilities or intermodal developments. These considerations help coordinate between public and private stakeholders to ensure that these freight-intensive developments operate in a community-friendly manner. In addition, the checklist ensures that new freight developments have conducted the proper studies and have incorporated the potential site features needed prior to development.

The checklist asks questions regarding three key considerations: Community Freight Planning, Land Use and Transportation, and Site Development and Operations. (Figure 2.4) Some questions in the checklist include:

- Community Freight Planning
  - Has a community freight plan been prepared?
    - Does the community plan identify major freight movement facilities, infrastructure and networks?

- Land Use and Transportation
  - Is the proposed development consistent with the Community's Land Use Plan?
  - Have Development Plans been reviewed to determine the impact to existing freight corridors and facilities?
    - If impacts exist, have appropriate design or mitigation measures been proposed to avoid conflicts?

- Site Development and Operations
  - Does the development plan provide appropriately located and sized access points of all modes of transportation that will serve the development?
  - Has a detailed traffic impact study been prepared for the project?
    - Does the project provide necessary infrastructure improvements to meet the anticipated traffic impacts?

Workforce Transportation

To get a better understanding of Transportation, Distribution, and Logistics (TDL) workforce constraints, two workforce forums were held in Will County to gather information and feedback from human resource and workforce leaders in the freight industry. The information gathered from these forums helped develop the TDL Workforce Action Plan, which was designed to help attract, retain, and build the TDL workforce in Will County.

Figure 2.4: Will County Freight Development Checklist

Freight Development Checklist

Item	Complete			Comments/ Notes
	Yes	No	N/A	
Community Freight Planning				
Has a community freight plan been prepared?				
• Does the community plan identify major freight movement facilities, infrastructure and networks?				
• Have the results been incorporated into local planning and transportation policies?				
• Have key facilities, infrastructure or networks been coordinated with neighboring Municipalities, Townships and the County?				
• Have key facilities, infrastructure or networks been coordinated with IDOT?				
Land Use and Transportation				
Is the proposed development consistent with the Community's Land Use Plan?				
If the area is in proximity to residential or other sensitive areas, have mitigation measures been taken?				
Have Development Plans been reviewed to determine the impact to existing freight corridors and facilities?				
• If impacts exist, have appropriate design or mitigation measures been proposed to avoid conflicts?				
• Is the location of the project in close proximity to highways, freight, facilities, or railways to promote freight consolidation?				

Source: Will County Community Friendly Freight Mobility Plan

One of the key workforce strategies developed in the TDL Workforce Action Plan to increase the availability of the workforce is providing enhanced mobility to connect employees to TDL job centers. This provides employees increased access to their job clusters and reduces commute time. By providing better mobility options, the TDL industry expands the pool of potential employees within a typical commute distance. Interviews with TDL business leaders showed that long commute times were often cited as a barrier to employee retention.

One of the actions developed through the Workforce Action Plan was to increase transportation options between population centers and TDL employment centers. The key stakeholders included in the development of the Workforce Action Plan included local transportation authorities, local governments, the TDL Industry, the county economic development agency, TDL Industry leaders, and the county's Department of Transportation. The steps identified were:

- Identifying a group of TDL Industry Leaders to develop a TDL Center
- Partner with local transportation authorities to develop a plan to invest in key transit routes

- Partner with the TDL industry to identify opportunities to provide a transit service hub in TDL business parks
- Identify opportunities to partner with ride-sharing services such as Lyft, to provide last-mile connections to TDL job centers
- Identify opportunities to coordinate with the county's bikeway plan efforts to expand bike access to TDL job centers

2.2.3 Applicability to ACOG Region

Accommodating Freight Growth While Mitigating Potential Equity Issues

As a part of their Project Prioritization process, the Will County Plan incorporated a Community Impacts goal in their project weighting evaluation filters when prioritizing the need and order of proposed projects. Not only are the projects evaluated on whether they improve the highway condition or address a high crash location, but are also scored based on whether the project provides access for sensitive populations, reduces impacts of freight movement on residential areas, and reduces impacts of freight movement on agricultural and preservation areas. These built-in filters ensure that while freight growth is achieved, there is also consideration for the community and that they are not disproportionately affected by a project. The ACOG should consider incorporating a community-based project goal as a part of their freight project prioritization process that includes freight filters that assess whether the project provides access or reduces impacts to communities.

Ensuring Meaningful Participation for Diverse Interest Groups

The Will County Community Friendly Freight Mobility Plan engaged with multiple types of stakeholders and interest groups in a variety of ways. The county sought input from the existing Will County Freight Advisory Council (FAC) as well as stakeholders from the private sector to gain information regarding the issues and needs of the freight industry. The TDL Workforce Action Plan is one example of how the feedback from the Workforce Forums and interviews generated a plan for attracting and retaining TDL employees. Also, the county did truck driver outreach by coordinating with businesses to display maps of the Will County roads to identify the issues they see on the road. This hands-on outreach ensures that the county is getting actual perspectives of those that work in the freight and trucking industries. ACOG should continue to engage the ACOG FAC and consider similar targeted interest group forums and outreach to gain more information on topics such as freight employment, roadway issues, or truck stops to determine what is needed from the people that work in these industries.

Defining Roles for Agencies and Executing the Plan

The Will County Community Friendly Freight Mobility Plan developed a Strategic Implementation Matrix listing the strategy, example projects or initiatives, key stakeholders, the lead agency, next steps, and time frame. This matrix is based on the program recommendations proposed in the plan. The matrix identifies who leads the strategy and what other agencies are necessary to move the strategy forward and provides an estimate of when the strategy needs to be completed. To establish a clear direction after the development of the plan, the ACOG should develop a Strategic Implementation Matrix to define what

strategies to implement and what stakeholders they need to work with to implement those strategies. Time frames or dates should be tied to these strategies to help track implementation progress.

2.3 Smart Columbus

2.3.1 Summary

In 2016, Columbus, OH won a $40 million USDOT grant through the Smart Cities Challenge. The program included a $10 million match from the Paul G. Allen Family Foundation. Grant funds are being used to deploy new transportation technologies that improve mobility, equity, and environmental outcomes. The program seeks to deploy a holistic approach to improving transportation that considers equity, economic opportunity, and health outcomes rather than just introducing new technologies. Further, Smart Columbus seeks to integrate this approach with other city services like public safety and energy. Key projects include:

- **Truck platooning and freight signal priority –** Truck platooning is a wireless technology that links two tractor-trailer trucks together such that the following truck mirrors the lead truck's braking and acceleration, allowing for shorter following distances and a reduction in fuel use and emissions. Freight signal priority reduces truck delays at intersections by enabling dynamically adjustable traffic signal phase timing that assigns priority to trucks when conditions allow.

- **Electric and automated vehicles –** Partnering with DriveOhio (a division of the Ohio Department of Transportation), Smart Columbus launched a self-driving shuttle service in December 2018 which provides free rides to destinations in downtown Columbus such as the National Veterans Memorial and Museum, Bicentennial Park, the Center of Science and Industry, and the Smart Columbus Experience Center. A planed second route will deploy 15-passenger automated shuttles in Linden, a disadvantaged neighborhood in Columbus. The route will connect Linden residents to community resources like public transit, affordable housing, recreation, and childcare.

- **Connected vehicles –** Columbus is deploying a Connected Vehicle Environment which will allow participating vehicles to communicate with each other and with traffic signals, enabling hazard alerts for drivers, favorable signal timing for buses and emergency vehicles, and enhanced traffic management. The initial deployment includes intersections with the highest collision rates in the city. Alerts will include red light violation warnings, blind spot detection, and rear-end collision warnings. The Connected Vehicle Environment is considered an enabling technology since it leverages technology that can be used for multiple mobility and safety applications.

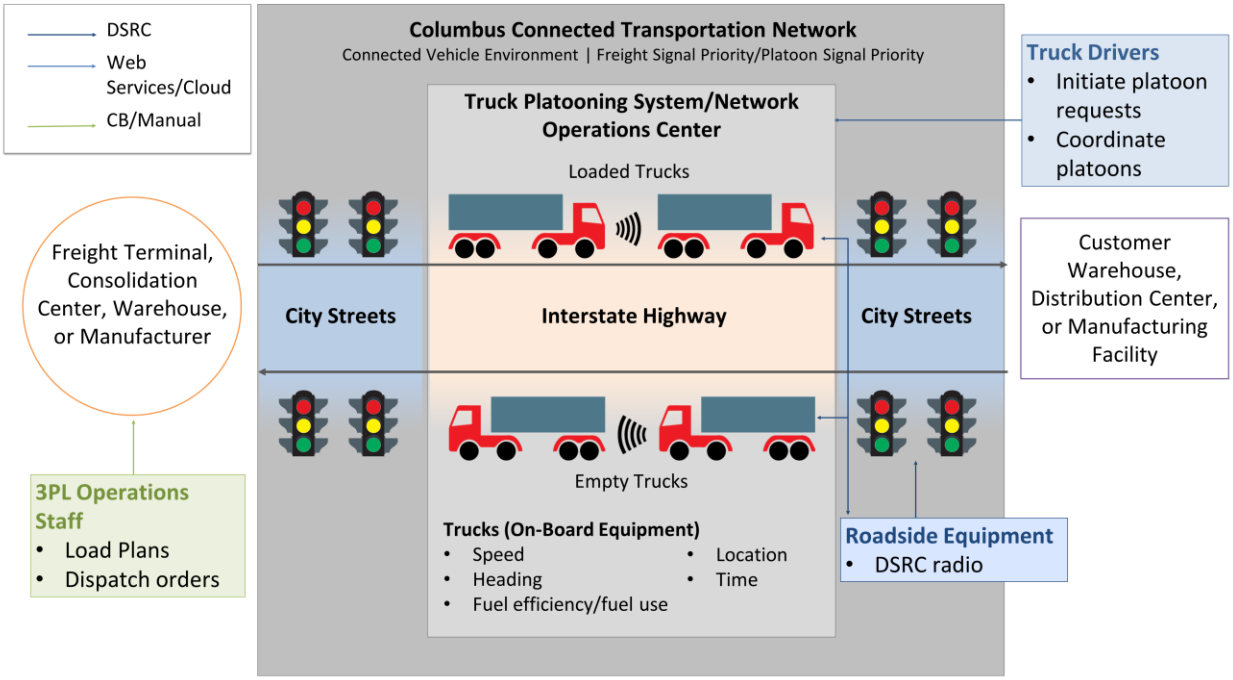
- **Smart Columbus Operating System –** A database that serves as the central repository for all data generated and used by the various deployments. This system is designed to ingest, scrub, aggregate, and publish data about the deployment projects and capture performance data for reporting to USDOT and the public. As such, it will provide baseline and deployment data for measuring project benefits, developing lessons learned, and generating ideas for new deployments or research projects.

2.3.2 Regional Freight Planning Best Practices

Truck Platooning and Freight Signal Priority

Smart Columbus developed a Concept of Operations for Truck Platooning and Freight Signal Priority. Truck platooning uses wireless technology to couple the brake and throttle controls of trucks traveling in convoy, typically on limited access highways. The wireless linkage enables the trucks to maintain very close following distances, thereby reducing aerodynamic drag and improving fuel economy and emissions. While most platooning focuses on long-haul highway operations, this concept explored urban platooning. In this scenario, Freight Signal Priority would help keep platooning trucks together until they reach a highway where platooning can begin (see **Figure 2.5**). Freight Signal Priority technology uses vehicle-to-infrastructure (V2I) wireless communications to make the traffic signal system aware of trucks approaching properly equipped intersections. The system can then adjust signal phase timing as needed to assign priority to freight trucks, smoothing traffic flows for freight and reducing stop/start cycles, which reduces emissions.

Figure 2.5: Smart Columbus Truck Platooning and Freight Signal Priority Concept



Source: CDM Smith

Although the Smart Columbus Truck Platooning and Freight Signal Priority project wasn't deployed in Columbus, it did lay the conceptual groundwork for a platooning system that would incorporate freight-focused signal timing.

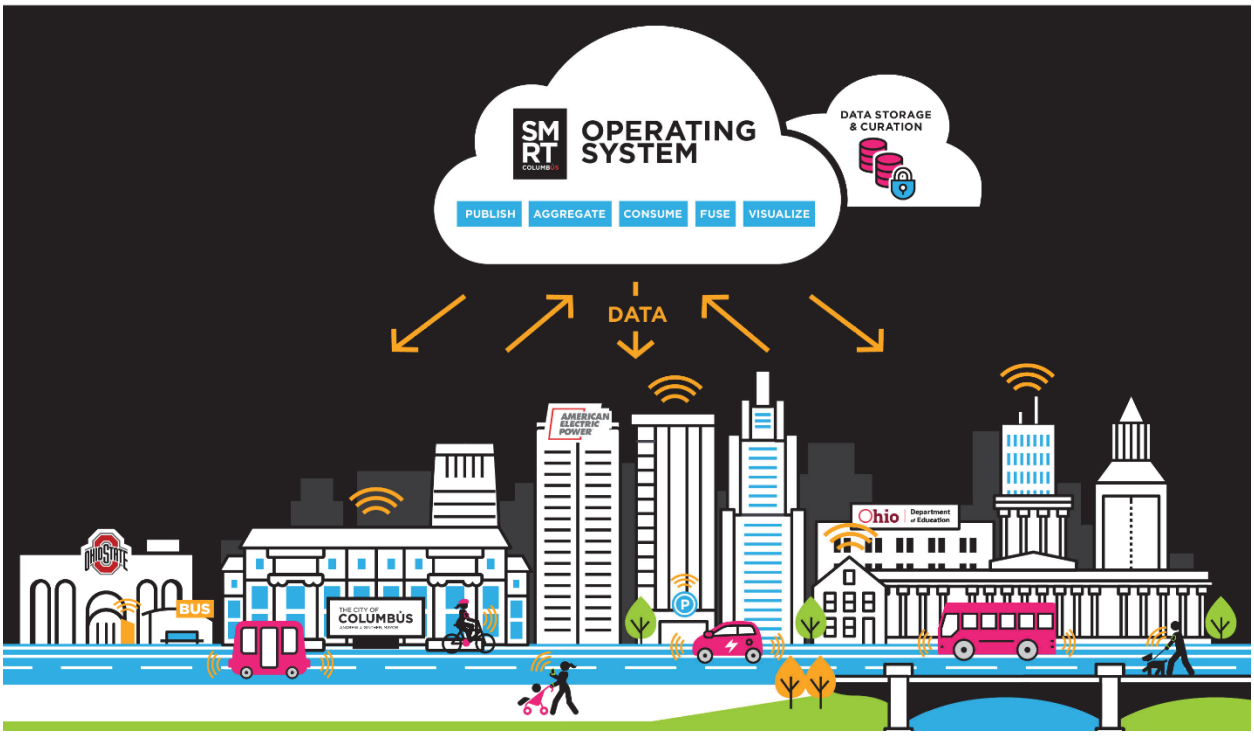
Smart Columbus Operating System

All projects within the Smart Columbus Program rely on the Smart Columbus Operating System to gather data for performance measures. The Operating System (visualized in **Figure 2.6**) is the central database for ingesting and sharing open data from deployment projects. It includes more than 3,000 datasets on traffic, infrastructure, parking, weather, emergency response, crash records, and other data of interest for

city operations. The system ensures data privacy by adhering to USDOT-approved Data Management and Data Privacy Plans. Releasable data are available to the public, researchers, agencies, universities, developers, and entrepreneurs. The system is collating data on various deployments including autonomous electric vehicles. Open datasets are available for search and download on the Smart Columbus web site.[1]

Although the Smart Columbus program does not yet include applications specifically geared toward freight mobility, any smart mobility deployment that relieves urban congestion would also benefit freight.

Figure 2.6: Smart Columbus Operating System Concept



Source: Smart Columbus

Partnerships

Partnerships with industry, nonprofits, and government agencies were a key reason Columbus won the Smart Cities Challenge. The City of Columbus partnered with One Columbus, an economic development organization for the 11-county region. The One Columbus vision is "to be the most prosperous region in the United States."[2] One Columbus members include:

- Columbus Chamber of Commerce – Support and advocacy for businesses in the region; includes the Columbus Regional Logistics Council, which helps organize support and participation from the regional transportation and logistics industry

[1] https://www.smartcolumbusos.com/
[2] https://columbusregion.com/onecolumbus/

- Columbus Partnership – Membership organization of CEOs from leading businesses and institutions
- Smart Columbus – The Smart City program, which is co-led by the City of Columbus and the Columbus Partnership
- Mid-Ohio Regional Planning Commission – Voluntary intergovernmental organization for transportation, land use, housing, and economic development planning
- Rev1 Ventures – Venture capital and business accelerator focused on early stage company development
- Local economic development organizations from the 11-county region
- JobsOhio – Nonprofit that promotes job creation in the state
- Ohio Development Services Agency – State agency focused on helping Ohio businesses compete in the global economy

This network of regional advocacy groups mobilized resources for the Smart Cities Challenge, including financial contributions that were a key factor in Columbus winning the award. The organizational structure also ensured broad-based support for the program.

In addition to the economic development community, Smart Columbus has partnered with Ohio State University as the lead research partner, providing specialized expertise in emerging transportation technologies to support the program. For example, Ohio State staff supported development and testing of the Linden shuttles and partnered with the regional transit agency to develop a navigation app for people with cognitive disabilities. University research arms involved include the Center for Automotive Research, the Center for Urban and Regional Analysis, and the Wexner Medical Center.

Finally, Honda and the Transportation Research Center (TRC) are key industry partners for the program. Honda has an automotive plant in Marysville, just northwest of Columbus. The TRC provides lab testing, track driving/proving grounds, research and development services, and crash testing, among other things. TRC recently built a 540-acre autonomous vehicle and connected vehicle testing facility.

2.3.3 Applicability to ACOG Region

There are many potential lessons for the ACOG in Columbus's approach to winning and executing the Smart Cities grant. First, agency and private sector coordination is critical for successfully designing and implementing a technology test, whether at the regional, statewide, or multi-state level. The cooperation between local communities, regional businesses, the MPO, and Ohio DOT was a critical factor for winning the challenge and for planning and conducting the Smart Columbus test deployments. The existing automotive industry in Central Ohio – including Honda, TRC, the Ohio State University Center for Automotive Research, and industry suppliers in the region – provided a springboard to create a vehicle automation technology cluster around Columbus.

In South Carolina, a potential technology deployment could involve truck platooning on I-26 between the Port of Charleston and the Upstate. This would likely involve the existing industry cluster, e.g. BMW, automotive industry suppliers in Charleston, Clemson University's International Center for Automotive Research (CU-ICAR), and the South Carolina Technology and Aviation Center. Platoon testing could be carried out initially on a closed track, followed by deployment testing on I-26 with before/after assessment of impacts such as fuel savings, emissions reduction, and effects on other Interstate highway traffic. For congested urban freight arterials, Freight Signal Priority could be used to improve truck operations and keep platooning pairs together until platooning can begin (the Connected Vehicles section below contains a case study of a Freight Signal Priority deployment in South Florida).

3. Emerging Technologies in Freight Mobility

While emerging communication and information technologies are gaining significant ground in the transportation world, it's important to review emerging transportation technologies opportunities to help identify new approaches to solving freight issues in the BCD Region.

The Connected, Autonomous, Shared, Electric concept combines the most prominent and foundational mobility trends into a comprehensive future vision encompassing vehicle automation, vehicle and infrastructure connectivity, shared vehicles and fleet electrification. The emergence of this mobility concept will change how vehicles are owned and operated and could impact the number of vehicle miles traveled and affect how road usage charges are collected (e.g. toll or per-mile vs. per gallon). The following subsections discuss how each aspect could change freight mobility and the funding of supportive infrastructure.

3.1 Sample of Emerging Technologies

Connected vehicles (CVs) offer an opportunity to improve freight operations for private firms while also mitigating some of the issues that come with increased cargo volumes. CVs enable real-time communications between vehicles and infrastructure that can be used to transmit safety and travel information (e.g. incidents, congestion, construction zones, weather, and travel times), road maintenance needs (e.g. pothole detection, missing signs), and other system aspects that can be used to improve trip planning and increase the capacity and safety of the transportation ecosystem. These involve sensors, devices, and applications as part of a larger connected environment often referred to as the *"Internet of Things (IoT)"* – all producing evermore data, often referred to as *"Big Data"*. The cybersecurity risk profile for the IoT and data will continue to grow and become more complex. To ensure organizations are positioned to take full advantage of the benefits offered by connected technologies and expansion of the IoT, organizations should make certain they are well equipped with information technology resources and specifically qualified staff.

The implications of CVs, including Bluetooth enabled on-board units, on roadway capacity and congestion is yet to be determined. Specific considerations to follow in the near future include:

- The ability for CVs to coordinate their travel speeds and engage in "platooning" or other similar travel behaviors
- Need for special lanes or roadside equipment needed to accommodate these vehicles
- Implications for the use of transponders as a means of collecting tolls and concerns regarding interoperability of such vehicles

With CVs not only relaying the location of the vehicle, but also providing data collected by all of the on-board vehicle sensors, including travel speed, fuel efficiency, tire pressure, etc., much can be done to use

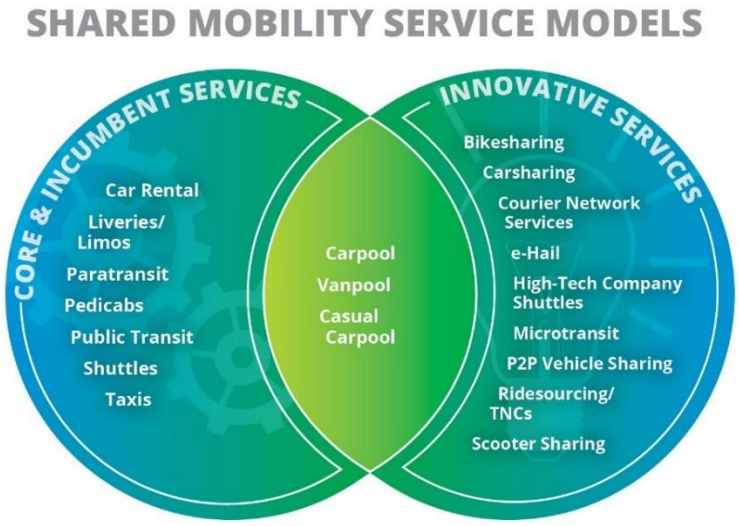
the data for planning and system management. Planning agencies and departments of transportation may consider leveraging this data using artificial intelligence to predict incidents or prepare drivers for unsafe conditions.

Automated technologies (AVs), ranging from existing driver-assistance technologies such as adaptive cruise control to more fully automated systems such as full driver-less vehicles, automated vehicle applications are among the most high-profile emerging innovations. Although vehicles with fully automated capabilities are available, they represent an extremely small share of the overall vehicle market and are very expensive. As technologies improve, costs decline, and a regulatory framework for their development and operation evolves, organizations must decide how to adapt. Fully automated vehicles will fundamentally impact how drivers interact with transportation infrastructure. For the toll industry, there is uncertainty on how autonomous vehicles will be incorporated and accommodated on tolled facilities. It is unknown if drivers will be willing to pay tolls for quicker, more reliable travel times if they can do things in their car other than drive.

Under AV Level 3, which is currently on the market, vehicles can provide short-term assistance to the driver under auto-pilot, lane changing, parallel parking and other functions. Under AV Level 4, which is anticipated to be available to the general public within the next 5 to 10 years, vehicles will be able to drive themselves within a geofenced area. It is yet to be determined when these vehicles will saturate the market and to what degree such saturation may occur. Considerations to follow include:

- Vehicle ownership trends – individual or fleet ownership
- Driverless operation or human controlled
- Potential for such vehicles and toll pricing
- VMT fluctuations if AVs travel between trip segments or return to designated parking locations during off hours
- AVs usage for freight and transit in origin and destination parking

Shared mobility applications, including car-sharing, ride-hailing, and multimodal single point-of-sale payment options, are penetrating the market at a rapid rate. Users can hail rides for single trips, or "rent" cars for hours or days at a time. Transportation Network Companies (TNC) such as Uber and Lyft enable travelers to access and benefit from the transportation network in a personal vehicle without necessarily having to own one. This has significant implications for long-term infrastructure needs due to potential increases in VMT and increased congestion in urban cores and roadway networks. Mobile applications will continue to evolve into a system that connects all modes of transportation (e.g. roads, bridges, transit, rail, waterways, airports) as customers increasingly expect multimodal



transportation. Future applications will provide a full suite of transportation modes offered by numerous organizations and providers that can be booked and paid for by a mobile device. Mobility on Demand (MOD) and Mobility as a Service (MaaS) applications represent an initial step in this development.

Electrification of the vehicle fleet will have significant impacts on infrastructure funding in the United States. Highways are funded predominantly with fuel taxes, which a fully electric vehicle does not pay. Adoption is expected to increase as the cost of electric battery systems decline and charging infrastructure becomes more widely available. To the extent that electrification trends continue to impact transportation funding sources, there will be an even more pronounced role for the toll industry in meeting infrastructure needs. Although highway freight may well continue to move mostly by diesel-powered vehicles, declining gas tax revenues resulting from electrification of the overall vehicle fleet could reduce available funding for freight projects.

An electrified vehicle fleet will require significantly different fueling (charging) infrastructure, and many emerging technologies offer the opportunity to integrate charging infrastructure in new and innovative ways. Implications to consider for freight fleet electrification include:

- The schedule for the production of electric vehicles
- The market share of electric vehicles be in five or ten years and what market saturation will mean for fuel revenues
- The positive impacts of electric vehicles on air quality, noise, or other common perceptions of non-electric vehicles

Communications technologies can be used for the transmission of information between vehicles, infrastructure, and other instrumented roadway elements. Many technologies listed are well established and have been in use for decades. Others may have limited deployment or current applicability but could impact transportation operations if certain improvements are realized.

- **Sensing & Detection** – These are technologies used to detect and identify objects, including vehicles and pedestrians, in a roadway environment. Such technologies are commonly used in existing automated vehicle identification (AVI) applications but subsequent improvements to emerging technologies could enable operational use cases.

- **Data & Analytics** – This category represents a broad range of data, data processing and analytics-based applications and encompasses business and operations processes applications that might be used in advanced modeling and simulation efforts.

- **Automation & Connectivity** – This category includes technologies and applications that automate activities such as driving that connect people, vehicles and infrastructure for improved safety and system performance.

- **Consumer Goods & Services** – This category includes a broad range of goods and services that are likely to be utilized by consumers over the long term and might be leveraged by agencies for improved operations, maintenance and administration.

- **Transportation Demand Management** – These represent established and emerging strategies for managing demand on roadways. It includes strategies such as congestion pricing as well as

active traffic management strategies that support the dynamic management of roadway conditions in real time such as speed harmonization and adaptive ramp metering.

3.2 Influential Applications of Emerging Technologies

- **Telecommuting:** As a result of the government restrictions related to COVID-19 that were imposed in April and May 2020, many employees, particularly professional services, have transitioned work activities from an office to a home environment. Advances in technology, internet bandwidth, personal computing, secure networks, access to cloud-based data-files, telephone and video conference capabilities have enabled companies and employees maintain productivity. It is unclear what proportion of workers will shift more, or even fully, to telecommuting post-COVID and what the potential impacts to travel on the transportation system if telecommuting increases beyond pre-virus levels. Similarly, as commuting patterns remain uncertain, freight patterns are likely to trend in the routes most desirable and least congested, utilizing capacity previously used by commuting vehicles.

- **E-Commerce:** The advent of digitization, network connectivity, and COVID-19 have tremendously influenced e-commerce growth and trends in the United States. The major impacts of e-commerce to supply chains, e-commerce, and goods flow remain unclear for post-COVID conditions. Currently, however, e-commerce continues to increase year over year, only exaggerated by the pandemic.

- **Physical Infrastructure Improvements:** These innovations relate to infrastructure assets such as pavement, asphalt, roadway signs, striping, lighting, etc. Such innovations have the potential to impact how facilities are constructed and maintained and could enable higher-tech applications. his allows for reduced life-cycle costs and lower maintenance when technologies most appropriate for freight facilities are included in infrastructure design and construction.

- **Artificial Intelligence:** These innovations include a series of analytical tools that use the availability of big data to forecast information about the transportation system. An example of this includes the use of historical observations of weather patterns, pavement types, safety data, and traffic volumes to forecast the likelihood of incidents or high congestion on a dynamic basis. This not only allows for the preplanning of freight routing by time of day or year but also providing real time forecasts to prepare drivers for potential incidents based on current conditions on their route. This not only supports safer driving and route decisions but prepares vehicles for slower driving conditions, improving the overall safety of the system.

4. Future Technology Trends

The National Freight Strategic Plan (NSFP) notes the freight industry is on the cusp of a technological revolution driven by innovations in communication and information technologies.[3] Firms are increasingly using web-enabled devices and "big data" applications to find new supply chain efficiencies and drive down costs. Public agencies, for their part, are seeking ways to partner with freight stakeholders to effectively plan for growth, safety and mitigate community concerns. This section will consist of a review and identification of key emerging technologies trends that could potentially impact freight and transportation mobility to/from/within the ACOG region.

This section reviews actual recent and ongoing real-life case studies that are relevant for the ACOG region:

- **Connected vehicles –** After defining connected vehicles and their potential applications, the following case studies are profiled:
  - **Communications:** the Miami-Dade ITS deployment
  - **Sensing and Detection:** the Illinois Tollway Authority CV Pilot
  - **Transportation Demand Management:** The Truck Parking Information Management System (TPIMS) in the Midwest
  - **Data and Analytics:** The Gateway Cities Drayage Freight and Logistics Exchange system
  - **Automation and Detection:** The Automated Driving Systems project in Ohio/Indiana
- **Automated Vehicle Technologies –** The following technologies are described, with potential implications for the ACOG region:
  - **Positive Train Control:** Railroads are deploying this safety technology across their networks per a Congressional mandate.
  - **Terminal automation –** Rail and port terminal operators are increasingly turning to automation technologies to improve efficiency and safety. This section provides general background on emerging gate automation and terminal operating strategies that are mainly driven by the private sector but may have impacts outside the terminal gates.

[3] USDOT, *National Freight Strategic Plan*, retrieved on October 8, 2020 from https://www.transportation.gov/sites/dot.gov/files/2020-09/NFSP_fullplan_508_0.pdf

4.1 Connected Vehicles

4.1.1 Background

The USDOT defines connected vehicles (CV) as cars, trucks, buses, and other vehicles that use advanced technology to "talk" to each other and to the infrastructure via wireless devices. These devices continuously share safety and mobility information, thus enabling crash prevention, environmental benefits, and continuous real-time data sharing and performance monitoring.[4] These communications are supported by a variety of technologies, though the primary types are Dedicated Short-Range Communications (DSRC) and Light Detection and Ranging (LIDAR) sensors. Figure 4.1 provides a conceptual view of such wireless connectivity.

Figure 4.1: Connected Vehicles Concept

Source: USDOT

Information can be exchanged between different types of vehicles, the infrastructure, and across networks and devices. Applications include:

- **Safety Alerts** – For example, spot weather impact warnings, forward collision warnings, and work zone information
- **Traffic and Traveler Information** – Such as weather alerts, road conditions, incidents, and speed restrictions
- **Signal Priority** – Permits certain types of vehicles like trucks or transit buses to receive priority green lights when traffic conditions warrant

[4] https://www.its.dot.gov/cv_basics/cv_basics_what.htm

- **Distress Notifications** – Allows a connected vehicle to broadcast a distress signal when systems detect a situation that may require assistance from others

4.1.2 Case Studies

Communications: Miami-Dade ITS Deployment

Signal priority is an ITS strategy aiming to reduce traffic delay to targeted types of vehicles, such as freight vehicles, at signalized intersections. This requires communication between the freight vehicles and the traffic signals to alter the signal timings to favor freight operations. The basic concept involves detecting the presence of and predicting the arrival of freight vehicles. Depending on the current traffic conditions and internal system logic, the traffic signal can alter and adjust the signal timings. These adjustments are achieved without interrupting the system coordination of green indications between adjacent intersections.

Miami-Dade County Department of Transportation and Public Works (DTPW) started testing adaptive signals in 2016 and began installing about 300 smart traffic signals in 2017, with the primary focus being on transit vehicles.[5] In 2018, having upgraded multiple intersections with Caltran 2070LX Safetran traffic signal controllers, Miami-Dade County noticed the benefits of signal prioritization in terms of improving travel time and providing smoother and more seamless bus services.[6] The DTPW then decided to implement the technology along freight corridors to enhance the movement of freight vehicles, of which phase 1 is currently installing the following technology:

- Deploy 18 upgraded traffic signals with Dedicated Short-Range Communications (DSRC)
- Deploy a smart freight mobility application
- Install 500 DSRC radios

Phase 2 will:

- Deploy 60 upgraded traffic signals along identified corridors, with dynamic signal priority that accounts for traffic on cross streets, and expanded recruitment of cellular-based users of the smart freight mobility application (September 2020 – October 2021)

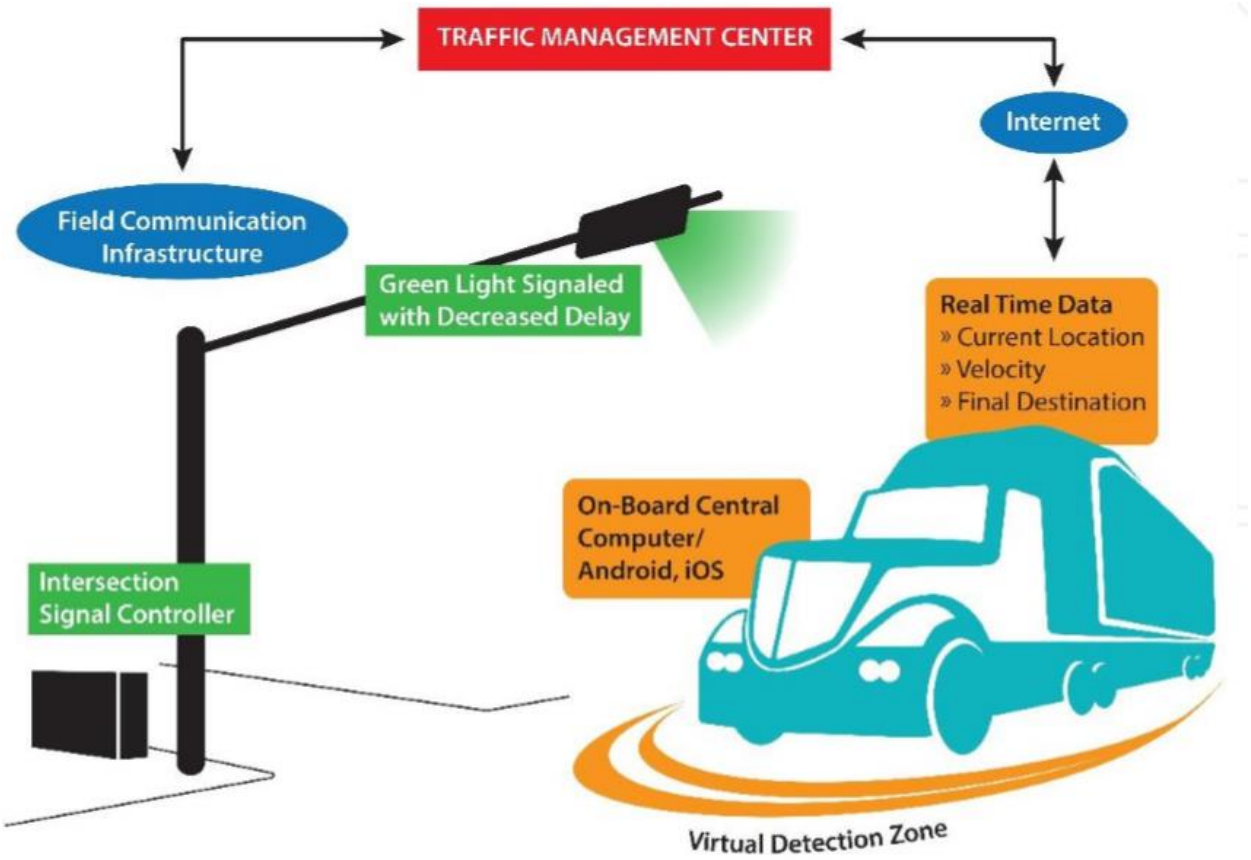
The project, which will cost a total of $7.5 Million, was funded through a partnership that included the following agencies:

- FDOT
- Miami-Dade Transportation Planning Organization
- Miami-Dade Department of Transportation and Public Works
- City of Doral
- Florida Trucking Association

[5] https://www.miamidade.gov/releases/2017-07-28-dtpw-300-smart-signals.asp
[6] http://www.miamidade.gov/releases/2018-07-18-dtpw-tsp-along-transitway.asp?utm_campaign=2018-07-19-press-releases.html&utm_medium=email&utm_source=Eloqua&elqTrackId=a77084bc3ebc485f820801c6b659d9d1&elq=6651a76220794e5e89892468069ba6db&elqaid=475&elqat=1&elqCampaignId=266

Signal controllers receive location, velocity, and destination information from trucks. Information is relayed through Traffic Management Center to the Field Communication Infrastructure, which enables the signals to provide green lights for freight. The features of this technology can be seen in **Figure 4.2**.

Figure 4.2: ITS Communication for Freight Signal Priority



Source: Florida Department of Transportation (FDOT)

Based on analysis conducted, the implementation of the freight signal priority will result in a 7 - 10% decrease in delays, and corridors with dynamic signals will experience a 14 - 20% decrease in delays. The fuel savings analysis expects a savings of 62.9 thousand gallons of fuel with Freight Signal Priority and 125.8 thousand gallons of fuel saved with dynamic signals along studied corridors. In total, the combined implementation of freight signal priority and dynamic signals along the specified corridors is expected to result in an annual economic benefit of $2.5 million based on a $24.70 hourly wage for truck drivers, an average of 260 workdays per year, and $2.75 per gallon for diesel.

Sensing and Detection: Illinois Tollway Authority CV Pilot

The Illinois Tollway began a pilot CV program in 2018. This project installed nine roadside units (RSUs) configured to receive messages from any CV-equipped vehicles within about half a mile. Equipped vehicles contain onboard units (OBUs) that generate and broadcast a Basic Safety Message (BSM) with data such as speed, heading, acceleration, location, and travel direction to the roadside units up to 10 times per second. The system collected 1.6 million BSMs in 2019.

Eight of the RSUs are located on a 10-mile stretch of I-90; the other RSU is on I-294. Of the messages collected by the end of 2019, 81% came from three Tollway-owned vehicles that traverse the two corridors regularly; the remaining 19% came from non-Tollway vehicles. While most of the data collected thus far comes from Tollway vehicles, the project is focusing on results from non-Tollway vehicles since they provide more insight into CV market penetration and Tollway travel patterns.

In 2019, the pilot reported the following results for non-Tollway vehicles:

- Average speeds ranged from 62 mph to 73 mph
- The system detected 429 trips in 2019 (trips are defined as a single vehicle traversing the CV system in one direction, with a maximum gap between messages of 90 seconds)
- More CV trips were detected on weekends (Friday through Sunday) than weekdays
- More CV trips were detected on I-294 in only four months than on I-90 for the entire year, indicating that additional RSUs should be constructed on I-294 since it appears to have higher market penetration of CVs

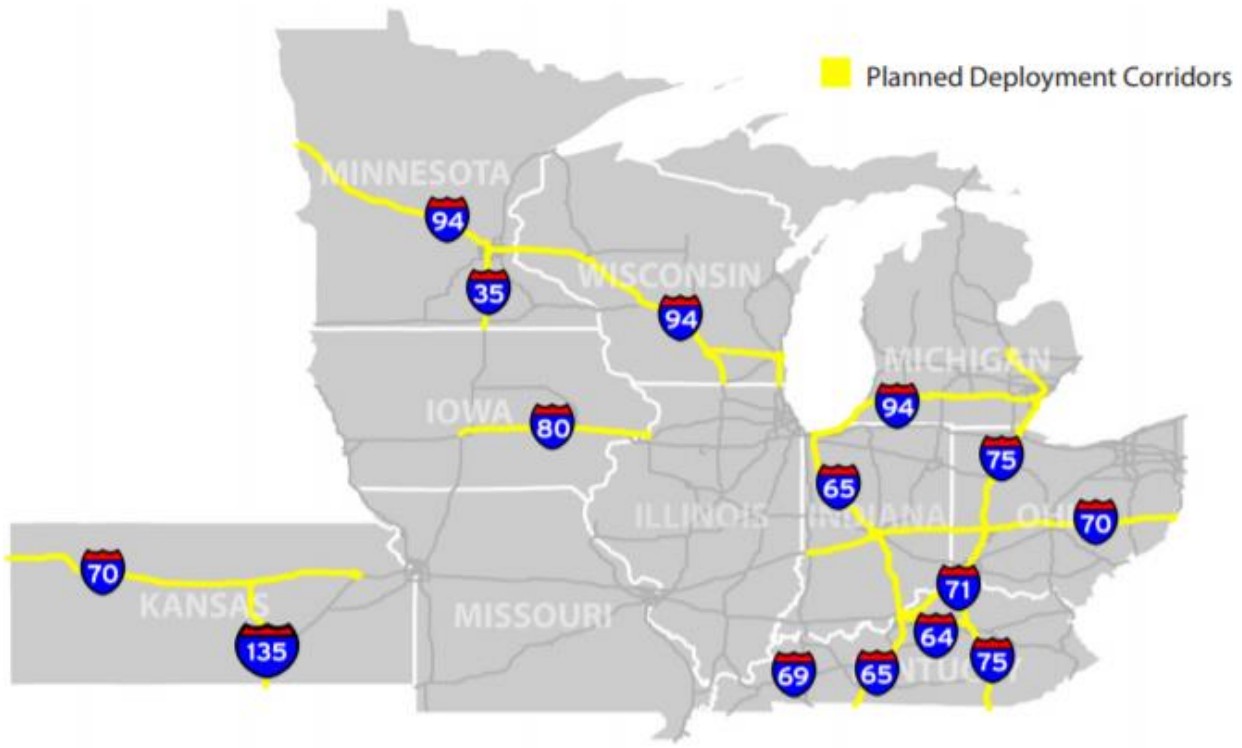
BSMs feature high location accuracy and broadcast frequency, allowing for highly localized operational analysis. Road segments as small as a few feet could be isolated and analyzed for safety issues related to roadway curvature. Highly precise corridor travel time measurement could also be reported back to vehicles using the roadway in the future. The benefits of such analysis and reporting would increase as CV market penetration grows. Although the penetration rate of such vehicles is low at present, it is expected to grow as more vehicle models come standard with "intelligent" features like Wi-Fi and navigation support built-in. road agencies are increasingly partnering with private sector vehicle/device makers to develop and evaluate CV applications for specific use cases.

Transportation Demand Management: MAASTO Truck Parking Information and Management System

The Mid-America Association of State Transportation Officials (MAASTO) created the Truck Parking Information and Management System (TPIMS) to address regional shortages of safe and convenient truck parking options and provide real-time information on parking availability. The states which participated, as well as the corridors where the technology was deployed, are seen in **Figure 4.3**.

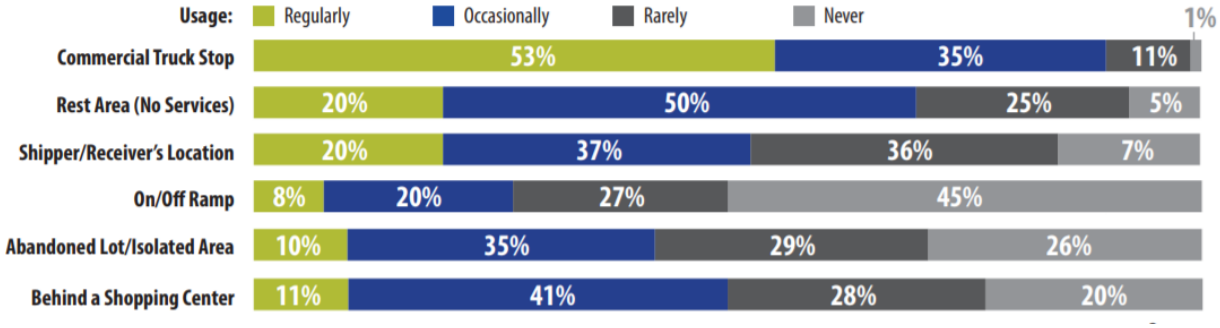
Studies show that in 2013, 83% of drivers spent more than 30 minutes looking for parking and 39% took more than an hour. Those who don't find parking often park illegally. **Figure 4.4** highlights the locations that truckers typically use for parking. Unauthorized sites like abandoned parking lots, behind shopping centers, and along freeway on/off ramps are all popular choices.

Figure 4.3: Truck Parking Deployment Corridors



Source: Kansas Department of Transportation (KDOT) TIGER Grant Application

Figure 4.4: Where Truckers are Parking



Source: KDOT TIGER Grant Application

The focus of the grant was to create a Truck Parking Information and Management System that would enable truckers on the selected Interstate corridors to find safe places to park. **Table 4.1** highlights the deployment corridors by state.

Table 4.1: Deployment of Truck Parking Technology by State

Corridor	Deployment Coverage
I-35	Minneapolis, MN to Iowa
I-65	Gary, IN to Kentucky/Tennessee border
I-71	Louisville, KY to Cincinnati, OH
I-75	High truck volume areas from Flint, MI to the Kentucky/Tennessee border
I-135	Entire corridor in Kansas
I-64	Entire corridor in Kentucky
I-70	I-70 through Kansas, Indiana, and Ohio
I-80	Iowa from the west side of Des Moines to the Mississippi River
I-94	Moorhead, MN to the Canada/Michigan border at Port Huron, MI

Source: KDOT TIGER Grant Application

The total cost of the project was $28 million, of which $25m was covered by TIGER funds. The remaining funds were supplied by matching state funds, with each of the eight states equally funding the project based on the percentage of the deployed projects in their state. With the implementation, truck drivers spent less time looking for safe parking options.

The data structure is operated by each state independently; however, they use the same data standards to allow interoperability across state lines. Technology deployed at parking facilities and roadside signs integrates with each state's ITS network and software. An Application Programming Interface (API) was developed to exchange parking information between all parties, both public and private.

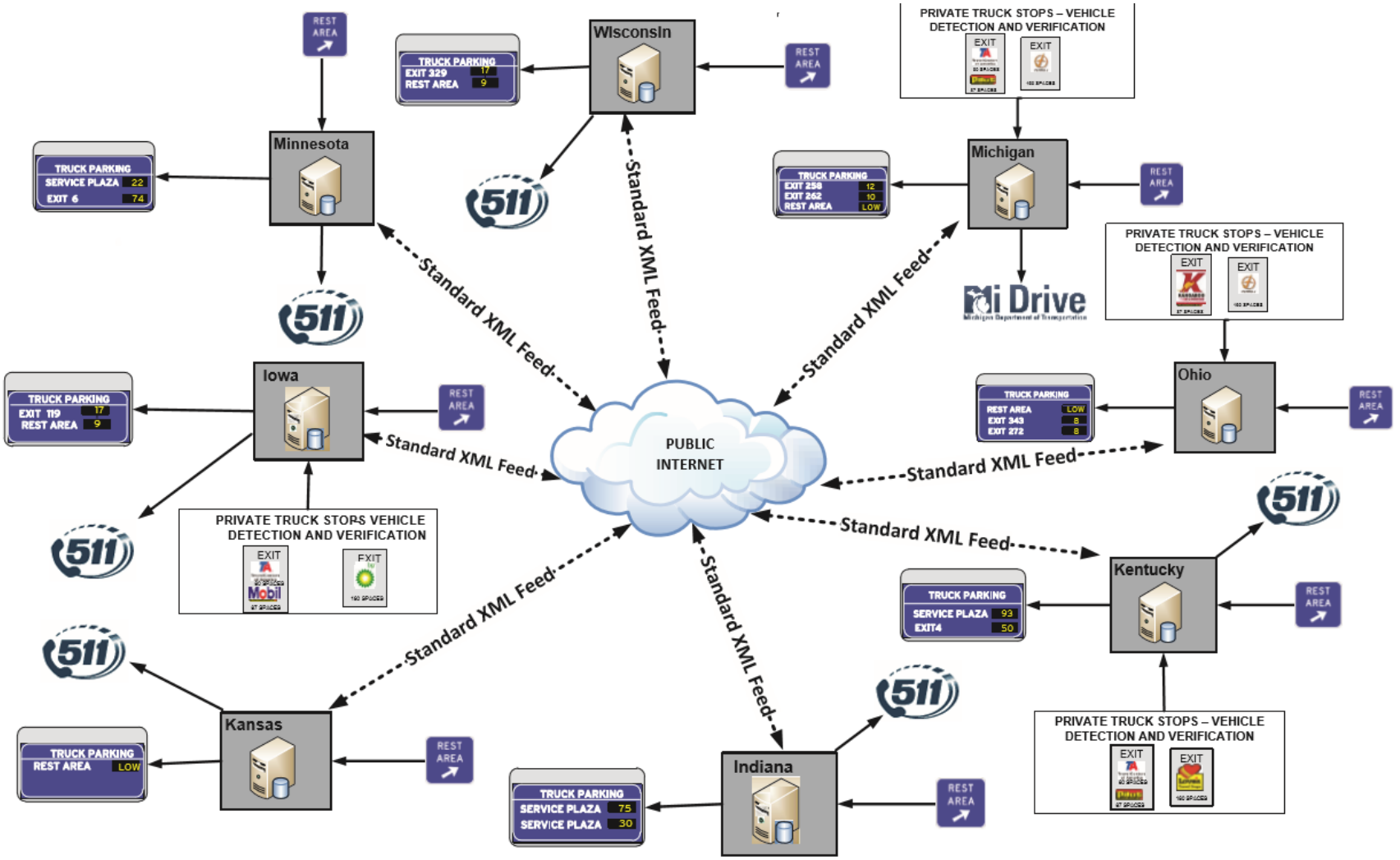
The setup was based on success seen within Michigan's technology that allowed seamless data exchange information between MDOT and private project partners. This architecture allows for the technology to be scalable across additional sites, states, and data platforms in the future. An example could be Georgia or North Carolina wishing to adopt the technology later and borrow on what has been created in this region.

Figure 4.5 displays the communication matrix between each of the partners for the truck parking deployment.

Information can be shared with users in three ways:

- **Dynamic Truck Parking Signage (or Variable Message Signs) –** signs upstream of parking locations that identify parking opportunities along the corridor. This was found to be the preferred method by commercial operators in the Midwest.
- **Smart Phones –** mobile applications with FMCSA one-touch compliant operations can disseminate information to drivers through subscription services on third-party platforms.
- **Websites –** 511 websites and databases that are public facing can share this information as well.

Figure 4.5: Information Sharing Between Regional Mid-West Association of Governments



Source : KDOT TIGER Grant Application

Data and Analytics: Gateway Cities DrayFLEX Program

The ports of Los Angeles and Long Beach form the biggest port complex in North America and handle two thirds of the country's containerized imports via 13 container terminals. In fiscal year 2019/2020, this amounted to nearly 8.6 million containers at the Port of Los Angeles;[7] the Port of Long Beach handled over 7.6 million containers in calendar year 2019.[8] This volume of traffic has led to increasing traffic congestion, emissions, and crashes around the two seaports. Meanwhile, expanding infrastructure in Southern California is difficult for cost and environmental reasons.

The Drayage Freight and Logistics Exchange (DrayFLEX) program is deploying ITS technology in the region to address these issues. The overall program goals are to:

- Improve freight movement coordination
- Improve terminal efficiency
- Reduce delays and truck queueing
- Reduce fuel consumption and emissions

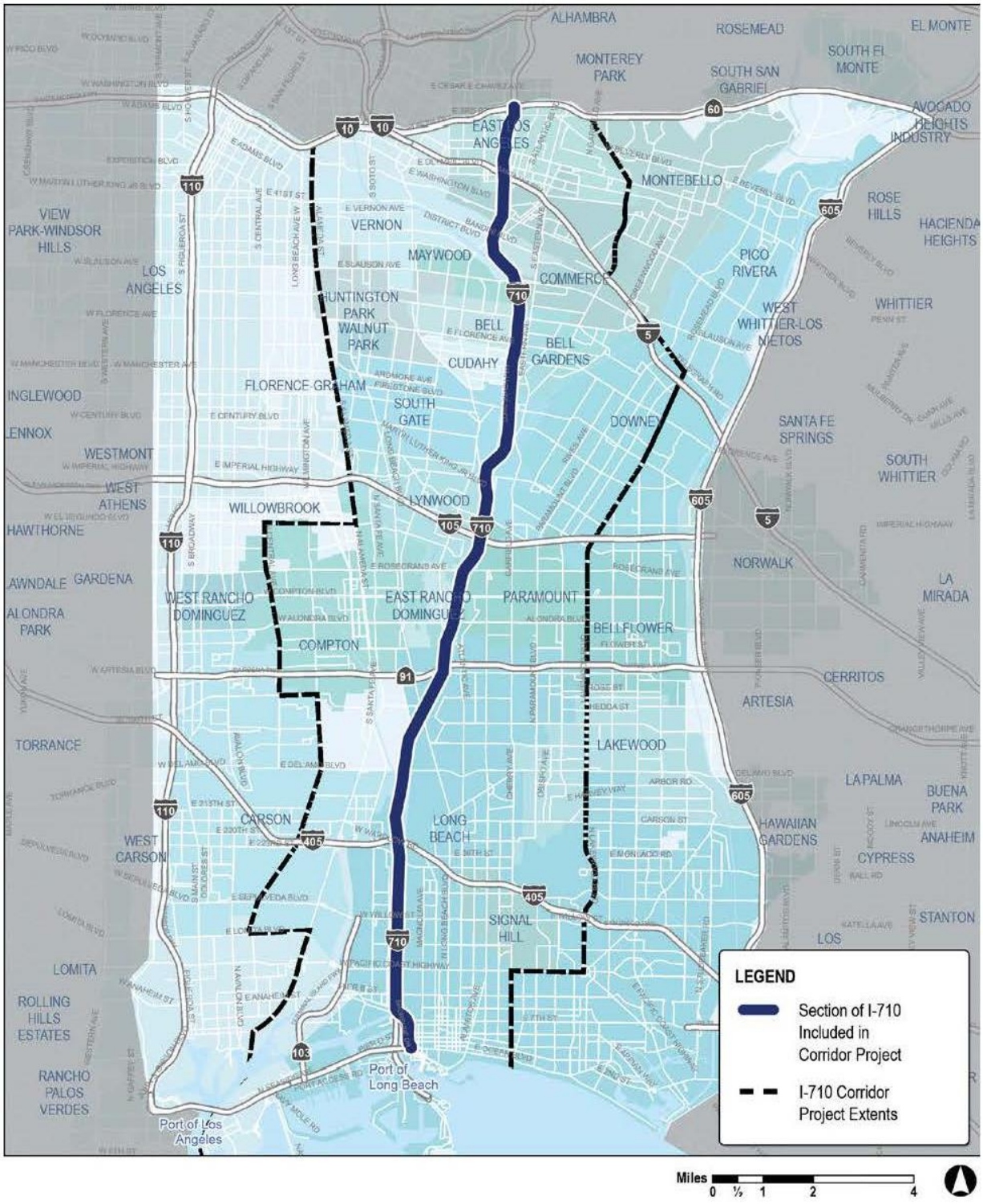
Figure 4.6 shows the DrayFLEX project area where the technology is being deployed. The section of I-710 highlighted in the map connects the port complex with the Interstate highway network and various transportation, logistics, and distribution businesses.

There are two deployment groups in the DrayFLEX program:

- DrayFLEX Core efficiently allocates trucks and drivers to appointments at the terminal and provides truck arrival times to terminals for resource planning and dynamic management. The application integrates external public sector and private logistics firm systems to capture, process, and disseminate historical and real-time data that can be used to optimize port truck movements. This requires integration with trucking company and terminal operator management systems, which is resource-intensive but offers the potential to improve the full life cycle of port truck operations.

[7] https://www.portoflosangeles.org/business/statistics/container-statistics/historical-teu-statistics-2020
[8] https://www.polb.com/business/port-statistics/#yearly-teus

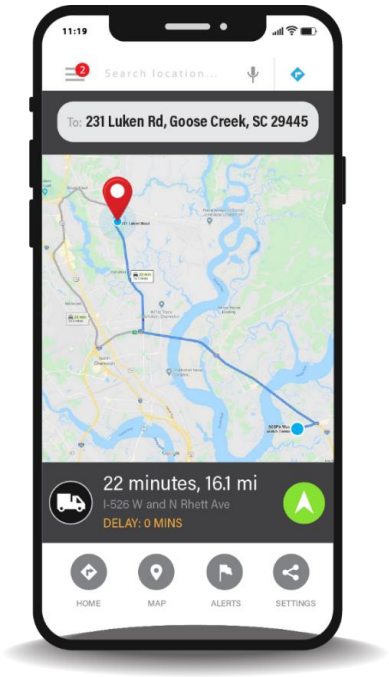
Figure 4.6: DrayFLEX Project Area



Source: Los Angeles County Metropolitan Transportation Authority, Los Angeles/Gateway Freight Technology Program

- DrayFLEX Trip provides in-cab truck traveler information and real-time routing advice. It accounts for traffic, construction, incidents, and truck-permitted routing. It also warns drivers of dangerous traffic slowdowns. Routing is always truck-friendly (see conceptual app view in **Figure 4.7**) and includes notifications like fuel efficient routes, dangerous slow-downs, and incidents. Truckers enter destination information in a mobile app, with an appointment time at the terminal. The app the generates a recommended departure time and route. The app provides speed recommendations during the trip to avoid incidents, reduce travel time if possible, and minimize pollution. The app also features Freight Queue Warning functionality, which can warn truckers about upcoming traffic slowdowns near congested port terminal gates and along congested freight corridors where sudden slowdowns contribute to rear-end crashes.

Figure 4.7: Conceptual DrayFLEX Trip Routing

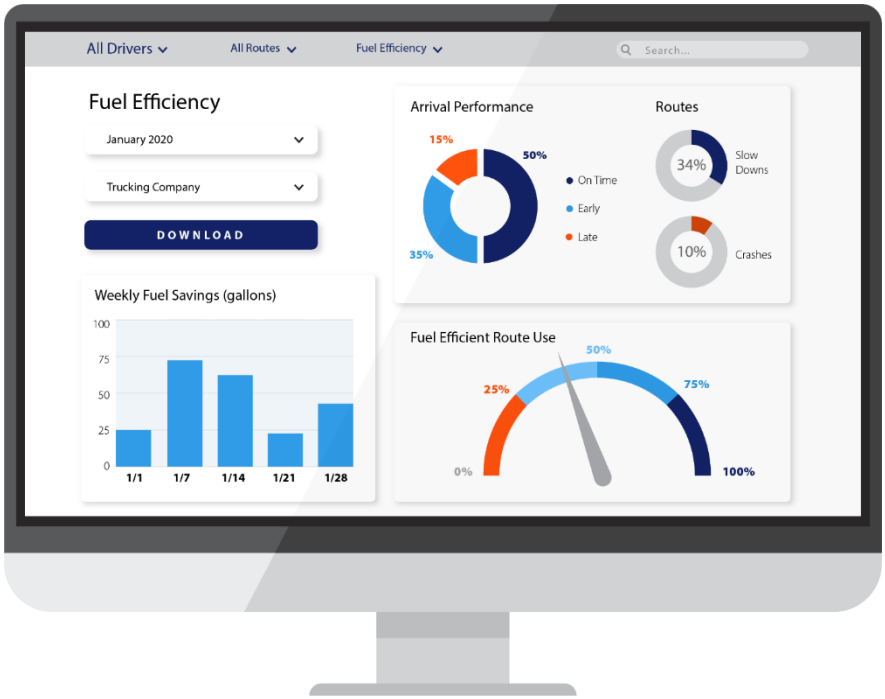


Source: CDM Smith

DrayFLEX was designed so it could integrate with L.A. County's regional ITS.

DrayFLEX also features performance dashboards to understand program impacts. Metrics can be tailored to different user groups like agencies and truck drivers (see **Figure 4.8**).

Figure 4.8: Example Performance Dashboard



Source: CDM Smith

Automation and Detection: DriveOhio Automated Driving Systems

DriveOhio (a branch of the Ohio Department of Transportation) recently won an Automated Driving Systems (ADS) grant from the USDOT to deploy autonomous vehicle technologies in rural environments, which have been mostly overlooked in autonomous systems development and testing. The grant will be used to deploy truck platoons and higher levels of freight automation on the I-70 corridor between Columbus, OH and Indianapolis, IN and to test ride-hailing in rural areas, for instance to help disadvantaged populations get to medical appointments and other services. Overall goals are to:

- Close data gaps for ADS use in rural/cooperative highway environments, and
- Deliver safe and integrated ADS tests.

Each deployment in the program is to be supported by a robust systems engineering effort, designed to be fully compliant with USDOT requirements for technology deployments. This includes test planning and preparation, data collection/privacy protocols, and testing in a controlled track environment and in the field. It also involves an outreach program designed to educate the public and encourage/promote ADS adoption with the goal of advancing the program objective of expediting the safe and effective integration of ADS into rural Ohio and the national transportation system.

DriveOhio will install RSUs to support the rural ride-hailing and truck platooning projects; this infrastructure will be key to gathering data from the ADS deployment tests and building data queries such as travel time and congestion, and potentially providing real-time route decision-making information to the ADS vehicles.

Data collection will be governed by a Data Management Plan developed to USDOT standards. Working with project deployment partners, DriveOhio will define a cloud-based system to receive data from vehicles and external sources and perform preliminary analysis to prepare normalized and scrubbed data sets for reporting. For truck platooning/truck automation, key data points will include vehicle speed, hard braking, safety-critical events, fuel use, driver behavior (for instance, when forming a platoon), and behavior of other vehicles around the automated or platooning trucks.

Data privacy will be important in the ADS deployments, so the data plans will address how personal identification and competitive information will be protected. This could include a requirement to obtain human use approval from an Institutional Review Board.

4.1.3 Applicability to ACOG Region

Connected Vehicles

The success of connected vehicles within the ACOG region will primarily come down to having buy-in from both the public and private sectors. While the how-to can be brought in from either partnering with the USDOT through grants or research opportunities for deploying new technologies or working directly with the technology providers, having the desire from the freight industry for these improvements will be paramount.

For the ACOG region, this technology would best benefit from implementation across a key freight corridor within the region, which in this case would be route I-26 or I-85. Local jurisdictions would be

responsible for any DSRC technology or sensors that may be installed along local corridors. SCDOT would be responsible for DSRC technology or sensors that may be installed along highways.

Individual costs, longevity, and life cycle of sensors, DSRC technology, or 511 webpage applications is difficult to discern at this time but further communication with the USDOT and partner agencies may shed light on this. As an example, the Miami-Dade ITS Deployment cost about $75,000 - $125,000 per signal, with DSRC units on trucks incurring an additional cost that would need further exploration.

Truck Parking Technology

For the MAASTO truck parking study, the technology used was already shovel-ready, with the only requirement being to implement the technology in the field. The benefit-cost ratio for the project was relatively high (4.27 undiscounted) and showed that the safety benefits from reduced accidents, and environmental benefits from reduced trucks searching for parking, far outweighed the costs of implementing the application.

The applicability to the ACOG region can be either at the small-scale level or large-scale. Small-scale wise, Dynamic Truck Parking Signage and truck sensing technology at existing truck parking locations can be implemented on a case-by-case basis, or along a portion of a corridor within the region. These projects can be 'pilots' that are grown to encompass entire corridors from state line to state line, or even statewide. The large-scale option is to partner with state agencies or regional associations (I-95 Corridor Coalition did a pilot study in Virginia) to implement the technology along a vital corridor.

The first step to implementation of truck parking technology would be to identify the most desired locations within the region for implementing the technology. These locations can be identified by looking at areas with high fatigue-related truck crashes or high numbers of trucks ticketed for illegal parking. Travel time analysis could also be conducted from warehouse/intermodal facilities to find the limits for how far truck drivers can travel.

4.2 Automated Vehicle Technologies

4.2.1 Positive Train Control

PTC refers to technology that has been specifically designed to prevent certain train accidents caused by human error. The Association of American Railroads (AAR) states that a PTC system is designed to prevent train-to-train collisions; derailments due to excessive speed; prevent unauthorized incursions by trains onto sections of track currently under maintenance; and prevent trains from moving through a track switch left in the wrong position9. Implementation of PTC is the result of substantial financial investment and collaboration among railroad industry partners. PTC systems will not prevent accidents caused by track or equipment failure, improper vehicular movement through a crossing, trespassing on railroad tracks, and certain types of operator error.

In 2008, Congress mandated that Class I freight railroads implement PTC systems through the Rail Safety Improvement Act. The regulations apply to freight trains on mainlines that transport passengers and

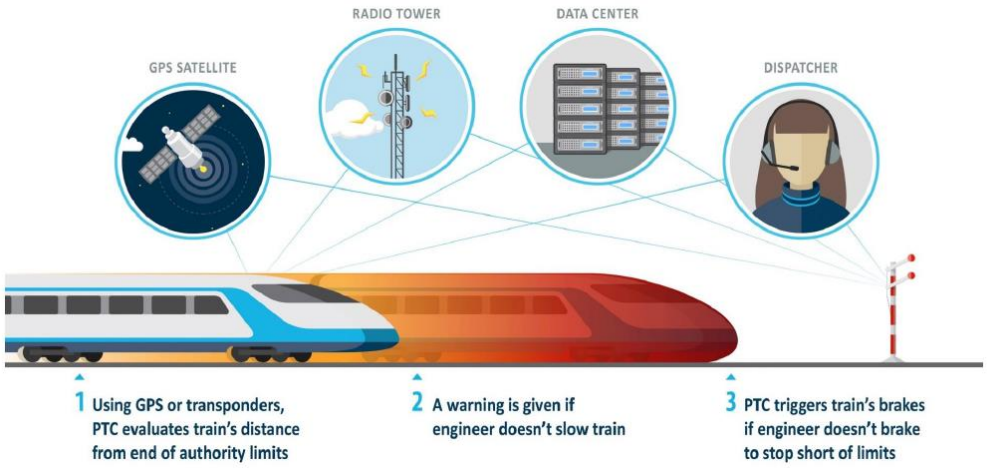
[9] https://www.aar.org/wp-content/uploads/2020/08/AAR-PTC-Fact-Sheet.pdf

toxic-by-inhalation materials. PTC was implemented at the end of 2018 and testing is scheduled to be complete by the end of 2020. According to AAR, as of January 2020, 98.5% of the required Class I route miles are operating under PTC service. Responsibility for installation and maintenance of PTC equipment and monitoring is shared by multiple parties, including the rail infrastructure owner/operator and the equipment owner/operator.

PTC systems are comprised of three primary operating components, listed below, and are supported by dispatch operators and networked technology infrastructure. **Figure 4.9** further illustrates these connection points:

- Onboard or locomotive systems track train position and speed, with capability to activate braking for enforcement of speed restrictions and prevent unauthorized train movements;
- Wayside systems monitor track signals, switches, and individual track circuits to communicate data with the onboard systems; and
- Back office servers store and transmit data related to the rail network and operating trains, such as speed restrictions, movement authorities, and train composition to onboard systems.

Figure 4.9: Positive Train Control Infrastructure



Source: Amtrak

The rail network in the US is comprised of both privately and publicly owned rail lines, serving the interests of both freight and passenger/commuter systems. Given the interconnections inherent within the rail industry, ensuring interoperability among various entities is the keystone to a functional PTC system. On any given day, hundreds of locomotives must be able to swiftly and reliably communicate with the PTC system of another railroad, considering thousands of operational variables. The PTC network of technological and human functions must work together seamlessly, regardless of which operating partner owns either the locomotive, or the track. The act of stopping a train requires consideration of train speed, terrain, train weight and length, the number and distribution of locomotives and freight cars comprising the train, as well as additional factors.

In January 2019, the AAR characterized the planning, installation, and implementation of the PTC network as a monumental feat. The rail industry partners were tasked with achieving several objectives and are nearly 98.5% complete, including:

- Physical survey and geo-mapping on nearly 54,000 freight route-miles, including more than 450,000 field assets along right-of-way;
- Installation of more than 28,500 custom wayside infrastructure units (WIU) that transmit information from signal and switch locations to locomotives and rail facilities;
- Installation of PTC technology on nearly 16,400 locomotives;
- Development and deployment of new radio systems at tens of thousands of base stations, trackside locations, and locomotives;
- Upgrades to 2,100 switches in non-signaled territory and signal replacement projects at 14,500 additional locations; and
- Development and integration of back office systems and dispatch software.

4.2.2 Terminal Automation

Terminal automation consists of the use of integrated technology when developing solutions for the efficient control of traffic and trade flows at a terminal, resulting in increased capacity on an existing facility's footprint. Automation integrates intelligent operating equipment with a facility's existing terminal operating systems and a remote operating station. With the advancements of relevant technologies, new and better methods of controlling terminals have emerged, leading to a gradual shift towards automation in all process flows and terminal operations. Implementing automation encompasses terminal equipment purchases, operations, and civil design choices. More efficiently and densely stacked containers help to increase facility capacity through reduced container dwell time.

Figure 4.10: Automated Container Operations

Source: felixstowedocker.blogspot.com

Automation's reach comes in many forms – material unloading and cargo handling equipment, digital recordkeeping and inventory management practices, infrastructure, and container move and storage operations are all examples of the big-picture of automation. There are two primary principal areas of terminal automation, to include:

- Gate Automation; and
- Automation of container storage/stacking operations.

Railroads have started seeking opportunities for these infrastructure improvements to gain operational and cost efficiencies as well. The following sections will mainly focus on port discussions; however, Class I railroads have begun implementing automation at their gates and in their cranes as well.

The benefits of a successfully integrated, automated operating environment are far-reaching. The following are just a few examples:

- Increased safety, process predictability, reliability, and container tracking;
- Reduced operational costs, congestion, and idling time; and
- Ability to phase planning of new or existing facilities.

Automation technology has been a critical factor in improving efficiency and productivity at terminals. This goal of operational efficiency focuses on limiting the amount of time and physical space resources used to perform a particular function. Sensors and other electronic equipment increase the productivity rate of conventional process flows. Manual errors and delays are eliminated while reducing the associated emissions. With fewer manual errors, a more stable container handling environment emerges, allowing for greater predictability and more precise planning and execution. Greater automation also increases the window for operating hours at a terminal.

Gate Automation

Gates are the checkpoint for all entities entering or leaving a terminal. Additional processes may be needed, such as verification, customs, immigration, and quarantine to protect the integrity of the freight by enhancing security protocols. As container traffic throughput volumes increase, these processes strain both the time and resources of a port and its staff. Automation helps alleviate these burdens by using technology to handle tasks associated with entry/exit logs, verification, and docking payments.

Gate automation is used as a means for increased efficiencies at both ports and intermodal facilities. Implementation of gate automation systems can significantly decrease the amount of time needed to complete a gate transaction as well as reduce queuing outside of the gate. For instance, adoption of an automated, paperless gate system at the Virginia Ports Authority marine terminals aims to reduce each truck gate entry by four minutes.[10] This reduces the turnaround time for the truck driver as well as idling within the gate area, thereby increasing potential truck turns per day and reducing emissions from idling trucks. In addition, camera systems, installed as part of new automated gate systems, can identify damage to inbound equipment, thereby eliminating charges resulting from damages previously missed by visual inspection alone.

[10] https://ops.fhwa.dot.gov/fastact/atcmtd/2017/applications/portofva/project.htm

Terminal Equipment and Operating Systems

A straddle carrier, or an automated guided vehicle (AGV), can move containers to stacking areas. At that point, some form of Rubber Tire Gantry (RTG) crane will put the container in the stack to wait for a truck pick up. It is likely that AGVs will become standard in the future as they are less bulky than straddle carriers. Containers are then classified by cargo type and stacked and loaded to trucks based on algorithms to increase efficiency and lifts per hour. Container handling systems are designed to be predictable and efficient, using a computer-controlled process to achieve the desired ends in the least amount of time possible.

Electrified equipment is also playing a major role within the automation spectrum. Electrified rubber-tire gantry cranes (ERTG) are replacing former diesel systems, which are large source polluters at ports. These ERTG systems dramatically reduce fuel consumption and maintenance expenditures, increase flexibility in handling varying volumes, result in higher productivity, improve the working environment for staff and cargo, and reduce emissions.

Following the offloading of cargo, terminal operating systems direct cargo handlers and stacking cranes to sort containers based on their specified category. Inventory is often managed according to its date of departure inland. When the container is ready for dispatch for further transport, this equipment is again used for internal container moves. Design of this network should consider safety in terms of the level of human interaction with automated equipment as well as minimizing friction between multiple operational processes.

4.2.3 Applicability to ACOG Region

PTC implementation will continue to be driven by the railroads in response to the Congressional mandate. As such, ACOG and its partner agencies should focus on collaborating with rail stakeholders to understand implementation status and identify opportunities for partnerships that can improve rail safety. This doesn't have to be limited to PTC. For instance, ACOG could work with railroads and SCDOT to establish a grade crossing safety program that identifies and prioritizes regional grade crossings for safety upgrades, closure, or grade separation.

Terminal automation will be mostly driven by private sector port and rail terminal operators. However, since these technologies increase terminal throughput, they can impact the transportation network outside the terminal gates. Improved efficiency may reduce queuing outside the gates and thus congestion on local roads, but it can also mean more trucks traversing such roads which can impact pavement conditions. It will be important for ACOG to work with Inland Port Greer and SCPA officials to mitigate issues that may arise from changes to terminal operating procedures.

Intelligent Transportation Systems (ITS) combine leading-edge information and communication technologies to promote and improve the safety, efficiency, and sustainability of the transportation network. These technologies communicate and share real-time information between equipment on the ground, Traffic Management Centers (TMCs), and the users traveling on the transportation network. Traffic data connectors, such as a low-voltage wires that are buried underground, send an electrical pulse once a vehicle traverses them. These electrical pulses are sent to a TMC where the data is stored and disseminated via different methods such as Variable Message Signs (VMS, see **Figure 5.1**), 511 web sites, or mobile applications. Information provided can include traffic congestion, incidents, road work, travel times, special events, weather, emergencies, and recommendations for alternative routes.

Vehicles affected by an incident typically can benefit from reduced delays and reduced congestion associated with the incident when ITS solutions are implemented. Other benefits include environmental benefits attributed to a reduction in idling vehicles, increased safety, and improved freight movement efficiency.

Figure 5.1: Variable Message Sign

Source: South Carolina Statewide ITS Architecture

Many of the technologies profiled in this report (e.g., Connected Vehicles/V2X, terminal automation, truck platooning, and freight signal priority) consist of ITS applications or can be integrated with existing regional ITS. It's therefore important to have a framework for identifying and executing local and regional ITS projects that adheres to relevant federal guidance and can integrate with the statewide ITS architecture.

5.1 Framework for Regional ITS Implementation

State, regional, and local governments may develop Regional ITS Architectures that are tailored to their respective geographical boundary. The framework to build a Regional ITS Architecture is clearly defined by FHWA Rule 940.9. To develop a Regional ITS Architecture, the FHWA rule requires inclusion of the following:

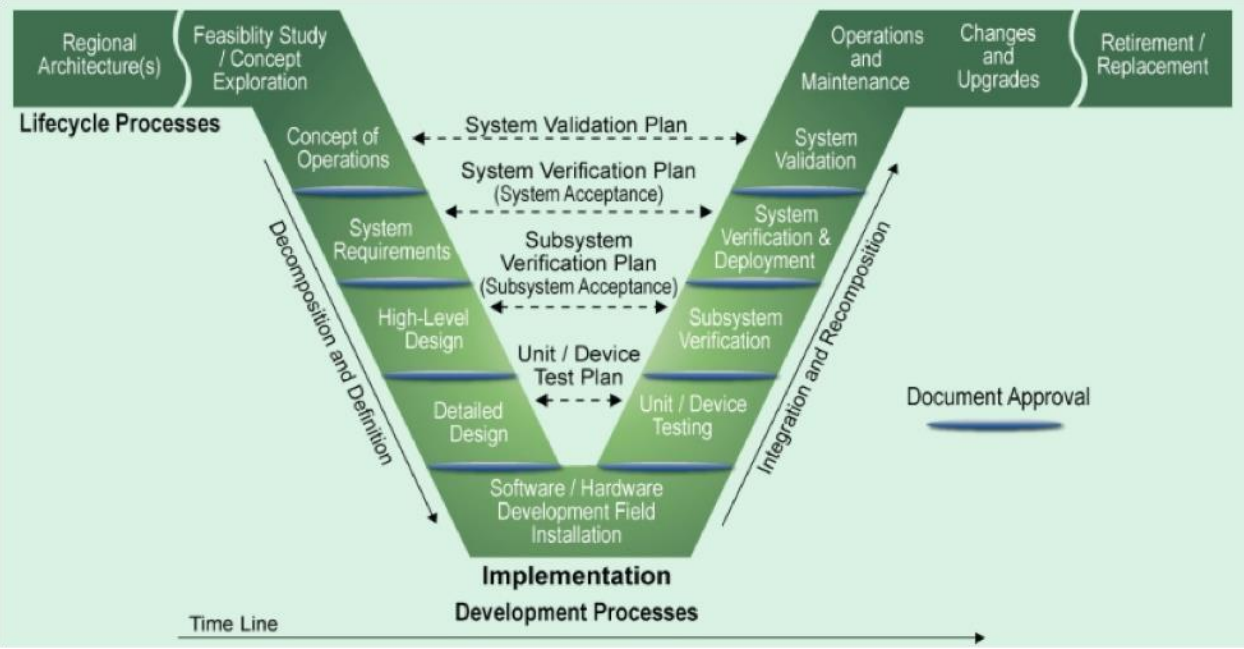
- National ITS Architecture
- Various stakeholders including highway agencies, public safety agencies (e.g., police, fire, emergency/medical), transit operators, federal lands agencies, state motor carrier agencies, and other operating agencies necessary to fully address regional ITS integration
- Description of the region
- Operational concepts that identify the roles and responsibilities of participating agencies and stakeholders who are involved in the implementation and operation of the ITS system
- Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture
- System functional requirements
- Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture)
- Identification of ITS standards supporting regional and national interoperability
- The sequence of projects required for implementation.[11]

For instance, the SCDOT developed and continues to maintain the South Carolina Statewide ITS Architecture which accommodates the FHWA rule.[12] Regional entities, like MPOs, can also develop their own ITS architectures to further focus implementation with federal funding for specific localized ITS projects.

To integrate ITS at the project level, a systems engineering approach is required if federal funds will be used on the project (**Figure 5.2**).

[11] https://ops.fhwa.dot.gov/its_arch_imp/policy_1.htm#940_9
[12] https://centralmidlands.org/wp-content/uploads/South-Carolina-Statewide-ITS-Architecture.pdf

Figure 5.2: Systems Engineering Approach



Source: Federal Highway Administration

Similarly, FHWA Rule 940.11 specifies minimum rules that must be followed for ITS project level implementation:

- Identification of portions of the regional ITS architecture being implemented, or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture
- Identification of participating agencies roles and responsibilities
- Requirements definitions
- Analysis of alternative system configurations and technology options to meet requirements
- Procurement options
- Identification of applicable ITS standards and testing procedures
- Procedures and resources necessary for operations and management of the system.[13]

5.2 Integrating ITS and Emerging Technologies into the Planning Process

Emerging transportation technologies continue to evolve rapidly across many subsectors including electrification, vehicle automation, intelligent transportation systems, and connected vehicles. These changes will also impact how agencies plan, finance, and develop new transportation infrastructure, but in

13 Ibid

ways that are not yet clear. Hence, it's important for agencies to incorporate general policy considerations for emerging technologies into their planning processes. This section offers several policy/outreach tools to help ACOG and its partner governments include new technologies in the planning process, followed by a conceptual framework for evaluating ITS assets, needs, and solutions.

5.2.1 Policy Considerations for Emerging Technologies

The following best practices outline ways ACOG and its partner agencies/stakeholders can build tools and processes to better incorporate emerging technologies into the planning process:

- **Define the vision –** Private firms (e.g., auto manufacturers and shared mobility platforms) are already redefining the way people and goods move, with or without public sector input. It's therefore important to articulate a regional technology vision that can guide future investments and pilot projects.
- **Develop goals, objectives, and a prioritization framework –** The vision needs to be supported by concrete goals and objectives that can be measured to evaluate and prioritize projects. Goals that can be supported by technology include optimizing safety, promoting reliable travel times, coordinating travel information across jurisdictions, and ensuring equitable access to mobility options. In particular, new mobility options (e.g. micro and shared mobility) give agencies the opportunity to focus on moving people and goods, not just vehicles.
- **Broaden outreach efforts –** The entry of technology players and auto manufacturers into transportation services provision (traditionally dominated by the public sector) means that agencies should incorporate new perspectives in the process. Such outreach will help agencies identify new opportunities or challenges for emerging technologies. From a freight standpoint, trucking company or shipper involvement could identify opportunities for pilot projects.
- **Explore/collect new data –** Given the rapidity of technological change (and resulting changes in travel behavior), it is imperative for agencies to collect appropriate data to inform decision making. This will almost certainly involve data sharing across public and private transportation system users, managers, and providers to identify shifts in behavior and plan accordingly.
- **Conduct scenario planning exercises –** Technological uncertainty necessitates planning that can account for more than one potential future scenario, with implications for each. Developing "what if" scenarios and exploring implications for freight and passenger mobility is one way to help account for such uncertainty.
- **Develop new prediction tools outside of travel demand models –** While travel demand models are a critical tool in planning and programming transportation improvements, there is also a need to predict shorter-term changes in travel that may not be captured adequately by traditional modeling tools.
- **Evaluate the impact of emerging technologies on different populations –** Like all technological developments, new transportation technologies will impact different groups in different ways. As an example, ACOG could assess the impacts of emerging technologies on

elderly or disabled populations. Autonomous vehicles, for instance, may encourage more people to age in place.

- **Diversify and re-evaluate project portfolio –** Connected and autonomous mobility creates opportunities for agencies to consider projects that might maximize the benefits of these technologies. Examples include re-striping to encourage better computer interpretation of pavement markings, electric vehicle charging stations, and curbside policies to better manage limited curbside space. At the same time, cost estimates may need to be revised in light of design impacts for new technologies.
- **Revisit revenue scenarios and funding strategies –** Vehicle electrification may force agencies to re-evaluate future revenues and develop new funding strategies since most road infrastructure is financed by gas taxes. Identifying and leveraging innovative funding approaches may position ACOG to capture more funding opportunities, as innovation is often a merit criterion for grant programs.
- **Accelerate plan updates –** Given the pace of change, annual long-range plan updates may be necessary rather than waiting 4 to 5 years between updates.

5.2.2 Integrating ITS into the Planning Process

ITS represents a subset of emerging technologies that focuses on gathering/disseminating traveler information and effective management of existing transportation capacity. Public agencies typically have a strong role in planning, funding, and managing ITS. Hence, it's important to establish a process for planning, funding, and executing ITS projects that is coordinated with agencies' regular planning processes and the regional vision for emerging technologies.

While ITS has demonstrated enormous benefits in many deployments around the country, its application should be tempered with a strong operational concept and focus on functionality. This is why the USDOT stresses the importance of a user needs-based approach to ITS and technology planning, meaning the technology application should be designed so it responds to needs identified by system users. Integrating ITS into regional planning processes therefore requires inventorying the area's existing ITS assets, an understanding of regional issues that might be solved with ITS, and knowledge of non-ITS solutions that could be used or might already be programmed.

Figure 5.3 provides a high-level approach to incorporating ITS and emerging technologies into existing regional planning processes:

- A key first step is to inventory the region's existing ITS assets (whether or not they're being used for ITS applications). This could include traffic detection systems, cameras, weather stations, signal systems, and TMCs, among other items. This step provides a baseline for understanding the capabilities of the current technology infrastructure.
- The next step is to define the regional transportation needs, goals, and objectives that could be addressed with ITS. This can build upon existing planning efforts that have already identified issues and needs.

- Next, needs are matched against potential ITS solutions and deployment projects to define a set of potential ITS projects for implementation. This step can involve Requests for Information (RFIs) or 'Vendor Days' to help planners understand the current market for technology solutions.
- Potential ITS solutions should then be cross-checked with existing planning documents to understand where needs may be addressed by other non-ITS solutions. This follows the traffic engineering principle of applying the simplest solution first, with more complex treatments added as warranted. As an example, for safety concerns sometimes traditional approaches like improving geometrics, implementing signing, and improving road striping are attempted first. ITS solutions are introduced when safety issues persist even after traditional treatments are applied.
- The final step is to collect detailed user needs (via stakeholder outreach) to better define what users expect the system to do and use this information to define use case scenarios and functional requirements that will inform technology selection and data collection/performance monitoring.

Figure 5.3: Approach to Integrating ITS into Regional Planning Processes

Source: CDM Smith

6.1 Background

Public-private partnerships (P3s) consist of joint activity related to an agreement between an agency of the government and the private sector for the delivery of goods or services to the public.[14] This alternative procurement method leverages private resources and subject-matter expertise. P3s enable the private sector to take on traditionally public roles in infrastructure projects, while the public sector maintains its capacity of ensuring and enforcing public accountability. This section profiles selected P3 case studies addressing truck parking and intermodal rail capacity needs.

6.2 Case Studies

6.2.1 Truck Parking

The economic impact of time spent looking for parking equates to almost $7 billion annually, and thus creates a need for state, regional, and local governments to address.[15] There are many issues that affect the availability of truck parking today, which include:

- **Land Use/Real Estate Issues –** Within the urban area, roadway systems must cater to a variety of users which compete for parking capacity, roadside rest areas, and service plazas. These requirements can diverge when considering they must plan for long-haul, short-haul, local distribution, terminal-to-terminal, and other roadway users. At the same time, urban real estate costs have been rising which make it difficult for highway-oriented uses to compete with other retail components that may be more profitable.
- **Congestion –** Congestion along the nation's highways has continued to increase, especially during peak periods, which hampers drivers' ability to get to their destinations on time. Since restrictions on drivers are time-based rather than distance based, drivers end up needing to pull over to stop frequently between destinations which can be without truck amenities, which causes illegal parking at exit ramps.
- **Safety –** With the lack of parking facilities, drivers can become fatigued if they choose not to park illegally and continue to find a suitable parking location. Fatigued driving is a common cause of highway crashes and is avoidable when parking is readily available. Similarly, illegally parking at exit ramps, alongside highway shoulders, and at other locations is dangerous not only for other drivers, but for the drivers themselves at these unmonitored locations.

[14] Britannica Online: Public-Private Partnershipshttps://www.britannica.com/topic/public-private-partnership
[15] http://www.maasto.net/documents/TPIMS-Grant.pdf

In order to ensure that safe truck parking continues to be supplied throughout freight corridors, two truck parking P3s are explored to highlight efforts being taken today to increase the truck parking supply.

Weed, California Truck Parking

The City of Weed constructed a municipal parking lot by leasing land from private owners for truck-only parking. The City first acknowledged that was a need for truck parking along I-5 through Weed, and then assessed the best location for placing the parking. The location selected is adjacent to a Pilot travel center, with lodging and food options available within walking distance. The site was developed to contain 30 parking spaces, and no parking fees are charged for trucks that stay less than 72 hours.

Maintenance is provided by the Pilot travel center, and in exchange, they enjoy the increased business from truckers parked at the location. The site is patrolled by City of Weed police to ensure safety, and thus far no issues have arisen here. Since 2012, only 5 tickets have been issued to trucks parked on this location. To ensure that truck parking within the City remains curbed, the City has required new travel center developments to have truck parking spaces.

Brainerd Lakes Welcome Center Truck Parking

This tourism center in Crow Wing County, Minnesota features a partnership between the Minnesota DOT, the Brainerd Lakes Chamber of Commerce, Crow Wing County, the Minnesota Department of Natural Resources, and the Minnesota State Patrol. The center was developed within the right-of-way of an interchange off US Highway 371, which was leased by the Minnesota DOT.

The site features 30 truck parking spaces that were funded through a gift shop featuring local products that was built on-site. These funds cover the operating costs of the facility, with capital costs sourced through the DOT, Chamber of Commerce, and Department of Natural Resources. In addition to the gift shop and truck parking, the site features bathrooms and vending machines that are accessible from both directions of travel. Security is provided through the Minnesota State Patrol.

6.2.2 Intermodal Rail

The incentive for governments to partner with freight railroads is the resulting public benefits that a project is projected to provide, in comparison with the public costs associated with undertaking the effort. Examples of public benefits include:

- Reduced highway congestion;
- Increased economic development;
- Reduced fuel consumption and greenhouse gasses;
- Reduced roadway maintenance costs;
- Leveraging capital;
- Affordability of freight rail; and
- Expanded passenger rail capabilities.

The following are two examples of P3s within the railroad industry that have allowed governments as well as private rail entities to realize the benefits of this innovative project delivery method.

Crescent Corridor P3

The Crescent Corridor P3 is a $2.5 billion rail infrastructure project along the Norfolk Southern rail corridor and is part of a strategy to convert domestic freight transportation from highway to intermodal rail. The agreement exists between Norfolk Southern, the federal government, and the various state governments represented along the corridor. The PPP is a joint financial mechanism between NS, the States of Pennsylvania and Virginia, and the USDOT. NS has contributed $264 million towards property acquisition, design, construction, cranes, route improvements in five states, etc. Virginia has contributed $103 million for track capacity, access roads, and terminals. Pennsylvania has contributed $45 million for the construction of the terminals. USDOT has contributed $300 million in Transportation Investment Generating Economy Recovery (TIGER) grant funds for the project.[16]

The Crescent Corridor is the shortest intermodal double-stack route between the South and Northeast and spans 11 states, highlighting the importance of the corridor[17]. Independent studies evaluating the impact of the project estimate that when fully complete, the corridor improvements will translate annually into a savings of more than 169 million gallons of fuel; removal of more than 1.3 million long-haul trucks from roadways; save more than $575 million in costs associated with traffic congestion; reduce greenhouse gas emissions by 1.9 million tons; and create more than 122,820 jobs by 2030[18].

Alameda Corridor P3

A second public-private partnership, which was also funded through private and public sources, is also one of the most well-known, the Alameda Corridor. The Alameda Corridor, completed in 2002, is a 20-mile rail expressway that connects the Port of Los Angeles, Port of Long Beach, and rail yards near downtown Los Angeles. This corridor has made the area ports more productive, reduced noise and congestion in the surrounding communities, increased safety on the local roadway network, reduced pollution, and, most importantly, made freight rail faster and more efficient.

To complete the project, the Alameda Corridor Transportation Authority contributed $1.2 billion through revenue bonds, USDOT awarded a $400 million federal loan, the Port of Los Angeles and the Port of Long Beach contributed $394 million, the Los Angeles County Metropolitan Transportation Authority provided $355 million, and the railroads contributed $18 million.

6.2.3 Applicability to ACOG Region

Truck Parking

ACOG can identify locations in need of truck parking using the I-85 Truck Parking Study completed in 2017. Once identified, these areas can be evaluated to determine which locations are within existing right-of-way, are located adjacent to existing facilities, or may have opportunities for P3 implementation.

[16] https://www.railway-technology.com/projects/crescent-corridor/
[17] Norfolk Southern Sustainability Report
http://nssustainability.com/2013_sustainability_report/economic_performance/our_key_public_private_partnerships.html
[18] Norfolk Southern Crescent Corridor
http://www.nscorp.com/content/nscorp/en/shipping-options/corridors/crescent-corridor.html

After identifying the appropriate locations for implementation, working with local and state agencies to identify funding availability or operations and maintenance coverage may offer opportunities to implement truck parking at reduced costs to the cities themselves.

Intermodal Rail

Inland Port Greer is an example of a successful rail P3 already operating in the ACOG region. As freight volumes continue to grow, ACOG should work with SCPA, regional freight industry partners, and agency partners at SCDOT and CHATS to remain involved in project planning and implementation.

7.1 Incident Management

According to FHWA, incident management is "a planned and coordinated program process to detect, respond to, and remove traffic incidents and restore traffic capacity as safely and quickly as possible."[19] Incident management can reduce the time required to clear traffic incidents while ensuring the safety of those involved in an incident and the motoring public. The FHWA has developed guidance for agencies to develop incident management programs. The guidance revolves around making the appropriate business case for the program – both for the initial investment, and for ongoing program evaluation and improvement (see **Figure 7.1**). The key steps in this process are:

- **Develop a vision.** This step defines the problem or need being addressed, reasons for changing current processes, and outlines the proposed solution.
- **Evaluate and select.** This phase defines evaluation criteria (i.e., how alternative solutions are to be assessed), estimates benefits and costs, compares alternatives, and recommends a preferred alternative. It's important to ensure each alternative is evaluated the same way. Comparisons should include cost, risk, schedule, and agency/staff expertise requirements. Evaluation criteria can also be weighted according to agency or regional priorities (for example, if mobility is the highest priority, it can receive scoring weight accordingly).
- **Formalize.** This step incorporates incident management procedures into regular agency planning processes, engages stakeholders and partners, identifies funding sources, and establishes processes to improve the agency's incident management capabilities.
- **Prepare for implementation.** In this step, agencies develop project execution documents including an implementation plan, a risk management plan, and a performance management plan. These documents demonstrate agency commitment to program implementation, identify risks to the project and how they will be mitigated, and define how progress and performance will be tracked and measured.

Incident management necessarily involves a wide swath of public and private stakeholders including law enforcement, emergency services, transportation agencies, traffic information providers and media outlets, and towing services, among others. Hence, it is important for ACOG to involve such partners early and often in the planning process, if the region pursues an incident management program.

[19] https://ops.fhwa.dot.gov/eto_tim_pse/about/tim.htm#:~:text=Traffic%20Incident%20Management%20is%20a,Law%20Enforcement&text=Emergency%20Management

Figure 7.1: FHWA Traffic Incident Management Business Case Development Process

Source: FHWA

7.2 Railroad Safety

Moving freight by rail safely is important to protect the public, railroad employees, and the freight that is being transported. To improve the overall transportation network, strategies to reduce incidents and conflict for railroads will focus on at-grade railroad-highway crossings. At-grade crossings present the greatest opportunity for people, automobiles, and trains to collide. An at-grade crossing, as shown in **Figure 7.2**, is the intersection of a roadway and a rail line that are on level ground.

Figure 7.2: At-Grade Crossing North Forest Street

Source: NearMap

According to the Federal Railroad Administration (FRA), 97 percent of all rail-related fatalities and injuries occur at railroad crossings or are caused by trespassing.[20] Federal law states that grade crossings and tracks are the responsibility of individual railroads.[21] The FRA has undertaken measures to improve safety for at-grade crossings by developing the Highway-Rail Crossing Safety Business Plan.

7.2.1 FRA Highway-Rail Crossing Safety Business Plan

The FRA Highway-Rail Crossing Safety Business Plan is actionable and sets a path forward for improving safety by:

- Enhancing partnerships and expanding outreach to build awareness and expand the number of people who can see the problems;
- Leveraging and improving data to apply to resources effectively and creatively;
- Using regulatory oversight and enforcement to maintain safe rail operations while engaging partners in the rail industry; and
- Continuing to support research that helps improve rail safety.[22]

7.2.2 Quiet Zones

Official regulations governing the use of locomotive horns at public highway-rail grade crossings are established within the Federal Railroad Administration (FRA) Train Horn Rule (49 CFR Part 222). Among the regulations contained therein is a requirement that locomotive horns sound 15-20 seconds before entering public highway-rail grade crossings, or no more than one-quarter mile in advance of the crossing. The purpose of this action is to warn motorists and pedestrians that a train is approaching the grade crossing.

Figure 7.3: Quiet Zone Roadway Signage

Source: Petaluma pressdemocrat.com

[20] https://railroads.dot.gov/sites/fra.dot.gov/files/2020-02/Grade%20Crossing%20Business%20Plan.pdf
[21] https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title49/49cfr234_main_02.tpl
[22] https://railroads.dot.gov/sites/fra.dot.gov/files/2020-02/Grade%20Crossing%20Business%20Plan.pdf

The concept of the Train Horn Rule was spurred by an increase in train collisions in the late 1980s, particularly in areas where nighttime whistle bans were instituted. Based on the increase in this type of collision, Congress directed the FRA to enact federal regulations requiring train horns to be sounded at highway-rail grade crossings in 1994. In 2005, the final train horn rule, which included regulations on quiet zones, was adopted into the Code of Federal Regulations.

A quiet zone is a section of track, at least one-half mile long, which contains one or more consecutive public highway rail at-grade crossings at which horns are not routinely sounded when trains are approaching the crossing(s). Train horns may still be sounded within a quiet zone in instances of emergencies, or when a horn must be sounded to comply with a railroad or superseding FRA rule. Only a public authority – the governmental entity responsible for traffic control/law enforcement at the identified crossing – is permitted to create a quiet zone.

Quiet zones are established to reduce noise and promote/improve the quality of life in a locality, without compromising the safety of motorists, pedestrians, or the train. A 2017 study conducted by the United States General Accountability Office[23] states that FRA has analyzed data on crossings within quiet zones and determined that quiet zones are "generally" as safe as crossings where train horns are sounded. However, controls for variables such as train speeds and frequency were not incorporated into this research and have not been fully evaluated at this time.

In order to establish a quiet zone, a community must work with the owner railroad as well as the state transportation authority to assess the risk of collision at each highway rail at-grade crossing that is included as part of the quiet zone. Each designated crossing location must demonstrate that the highway rail at-grade crossing(s) meets one of the following conditions:

- Risk of implementing the quiet zone, calculated by the Quiet Zone Risk Index (QZRI), is less than or equal to the Nationwide Significant Risk Threshold (NSRT), with or without Supplementary Safety Measures (SSMs) or Alternative Safety Measures (ASMs);
- Risk of implementing the quiet zone, calculated by the QZRI is less than or equal to the Risk Index with Horns (RIWH) with additional safety measures, such as SSMs or ASMs; or
- Installation of SSMs at every public highway rail at-grade crossing, which represents the best method of reducing potential risk in a proposed quiet zone.

SSMs are pre-approved risk reduction tactics installed at certain public highway rail at-grade crossings within a quiet zone in order to maximize safety benefits while minimizing risk. ASMs are safety systems, exclusive of SSMs, used to reduce risk in a quiet zone. These include improvements that do not fully meet SSM requirements, thus requiring written submittal and FRA approval as to their efficacy in regard to risk reduction. Examples of SSM strategies include:

[23] US GAO Report to Congressional Addressees Railroad Safety: Quiet Zone Analyses and Inspections Could be Improved https://www.gao.gov/assets/690/688079.pdf

- **Temporary Closure** – Closure of the crossing to highway traffic during designated quiet periods;
- **Four Quadrant Gate System** – Fully blocking highway traffic from entering the crossing when gates are lowered;
- **Permanent Closure** – Permanent closure of the crossing to highway traffic;
- **One-Way Street with Gates** – Installation of gates in a manner that blocks all approaching highway lanes to the public highway-rail crossing;
- **Gates with Medians or Channelization** – Installation of medians of channelization devices on both highway approaches to a public highway-rail grade crossing; and
- **Wayside Horns** – Installation of a stationary horn located at the highway rail at-grade crossing designed to provide audible warning to motorists or pedestrians as to the imminent approach of a train (measure is not a true SSM but is viewed as a substitute for a locomotive horn).

Once the community completes all required engineering improvements related to safety, it must certify to the FRA that risk reduction has been completed to a level satisfying all compliance requirements. A quiet zone is not in effect until all safety measures are installed and operational.

In the event of a collision at a grade crossing located within an established quiet zone, court rulings will establish liability based upon factual evidence specific to the incident. FRA regulations regarding quiet zones are intended to remove failure to sound the horn as a cause of action in lawsuits involving collisions occurring at crossing within established quiet zone. Prior to crossing through a quiet zone, engineers have no legal duty to sound the train horn. Discretion may be exercised by the engineer during emergency situations. Per Federal regulations, an engineer must sound the horn to warn railroad maintenance or contracted personnel of its impending crossing.

7.3 Intermodal Facility Safety

Terminal automation, as referenced in the Future Technology Trends and Application Section, enhances safety for intermodal facilities by moving employees away from operations. These employees are moved within the command center and out of the way of automated equipment and vehicles. The Occupational Safety and Health Administration (OSHA) provides guidance for traffic safety within marine terminals; many of these principles would also apply to an intermodal terminal. These OSHA guidelines are not regulated but provide recommendations for the employees to reduce the number of accidents. None of the OSHA guidance identified specifically relates to intermodal facilities; however, the use of similar operating equipment away from the berth allows for similar recommendations as described herein.

Many work-related injuries and fatalities at marine terminals are the result of transportation incidents. As a result, OSHA recommends that marine terminal employers develop and implement traffic safety programs that focus on vehicles and container-handling equipment that travel within marine terminals such as forklifts, top picks, side picks, reach stackers, straddle carriers, hostlers, automobiles, vans, pickup

trucks, and semi-trucks.[24] Without specific guidance for intermodal facilities, there are safety measures that can be applied at intermodal facilities as shown in **Table 7.1**.

Table 7.1: OSHA Incident Factors and Prevention Tools

Potential Incident Factors	Examples of Incident Factors	Examples of Accident Prevention
Unsafe equipment	Broken, improperly maintained, or missing safety equipment, such as lights, seat belts, brakes, or horns	Mandatory safety checks pre- and post-inspection
Inadequate traffic controls	Lack of proper signage and lane markings	Functional traffic controls that are Maintained
Driving obstacles	Vehicles, stacked materials, containers, and even repair crews	Driver training and signage that is visible
Weather	Snow, ice, fog, or rain	Grooved pavement or rumble strips
Inadequate illumination	Poor lighting or shadows from large obstacles	Driver training and installation of lighting
Welding	Welding flashes can distract vehicle and crane operators	Arc-welding and cutting operations must be done in separate areas from where normal operations occur
Unsafe vehicle operation	Improperly loaded equipment and speed	Speed traffic controls and driver training
Distracted driving	Cell phones or completing paperwork	Driver training
Improper parking	Improperly parked personal or company-provided vehicles	Designated parking areas
Lack of communication	Technicians, mechanics, and other workers may fail to alert vehicle operators of their location, and employers may fail to notify workers of changes to traffic routes	Hold frequent safety meetings
Shift changes	Marine-terminal employers report that incidents often occur just before the end of a work shift	Hold frequent safety meetings
Fatigue	Fatigue and sleepiness	Employers should provide proper training related to fatigue to all employees
Substance abuse	Drug and alcohol use	Develop, implement, and monitor a drug-free workplace program

Source: OSHA

[24] https://www.osha.gov/Publications/3337-07-2007-English-07192007.html

To further illustrate the applicability of these safety measures, the SCPA has developed a safety brochure for their "terminals" - intermodal or seaport facilities. This SCPA brochure contains the following intermodal facility safety measures:

- Container stack safety - Do not walk or drive through openings in containers;
- RTG – After loading a truck, the truck must immediately leave the RTG area;
- RTG – Do not park or stand on RTG travel pads;
- Traffic safety vest – Everyone must wear a high visibility safety vest when working near containers or equipment;
- Container handling equipment – All personnel must remain a minimum distance of 40 feet from the equipment; and
- General traffic rules:
  - Terminal traffic signs and ground markings are to be obeyed by everyone;
  - Use marked roadways only;
  - Do not park in empty container stacks;
  - Park only in designated parking areas;
  - U-Turns are prohibited;
  - Never use a cell phone while driving, communicating with an operator, or while containers are being mounted or dismounted on a chassis or flatbed;
  - Obey all directions given by Port Police Officers;
  - Yield to all container handling equipment;
  - Yard trucks must obey all terminal traffic regulations; and
  - Equipment operators may not see you if you are in equipment blind spots. Only approach equipment if the operator stops operation and verbally directs you to approach.[25]

[25] https://scspa.com/wp-content/uploads/terminal-traffic-safety.pdf

Funding is often tight, with state, regional, and local agencies positioning select projects for funding. Federal discretionary grant programs are made available to assist in the planning, design, and construction of projects that promote in the movement of goods and directly benefit the freight industry. This section reviews five of these grant programs including information regarding the purpose of each grant, eligible project types, and specific information for each grant type.

Even projects that address much needed areas, such as truck parking, may not be selected for submittal for funding. It is important then that agencies do all they can to ensure a project will be positioned to not only be selected for submittal but has a chance of winning. This section therefore concludes with a case study of a rural rail rehabilitation project in the Carolinas that succeeded in winning a federal grant.

The five grant programs covered below include:

- Automated Driving System Demonstration Grant Program (ADS)
- Advanced Transportation and Congestion Management Technologies Deployment Grant Program (ATCMTD)
- Better Utilizing Investment to Leverage Development Grant Program (BUILD)
- Consolidated Rail Infrastructure and Safety Improvements Grant Program (CRISI)
- Infrastructure for Rebuilding America Grant Program (INFRA)

8.1 ADS

Automation offers the potential to improve safety conditions for vehicle occupants and other travelers sharing the road. To address this potential, the United States Department of Transportation (USDOT) appropriates funding for the ADS Demonstration Grants Program for a "highly automated vehicle research and development program".[26] Funding is made available for the planning, direct research, and demonstration of ADS and other driving automation systems and technologies. The USDOT has authorized $60 million in funding for the FY 2020 ADS Grant program.

Eligible project types include those that demonstrate automation, with preference for those demonstrating Level 3 or greater automation technologies. Level 3 indicates a level of automation where the driver is present to intervene if necessary, but safety-critical functions can be assigned to the vehicle itself. ADS projects can greatly benefit the freight industry and movement of goods by providing industry

[26] https://www.transportation.gov/policy-initiatives/automated-vehicles/ads-grant-overview

stakeholders with clear information on how to safely implement and benefit from ADS-equipped trucks, as an example.

Figure 8.1: CONOPS Virginia Tech ADS Grant Project

Source: https://www.transportation.gov/av/grants

The USDOT ADS Fact Sheet identifies the three primary goals of the ADS program:

- Safety: Fiscally support projects that demonstrate how challenges to the safe integration of ADS into the Nation's on-road transportation system can be addressed;
- Data for Safety Analysis and Rulemaking: Selected projects should be focused on significant data gathering and sharing of project data with USDOT and the public; and
- Collaboration: Create collaborative project environments that harness the collective expertise, ingenuity, and knowledge of multiple stakeholders.[27]

The USDOT has identified ADS program focus areas in order to help guide the project selection process. The seven primary focus areas include:

- Significant Public Benefit: Fund a select number of larger-scale projects that result in a significant benefit(s) to the public.
- Addressing Market Failure and Other Compelling Public Needs: Fund projects where industry lacks adequate incentives to participate. This includes areas where cost, risk, or complexity are too significant for any single private sector entity or where private sector investment has not proven sufficient to support particular groups.
- Economic Vitality: Recognizing Executive Order 13788, proposed projects must support economic vitality at the national and regional level, including advancing domestic industry and promoting domestic development of intellectual property.
- Complexity of Technology: Fund a collection of projects that demonstrate automation, with preference for demonstrating L3 or greater automation technologies.

[27] https://www.transportation.gov/policy-initiatives/automated-vehicles/ads-grant-award-fact-sheets

- Diversity of Projects: Fund a collection of projects that serve a variety of communities, including urban, suburban, and rural environments, and that serve a variety of transportation markets including freight, personal mobility, and public transportation.
- Transportation-challenged Populations: Fund projects that test applications with the greatest potential to service transportation-challenged populations, including older adults and individuals with disabilities.
- Prototypes: Fund projects that include technologies that are, at a minimum, in limited prototype state suitable to support safe demonstrations but do not need to be ready for broader deployment.

Examples of past, industry relevant ADS Grant award recipients include:

- Virginia Tech Transportation Institute – "Trucking Fleet CONOPS for Managing Mixed Fleets"
- Pennsylvania Department of Transportation – "Safe Integration of Automated Vehicles in Work Zones"

8.2 ATCMTD

Authorized in the FAST Act, the ATCMTD grant program makes competitive funding available for the deployment of advanced transportation and congestion management technologies to improve the safety of the transportation system. The process flow of these technologies is built upon the collection of real-time data which is relayed to travelers/carriers so they can make quick, informed travel choices. These types of technological improvements can assist in developing a more reliable and efficient system for the movement of goods by providing users with an accurate and real-time picture of current roadway and intermodal conditions. In 2019, $60 million in Federal funding was appropriated for the ATCMTD program.

The purpose of the ATCMTD grant program is to support candidate projects that reduce traffic related injuries and fatalities, reduce congestion, reduce emissions, optimize multimodal system performance, and provide real-time travel information. Candidate model technology deployment projects should help demonstrate how emerging transportation technologies, data, and their applications can be effectively integrated within existing systems, providing access to essential services and other destinations. The ATCMTD grant program projects should also increase connectivity to employment and education services, support workforce development, and contribute to community revitalization.

Eligible project types under the ATCMTD grant program include the following examples:

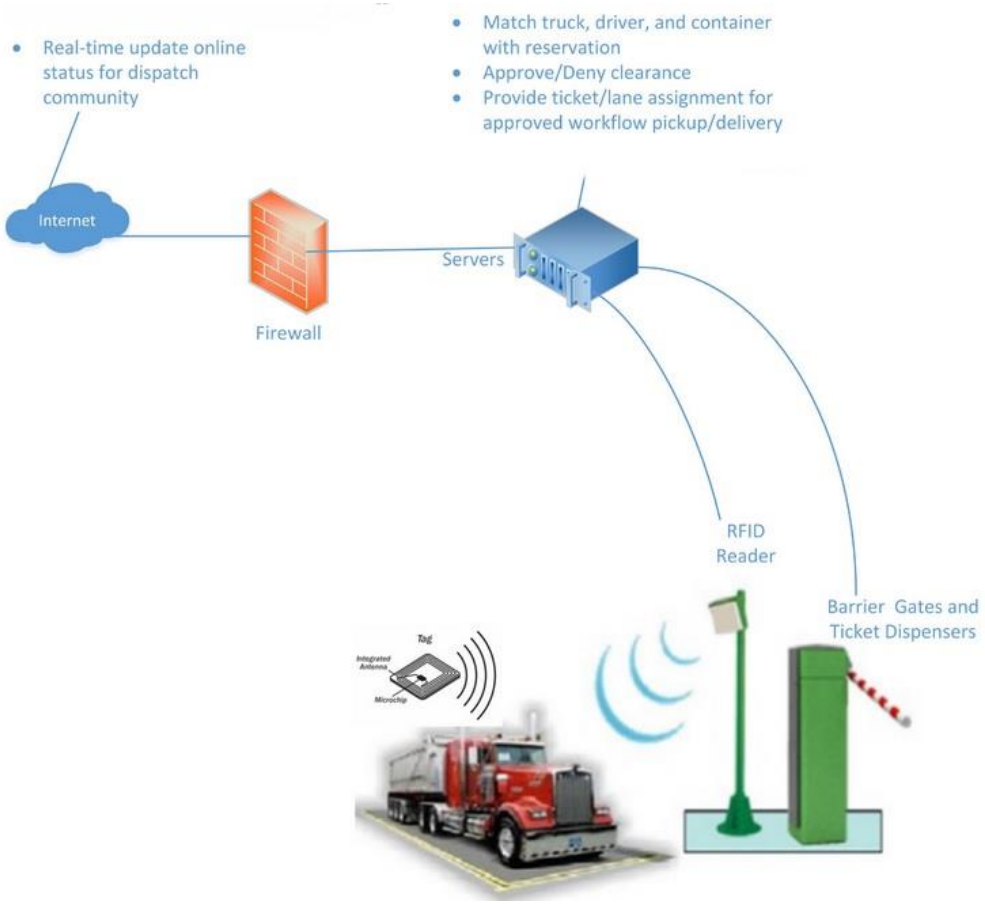
- Advanced traveler information systems;
- Advanced transportation management technologies;
- Infrastructure maintenance, monitoring, and condition assessment;
- Advanced public transportation systems;
- Transportation system performance data collection, analysis, and dissemination systems;

- Advanced safety systems, including vehicle-to-vehicle and vehicle-to-infrastructure communications;
- Technologies associated with autonomous vehicles and other collision avoidance technologies, including systems using cellular technology;
- Integration of intelligent transportation systems with the Smart Grid and other energy distribution and charging systems;
- Electronic pricing and payment systems; and
- Advanced mobility and access technologies, such as dynamic ridesharing and information systems to support human services for elderly and disabled individuals [23.U.S.C. 503(c) (4) (E)].

Examples of past, industry relevant ATCMTD Grant award recipients include:

- Virginia Port Authority – "Truck Reservation System and Automated Work Flow Data Model" (see **Figure 8.2**)
- City of Seattle DOT – "Multimodal Integrated Corridor Mobility for All"

Figure 8.2: VPA Truck Reservation Architecture



Source : https://ops.fhwa.dot.gov/fastact/atcmtd/2017/applications/portofva/project.htm

8.3 BUILD

The Better Utilizing Investments to Leverage Development (BUILD) transportation grant program directs federal funding for surface transportation infrastructure projects that will have a significant local or regional impact. Formerly named the Transportation Investment Generating Economic Recovery (TIGER) Grant, The FY 2020 BUILD program appropriated $1 billion, intended for projects that build, repair, and revitalize both freight and passenger transportation networks. This discretionary grant program directs capital investment for road, rail, transit, and port projects that directly achieve national objectives. The following are eligible project types under the BUILD grant program:

- Highway, bridge, or other road projects eligible under title 23, U.S.C.;
- Public transportation projects eligible under chapter 53 of title 49, U.S.C.;
- Passenger and freight rail projects;
- Port infrastructure investments (inland port infrastructure and land ports of entry); and
- Intermodal projects.

Given the flexibility of eligible project sponsors (e.g., municipalities, counties, port authorities, tribal governments, MPOs) BUILD grants enable multi-jurisdictional projects that are more difficult to support though the means of traditional USDOT programs. This is significant in that it broadly invites federal participation in port and freight rail projects that play a critical role in the ability to move freight and goods but have limited opportunities for federal funds. BUILD allows traditional partners at the state and local levels to work directly with entities that own, operate, and maintain much of the nation's transportation infrastructure.

BUILD grants additionally offer unique consideration for rural applicants. Fifty percent of all FY 2020 BUILD grant awards are reserved for rural projects that align with the merit criteria of the BUILD Grant program. Through BUILD, the USDOT is seeking to invest in rural projects addressing deteriorating conditions and disproportionately high fatality rates on rural transportation infrastructure. Example projects include those that improve infrastructure condition, address public health and safety, promote regional connectivity, and facilitate economic growth or competitiveness.

Examples of past, industry relevant BUILD Grant award recipients include:

- **South Carolina Ports Authority** – "Expansion at the Inland Port Greer and of the NS Carlisle Passing Siding"
- **Pinal County Arizona** – "Inland Port Infrastructure"

8.4 CRISI

The CRISI Grant program has been developed to fiscally support safety enhancements and general improvements to infrastructure for both freight and intercity passenger railroads. USDOT recognizes the importance of planning for life cycle asset management related to America's transportation infrastructure. Over $311 million dollars were made available in FY 2020 for eligible projects under the CRISI Grant program.

According to the CRISI Notice of Funding Opportunity (NOFO), the US rail network carries more than 1.8 billion tons of freight, valued at nearly $800 billion, and carries over 31.7 million passengers on intercity railroads annually. These figures demonstrate the critical role that rail infrastructure plays in the functions and growth of the nation's economy. Industry depends on the transportation network to move goods and facilitate the movement of workers responsible for their production. Properly functioning highways, railways, and ports reduce the costs of doing business as well as the burdens associated with commuting.

CRISI Grants allow for federal investment in a wide range of projects that improve railroad safety, efficiency, and reliability; mitigate congestion for both intercity passenger and freight rail bottlenecks; enhance multi-modal connections; and lead to new or substantially improved intercity passenger rail transportation corridors. Examples of project types that are eligible for CRISI funding include:

- Deployment of railroad safety technology;
- Capital projects, as defined in section 49 U.S.C. § 24401(2) for intercity passenger rail service;
- Capital projects that:
  - address congestion challenges affecting rail service,
  - reduce congestion and facilitate ridership growth along heavily traveled rail corridors, and/or
  - improve short-line or regional railroad infrastructure;
- Highway-rail grade crossing improvement projects;
- Rail line relocation and improvement projects;
- Regional rail and corridor service development plans and environmental analyses;
- Any project necessary to enhance multimodal connections or facilitate service integration between rail service and other modes; and
- The development and implementation of a safety program or institute.

The CRISI Grant program enables multiple partners to seek and apply for funding. Eligible applicants include states and groups of states; public agencies; Amtrak and other intercity passenger rail providers; Class II or Class III railroads or their holding companies; and rail carriers or rail equipment manufacturers in partnership with a state, municipality, or public agency.

Examples of past, industry relevant CRISI Grant award recipients include:

- **Georgia Department of Transportation** – "Heart of Georgia Class III Railroad Corridor Connection from Central Georgia from Cordele Inland Port at I-75 and Port of Savannah"
- **City of Minot** – "Intermodal Facility Improvements"

8.5 INFRA

INFRA Grant funding is intended to provide Federal financial assistance for projects improving the safety, efficiency, and reliability of the movement of freight and people; improve connectivity between modes of freight transportation; and address the impacts of population growth on the movement of people and freight. Funding is targeted for improvements of national or regional significance on major highways, bridges, ports, and railroads. In 2020, USDOT authorized $906 million dollars in federal funds for INFRA eligible projects.

The INFRA Grant program codifies a commitment to fix our national infrastructure by enabling a pathway for all levels of government and the private sector to use innovative project funding methods for building significant projects. Eligible project recipients include: a state or group of states; metropolitan planning organization with a population of more than 200,000; local government or group of local governments; political subdivision of a state or local government; special purpose district or public authority with a transportation function – port authority; Federal land management agency jointly applying with a state; tribal government; or group of public entities.

Safety is the top priority for USDOT and a major consideration within the INFRA Grant program. All projects that receive INFRA awards must consider and effectively respond to data-driven transportation safety concerns. Each project must perform detailed safety analysis and incorporate project elements that respond to state-specific safety priority areas. Along with its focus on improving safety, USDOT has identified four primary objectives that INFRA projects should accomplish:

- Supporting economic vitality at the national and regional level,
- Leveraging Federal funding to attract non-Federal sources of infrastructure investment,
- Deploying innovative technology, encouraging innovative approaches to project delivery, and incentivizing the use of innovative financing, and
- Holding grant recipients accountable for their performance.

An example of a past, industry relevant INFRA Grant award recipient is:

- **Southeast Arkansas and Northeast Louisiana** – "Multimodal Freight Corridor Improvements"

8.6 Case Study: Moving the Carolinas Forward

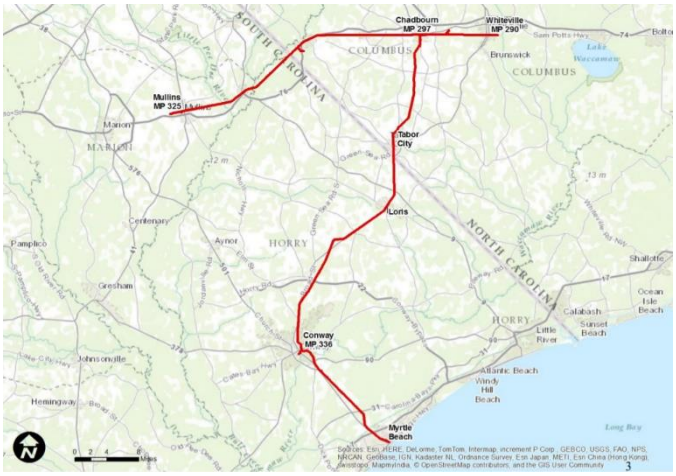
8.6.1 Summary

The Moving the Carolinas Forward rail rehabilitation project is a rural rail rehab project that renovated a disused rail line in North and South Carolina. It offers lessons learned for identifying and nominating a freight project for competitive federal grant programs.

The Carolina Line had been out of operation since 2011 and was purchased by R.J. Corman Railroad in 2015 for renovation. The purpose of the renovation was to provide better options to local businesses to transport commodities across the eastern South Carolina and North Carolina communities. As shown in

Figure 8.3, the rail lines run from Myrtle Beach, SC to Chadbourn/Whiteville, NC, then to Mullins, SC. The project connects to the Carolina's I-95 Mega Site, which was where the Inland Port Dillon, SC was opened.

Figure 8.3: Moving the Carolinas Forward Rail Map



Source: Horry County Government TIGER Grant Application

Before rehabilitation, the rail line had a service limit to 10 miles per hour, which was neither optimal nor efficient for moving rail traffic. The overhaul of the freight rail lines resulted in an increase to 25 miles per hour. The increase in rail traffic will lead to an economic rejuvenation for rural communities, with 200 permanent railroad jobs created at railroad terminals and distribution facilities along the corridor, as well as $7.8 million in yearly local tax revenue for cities along the corridor.

In addition to the economic benefits of the project, 39 railroad crossings were updated to increase safety for motorists along these routes.

To improve the railroad condition, Horry County Government applied for a Transportation Investment Generating Economic Recovery (TIGER) Grant. The construction costs were estimated at over $17.5 million:

- $9.8 million from the TIGER Grant
- $4.3 million from the South Carolina Department of Commerce, Marion County, SC, and Columbus County, NC
- $3.5 million from R. J. Corman

By identifying not only improvements to the railroad corridor itself, but to the safety and economic rejuvenation of rural communities in North and South Carolina, the project was positioned to win, with more than half of the costs being covered by the federal government.

8.6.2 Applicability to ACOG Region

Through identifying needs within the ACOG region, public and private entities can partner to develop projects that can be successfully implemented through funding from the federal government. Example focus areas for the ACOG region include rail corridors in need of repair, lines where double-stacking can be implemented for greater rail economic efficiency, or where safety issues currently exist.