BCD REGIONAL FREIGHT MOBILITY PLAN

APPENDIX B

Technical Memorandum

Freight Planning Best Practices and Emerging Technologies

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BCDCOG
BERKELEY-CHARLESTON-DORCHESTER
COUNCIL OF GOVERNMENTS

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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 a region with a largely trade-driven economy, the Berkeley-Charleston-Dorchester Council of Governments (BCDCOG) has been proactive in identifying and addressing freight needs while preserving regional quality of life. However, continued growth in freight and passenger movement is contributing to ongoing concerns about congestion, pollution, and safety. Not all these issues are addressable through traditional means given funding constraints and the difficulty in planning and building large infrastructure projects. 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 BCD 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 BCD 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, intermodal terminal automation trends, and truck gate appointment systems that may impact goods movement planning in the BCD 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 marine terminal and railroad safety and security best practices
- **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 CITIES 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 BCDCOG may wish to explore:

- **Gateway Cities (Los Angeles/Long Beach) –** Although much larger in population and cargo volume, Southern California sees similar issues of freight congestion, safety, and emissions to those found in the BCD region. Expanding infrastructure has become difficult in the Gateway Cities, leading them to deploy new technologies through the DrayFLEX program to mitigate the impacts.

- **Hampton Roads Transportation Planning Organization (HRTPO) Regional Freight Study –** HRTPO is the metropolitan planning organization (MPO) for the Hampton Roads, Virginia region. In 2017, the HRTPO developed a regional freight plan that contains best practices in harbor deepening, cross-harbor barge service, a dedicated port access interchange, and mitigating intermodal conflict points.

- **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 GATEWAY CITIES DRAYFLEX PROGRAM

2.1.1 Summary

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;[1] the Port of Long Beach handled over 7.6 million containers in calendar year 2019.[2] 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.

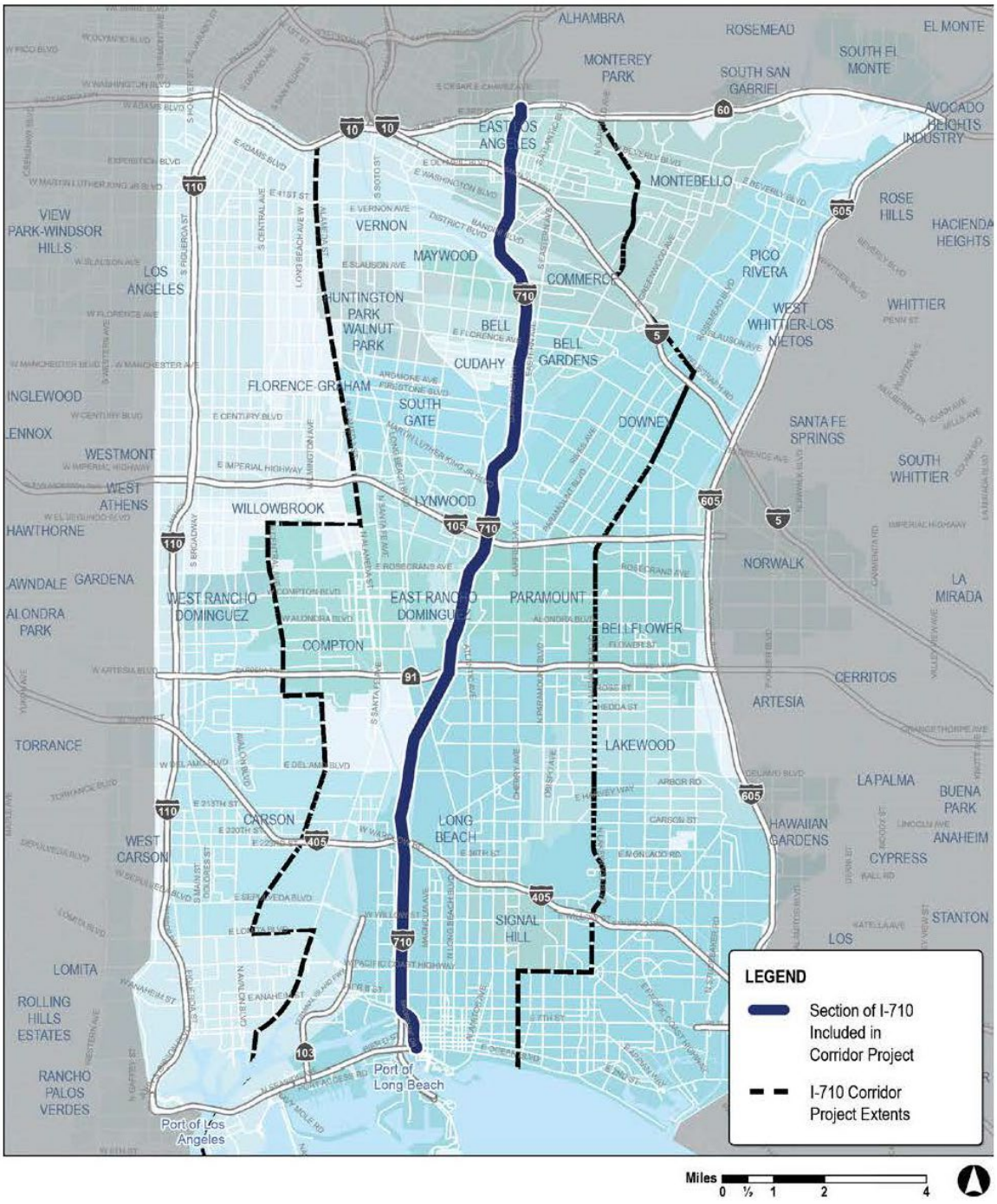
The Drayage Freight and Logistics Exchange (DrayFLEX) program is deploying ITS technology in the region to address these issues. The overall program goals are to:

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

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

Figure 2-1 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.

Figure 2-1: DrayFLEX Project Area



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

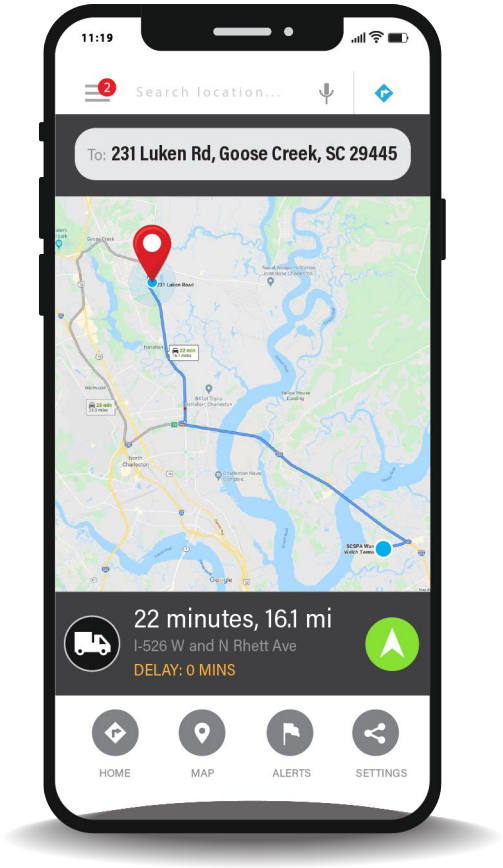
2.1.2 Regional Freight Planning Best Practices

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.

- **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 2-2)** 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 then 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 2-2: Conceptual DrayFLEX Trip Routing

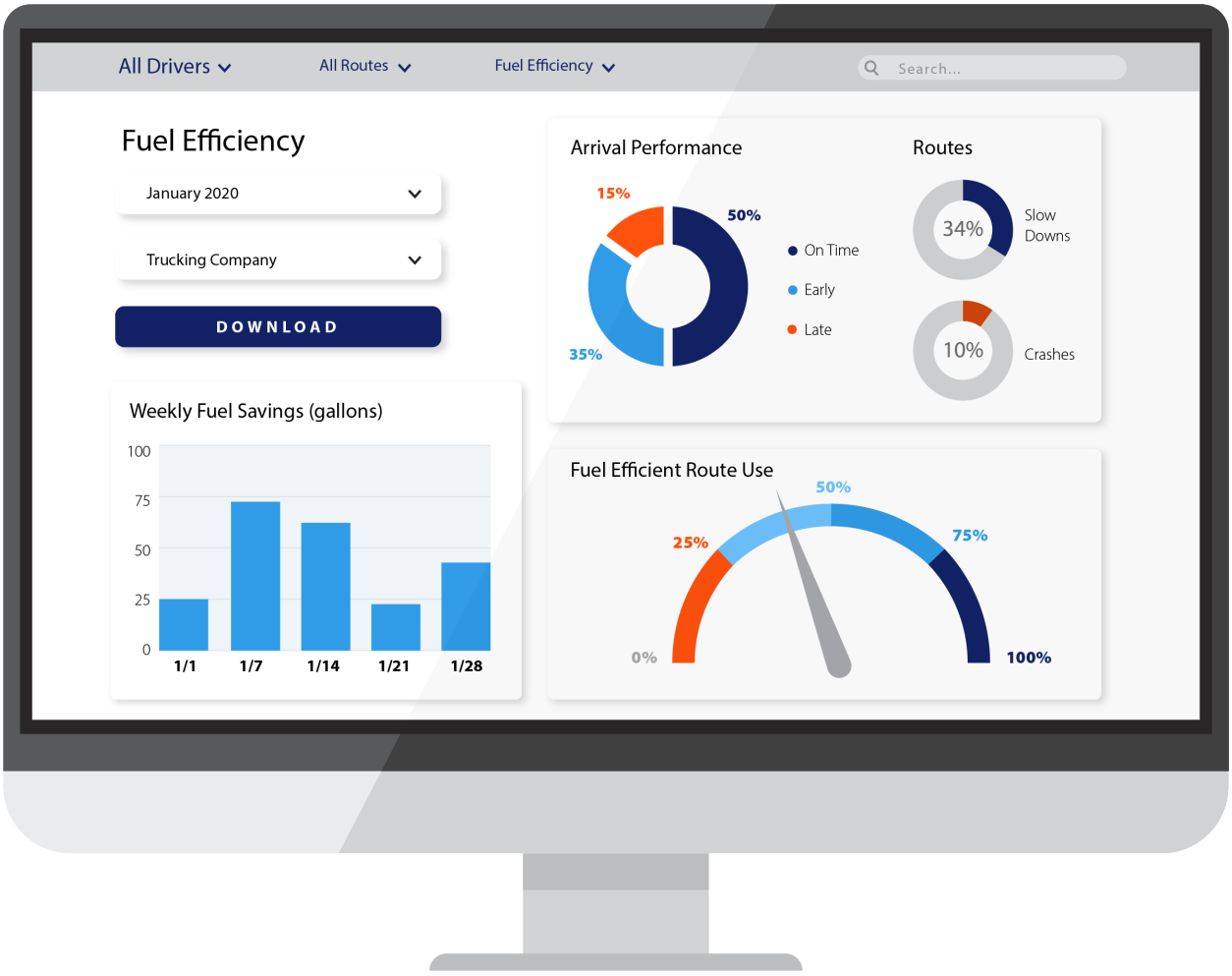


Source: CDM Smith

DrayFLEX was designed to integrate with Los Angeles 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 2-3**).

Figure 2-3: Example Performance Dashboard



Source: CDM Smith

As the largest container port complex in the western hemisphere, LA/Long Beach clearly handles a much larger volume of freight than the BCD region. Still, there are similarities and lessons learned that the BCD region can consider:

- DrayFLEX is designed to help mitigate some of the same issues (congestion, safety, air quality) that are increasingly occurring in the Charleston region, especially with ongoing truck freight growth on I-26 and I-526. Such growth has created challenges, but it also creates opportunities for innovative solutions. To capitalize on the growing freight volumes moving between Charleston and the Upstate, BCDCOG could partner with SCDOT and other agencies like the Appalachian COG to conceptualize, develop, and deploy a technology solution that improves freight operations.

- Involving industry to understand their needs is key to a successful project. This will allow for a user needs-based approach that is more likely to be adopted by carriers and drivers. The DrayFLEX program incorporated private terminal and trucking company feedback and needs from project inception. It's important to work with private sector partners both

in the conceptual stages and when the project moves towards field deployment. Depending on the scope of the project, this may involve integration with private terminal management and logistics company systems. Such buy-in and participation also helps secure federal funding, as a grant application that already has support from private partners is more likely to receive an award.

- Deployments should be designed to integrate with state and regional ITS resources. The DrayFLEX Trip application was designed to rely on publicly available data and does not require integration with private logistics firm management systems. This approach ensures the application can provide useful information for truckers with minimal deployment effort, thus maximizing participation.

2.2 Hampton Roads Transportation Planning Organization (HRTPO) Regional Freight Study

2.2.1 Summary

HRTPO is the federally designated MPO that funds and plans transportation projects in the Hampton Roads, Virginia region. HRTPO completed a Regional Freight Study in 2017 which looked at best practices including harbor deepening, container on barge service, and a dedicated port access interchange. It also looks at rail best practices, specifically identifying intermodal conflict points (e.g., grade crossings).[3]

2.2.2 Regional Freight Planning Best Practices

Harbor Deepening

Since the advent of containerized shipping in the 1950s, container ship size and capacity has steadily increased. Today's largest vessels are 1,300 feet long, require a draft of about 52 feet, and can carry up to 21,000 TEUs. Many ports including Charleston and the Virginia Port Authority (VPA)are deepening their harbors to accommodate such ships.

Larger vessels are used to move a greater number of containers and decrease the number of trips traveling across the ocean between ports. While the increased capacity of moving goods is vital, ports must be able to accommodate the larger vessel sizes, ensure efficiency of loading and unloading containers, and maintain functionality of the transportation network surrounding the port. Larger vessels and increased containers per vessel require strategic planning by the Port to ensure efficient operability to turnover their storage areas. Tactics to accommodate larger vessels may include gate or yard automation, truck gate appointment systems, or other operational changes aside from infrastructure changes. To address these concerns, the HRTPO Regional Freight Study emphasized improvement projects such as upgrading handling equipment, optimizing and expanding terminals (including the Richmond Marine Terminal), encouraging critical rail and highway improvements, and promoting the Richmond Express barge service. These types of investments inside and outside the port gates ensure that cargo operations remain efficient as vessel size and total volumes increase.

Container-on-Barge Service

VPA leases the Richmond Marine Terminal (RMT) from the City of Richmond, Virginia, one of six terminals that together comprise the Port of Virginia (POV). Operations are handled at RMT by

[3] https://www.hrtpo.org/uploads/docs/Regional%20Freight%20Study%20Update%202017%20Update%20-%20FINAL(new).pdf

the VPA, and the terminal is sited upon 121 acres of land along the James River. Since 2008, container-on-barge service has operated between Hampton Roads and Richmond. The HRTPO Regional Freight Study discusses the 64 Express, a container-on-barge service, which moved 19,602 containers during 2016 between Hampton Roads and RMT. The 64 Express reduced round-trip truck trips by 39,204 within the region in 2016.

The 64 Express served both the POV and other private customers, while its replacement, the Richmond Express container-on-barge service, is solely dedicated to freight moves between the POV's Hampton Roads terminals and the POV's RMT (see **Figure 2-4**). The Richmond Express' barges have the same container capacity as did 64 Express, but their customized barges used are wider and longer, which assists with loading and unloading operations by providing additional clearance for lift equipment. The new barge also allows stacking capabilities for refrigerated containers.

Figure 2-4: Richmond Express

Source: Maritime-Executive.com

Barging containers helps the POV in several ways. In 2007, the last ocean carrier customer cancelled service to RMT, and the terminal was in a state of decline.[4] The barge service provided the opportunity to move freight between terminals which allowed the POV to reinvest in the terminal with new equipment. RMT also reduced diesel emissions from trucks within the Hampton Roads region by shifting those moves to Richmond. The degradation of roadways within the Hampton Roads region is reduced by eliminating roundtrip truck moves. Similarly, container space at the Hampton Roads terminals would become available and can help eliminate a percentage of truck turns that would need to come through the port gates. This reduction in truck turns reduces truck queuing at the port gates and terminal congestion attributed to trucks.

[4] https://richmond.com/business/barge-service-and-other-improvements-at-richmond-marine-terminal-sparking-shipment-growth-new-economic-investments/article_83b68f4c-afc9-51d9-b37c-bff72be58aeb.html

Dedicated Interchange

The Virginia International Gateway (VIG) is a VPA terminal that operates on 576 acres with a throughput capacity of approximately two million twenty-foot equivalent units (TEUs) per year. The VIG has a dedicated diamond interchange on the Western Freeway (State Route 164) serving as the primary employee and truck access point for the Virginia International Gateway Port facility. The interchange, as shown in **Figure 2-5**, has access to Interstate 664, US Route 17, and US Route 58. This dedicated interchange moves truck freight in and out of the port expeditiously and prevents freight movement on local roads.

Figure 2-5: VIG Dedicated Interchange

Source: NearMap

Identifying Intermodal Conflict Points

The HRTPO Regional Freight Study identified rail intermodal conflict points as highway crossings and railroad drawbridges. A conflict point is where a train has the potential to collide with a pedestrian, automobile, or a water vessel. There are 296 highway-railroad at-grade crossings (at-grade crossings) and six railroad drawbridges in the Hampton Roads region. At-grade crossing accidents decreased in the Hampton Roads region between 2007 and 2016. Safety improvements to at-grade crossings in the Hampton Roads regions include eliminating at-grade crossings and upgrading and building grade separated crossings as shown in **Figure 2-6**.

Figure 2-6: Grade Separated Crossing in Hampton Roads Region

2.2.3 Applicability to BCD Region

The HRTPO study contains several best practices potentially applicable to the BCD region:

- **Harbor deepening –** The South Carolina Ports Authority is deepening Charleston Harbor to 52 feet to accommodate modern container vessels. This will allow such ships to call at the port's terminals at any time of day, regardless of tides. While this will improve the port's competitive position, it will also lead to traffic surges as ships discharge containers, putting strain on landside operations inside and outside the port gates. Stakeholders including BCDCOG, South Carolina State Ports Authority (SCPA), and South Carolina Department of Transportation (SCDOT) will need to work together to ensure cargo continues to move efficiently within and outside the port. This may involve operational improvements like gate/yard automation, truck gate appointment systems, upgrades to container handling equipment, encouraging landside road and rail improvements, and investing in alternate modes for moving cargo between terminals (e.g., barge service).

- **Barge service –** As noted in the *Network Assessment Technical Memorandum*, the Port of Charleston is planning for a potential cross-harbor container-on-barge service that would transfer containers between the Wando Welch and Hugh K. Leatherman terminals for further distribution via the new Navy Base Intermodal Facility. This service could move up to 200,000 containers per year, which would reduce truck demand on I-526 and local connecting routes. The Port and BCDCOG could look to the Richmond Express for elements that contribute to a successful service and potential ways to measure benefits (e.g., emissions reduction, reduced road wear, congestion mitigation).

- **Dedicated interchange –** As Port of Charleston volumes continue to grow, it will be important to manage and plan for landside road access needs. Having a dedicated interchange to facilitate smooth and efficient truck flows between the port and the road network can ensure continued efficiency and separate truck traffic from local roads as much as possible. The proposed Port Access Road between the Hugh Leatherman terminal and I-26 will fulfill this need for the new container terminal, but other port terminals may benefit from such an improvement if warranted by traffic levels. A direct connection from I-526 to the Wando terminal should be a consideration during the development of the I-526 Lowcountry Corridor EAST project currently in the development of a planning and environmental linkages study by SCDOT.

- **Identifying intermodal conflict points –** The *Network Assessment Technical Memorandum* identified key grade crossing conflict points in the BCD region. This is a good starting point for identifying candidates for grade crossing separation or closure, which would promote safety and more efficient traffic flows.

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 planned 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.

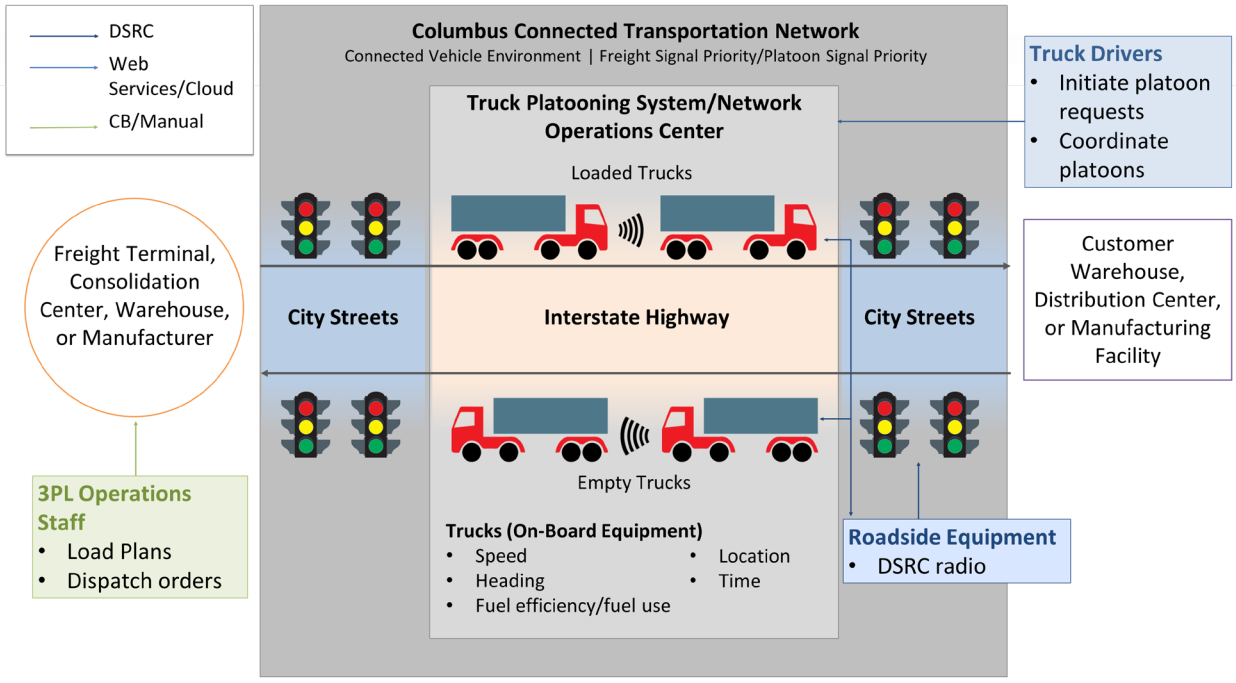
2.3.2 Regional Freight Planning Best Practices

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 2-7**). 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.

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

Figure 2-7: Smart Columbus Truck Platooning and Freight Signal Priority Concept



Source: CDM Smith

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 2-8**) 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.[5]

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.

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."[6] 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

[5] https://www.smartcolumbusos.com/
[6] https://columbusregion.com/onecolumbus/

Figure 2-8: Smart Columbus Operating System Concept

Source: Smart Columbus

- 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 BCD Region

There are many potential lessons for the BCDCOG 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),*" 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 vehicle 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 currently 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 autopilot, 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

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 to produce 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 or railroad elements. Many technologies listed below 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 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 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 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 include 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. This 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.[7] Transportation 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, and within the BCD region.

This section reviews recent and ongoing real-life case studies that are relevant for the BCD 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
  - **Automation and Detection:** The Automated Driving Systems project in Ohio/Indiana
- **Automated Vehicle Technologies** – The following technologies are described, with potential implications for the BCD 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.

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

[7] 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

prevention, environmental benefits, and continuous real-time data sharing and performance monitoring.[8] These communications are supported by a variety of technologies, though the primary types being 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
- 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 for 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

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

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.[9] In 2018, having upgraded multiple intersections with Caltrans 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.[10] 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:

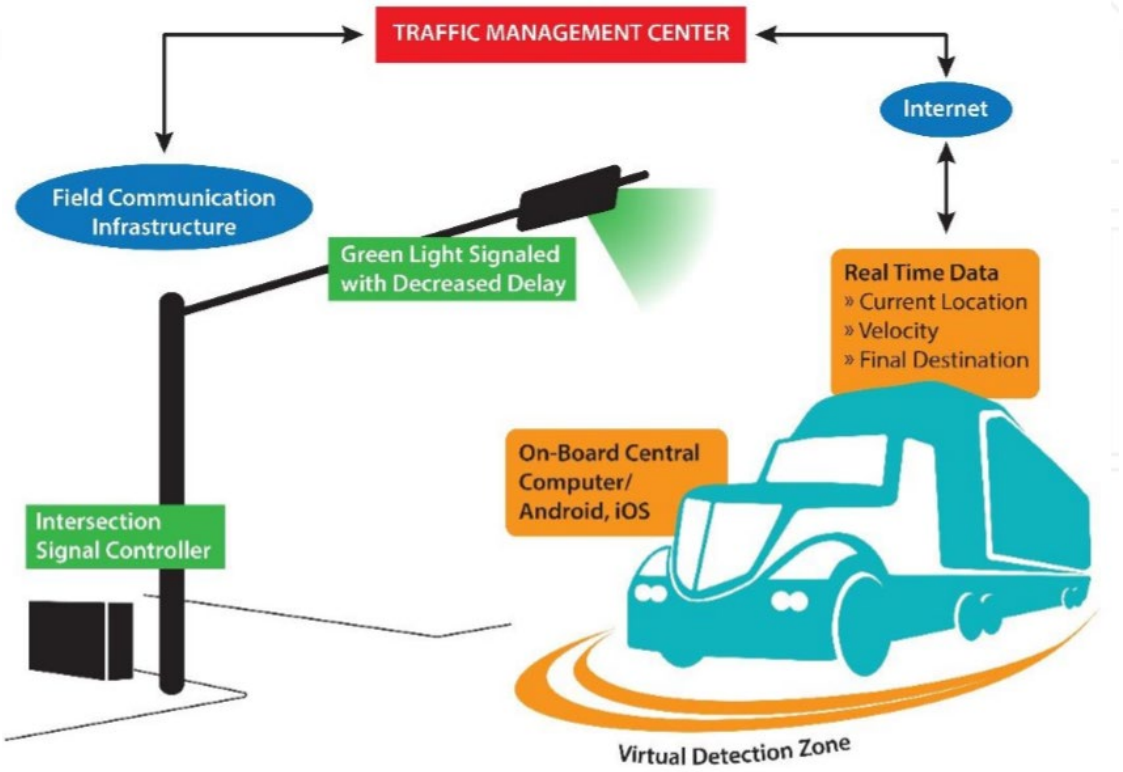
- FDOT
- Miami-Dade Transportation Planning Organization
- Miami-Dade Department of Transportation and Public Works
- City of Doral
- Florida Trucking Association

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**.

Based on analysis conducted, the implementation of the freight signal priority will result in a 7 – 10 percent decrease in delays, and corridors with dynamic signals will experience a 14 – 20 percent 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.

[9] https://www.miamidade.gov/releases/2017-07-28-dtpw-300-smart-signals.asp
[10] 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

Figure 4-2: ITS Communication for Freight Signal Priority



Source: Florida Department of Transportation

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 percent came from three Tollway-owned vehicles that traverse the two corridors regularly; the remaining 19 percent 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

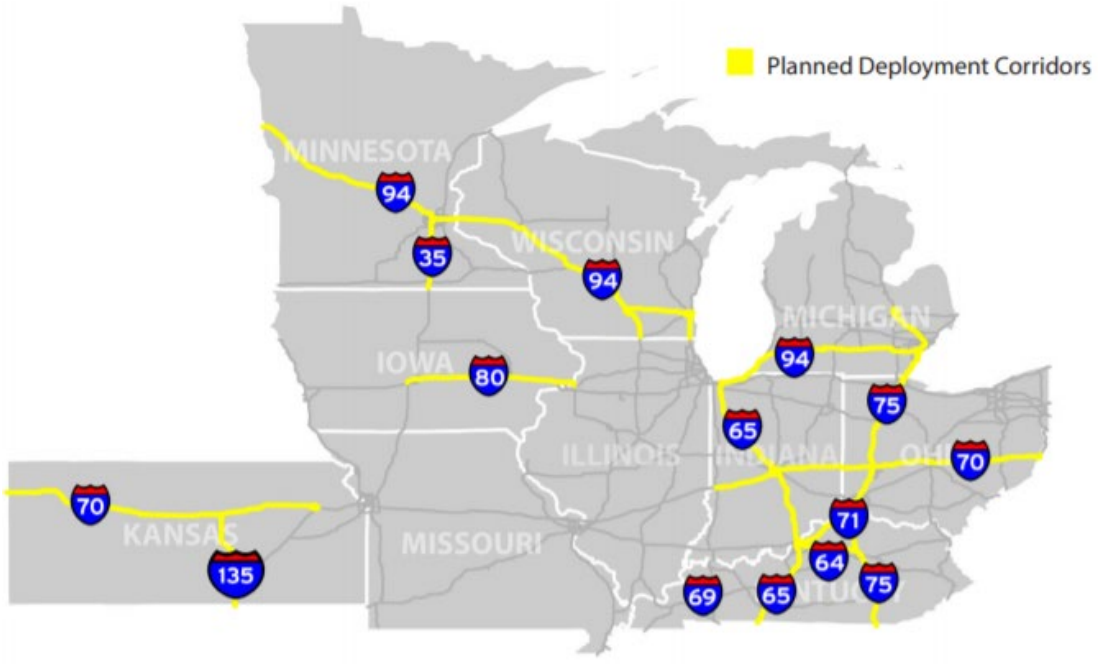
- More CV trips were detected on I-294 in only four months than on I-90 for the entire year, indicating that additional RSUs should be constructed on I-294 since it appears to have higher market penetration of CVs

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 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**.

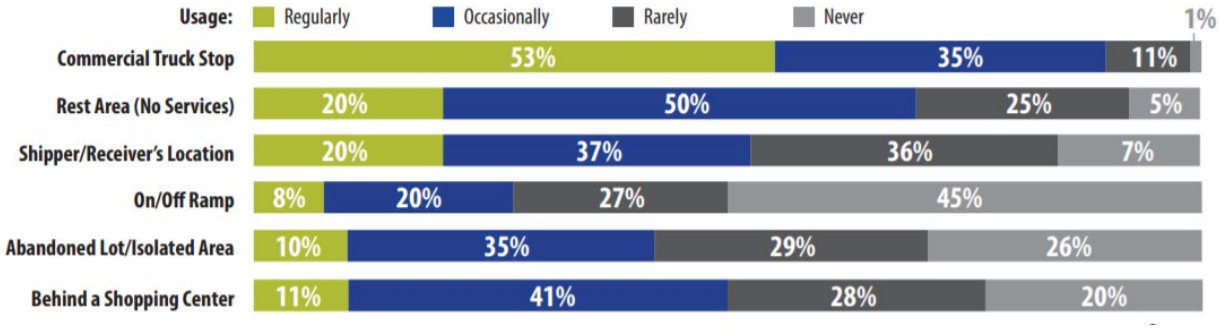
Figure 4-3: Truck Parking Deployment Corridors



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

Studies show that in 2013, 83 percent 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 4-4: Where Truckers are Parking



Source: KDOT TIGER Grant Application

The focus of the grant was to create a TPIMS 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 (2020)

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 $25 million 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 Michigan Department of Transportation 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 the BCD 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.

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.

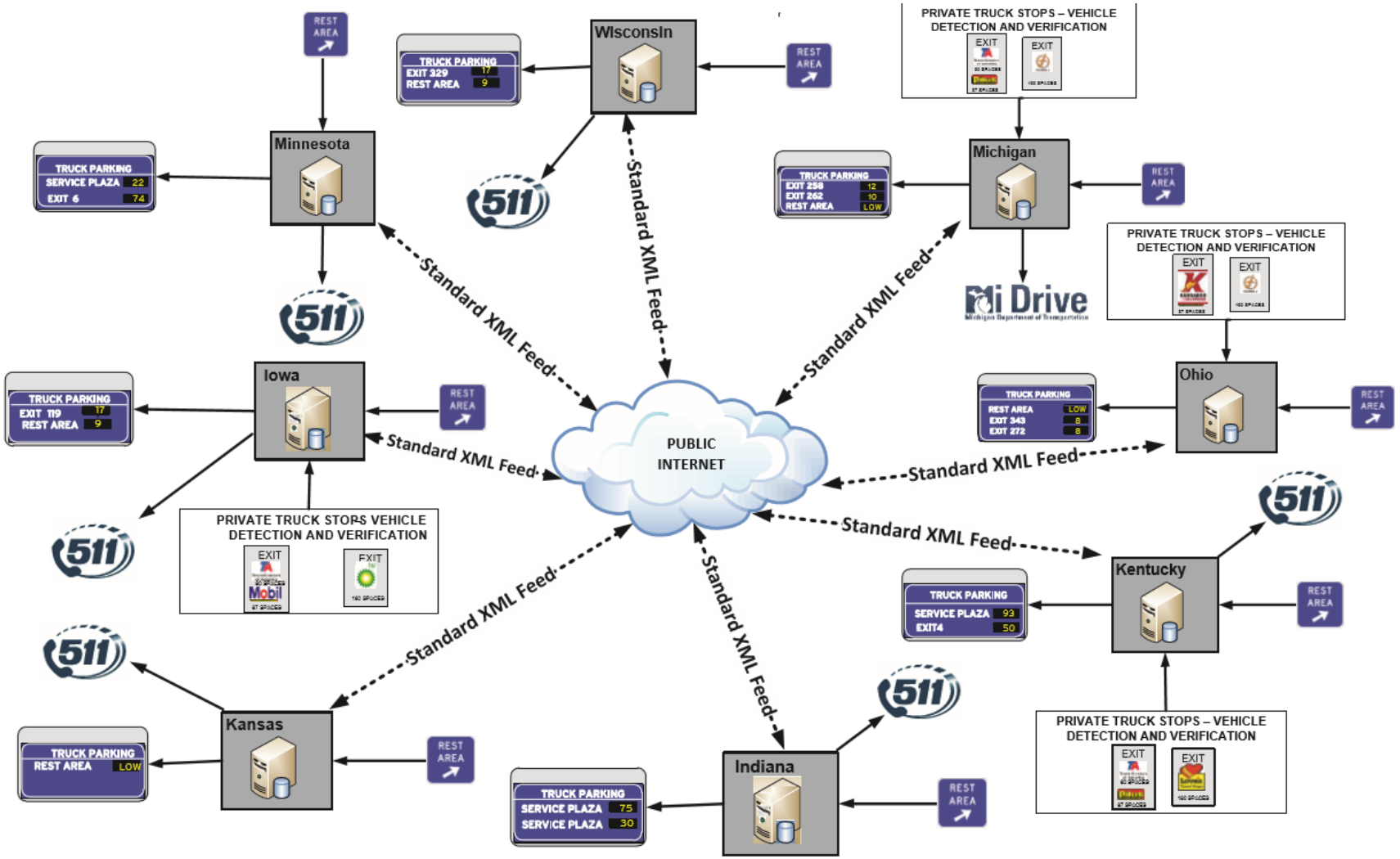
Each deployment in the program is to be supported by a robust system engineering effort, designed to be fully compliant with USDOT requirements for technology deployments. This includes test planning and preparation, data collection and privacy protocols, and testing in a controlled track environment and in the field. It also involves an outreach program designed to educate the public and encourage and 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 or other proprietary information will be protected. This could include a requirement to obtain human use approval from an Institutional Review Board.

Figure 4-5: Information Sharing Between Regional Mid-West Association of Governments



4.1.3 Applicability to BCD Region

Connected Vehicles

The success of connected vehicles within the BCD 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 BCD 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-526. 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 BCD 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, such as I-26.

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 from warehouse/intermodal facilities could also be conducted to find the limits for how far truck drivers can travel.

4.2 AUTOMATED VEHICLE TECHNOLOGIES

4.2.1 Positive Train Control

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

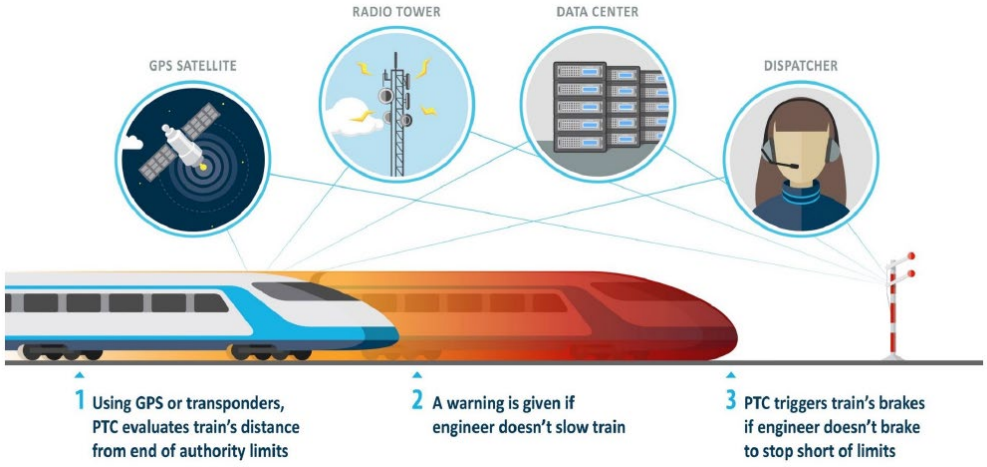
maintenance; and prevent trains from moving through a track switch left in the wrong position[11]. Implementation of PTC is the result of substantial financial investment and collaboration among railroad industry partners. PTC systems will not prevent accidents caused by track or equipment failure, improper 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 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 4-6** 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 4-6: Positive Train Control Infrastructure



Source: Amtrak

The rail network in the United States is comprised of both privately and publicly owned rail lines, serving the interests of both freight and passenger and 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

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

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 percent 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 ports and terminals have emerged, leading to a gradual shift towards automation in all process flows and port operations. Implementing automation encompasses port equipment purchases, operations, and civil design choices. More efficiently and densely stacked containers help to increase facility capacity through reduced container dwell time (**Figure 4-7**).

Figure 4-7: 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 ship docking, and maintenance are all examples of the big-picture of automation. There are three primary principal areas of port automation, to include:

- Gate Automation;
- Ship-to-Shore Crane 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.

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 port planning of new or existing facilities.

Automation technology has been a critical factor in improving efficiency and productivity at ports. This goal of operational efficiency focuses on limiting the amount of time and physical space resources used to perform a function. Sensors and other electronic equipment increase the productivity rate of conventional process flows. Manual errors and delays are eliminated, to the greatest extent possible, thus increasing the number of ships that a port can handle, 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 port. 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.

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. Adoption of an automated, paperless gate system at the VPA marine terminals in the HRTPO region plans to reduce each truck gate entry by four minutes.[12] 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.

Terminal Equipment and Operating Systems

As of March 2018, there were only 30 terminals in the world that could be considered fully automated in terms of container operations. Automated ship to shore cranes take containers off a ship and place them on the ground where a straddle carrier, or an automated guided vehicle

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

(AGV), can then move them to the stacking area (**Figure 4-8**). 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.

Figure 4-8: Automated Container Operations

Source: heizerrenderom.wordpress.com

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 BCD Region

PTC implementation will continue to be driven by the railroads in response to the Congressional mandate. As such, BCDCOG 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 does not have to be limited to PTC. For instance, BCDCOG 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 BCDCOG to work with SCPA officials to mitigate issues that may arise from changes to terminal operating procedures.

4.3 TRUCK GATE APPOINTMENT SYSTEMS

4.3.1 Background

Dockside operations at container terminals have become very efficient in servicing vessels with high container volumes. However, trucking operations that facilitate the inland movement of goods are largely dependent on a port's commitment to optimize processes that maintain a consistent flow of goods from the terminal and onto local roadways. According to the US Federal Maritime Commission[13], elimination of the congestion at our nation's ports is among the most crucial trade-related issues. Bottlenecks in port operations are often the result of extended queues at port gates. Historically, third-party motor carries lined up on local roadways and highways in the vicinity of a facility, impacting commuter congestion and increasing idling emissions. In response, Truck (gate) Appointment Systems (TAS) are being implemented at ports worldwide with these primary objectives:

- Minimize the length of the gate queue (**Figure 4-9**);
- Increase the effectiveness of container yard equipment;
- Densify terminal capacity within the same footprint;
- Reduce truck idling; and
- Reduce peak-hour traffic congestion on roadway networks.

Figure 4-9: Truck Queues at Container Yard Gate

Source: Container-news.com

A TAS encompasses a connected network of technologies allowing truck drivers to request specific pick-up and delivery windows from a facility. A TAS provides drivers' access to real-time operational data related to truck turn times, visibility to which terminal(s) are accepting empty and export containers, visibility of chassis availability, and more. This access to information facilitates positive operational effects in terms of a more balanced arrival of trucks at entry gates and other operations. Reduction in time spent at terminal gates and increased opportunity for a

[13] https://www.trucks.com/2017/03/28/ports-truck-drivers-shipping-container-appointments/
Ports, Truck Drivers Testing Appointment Systems 2.0 for Shipping Container Pickups

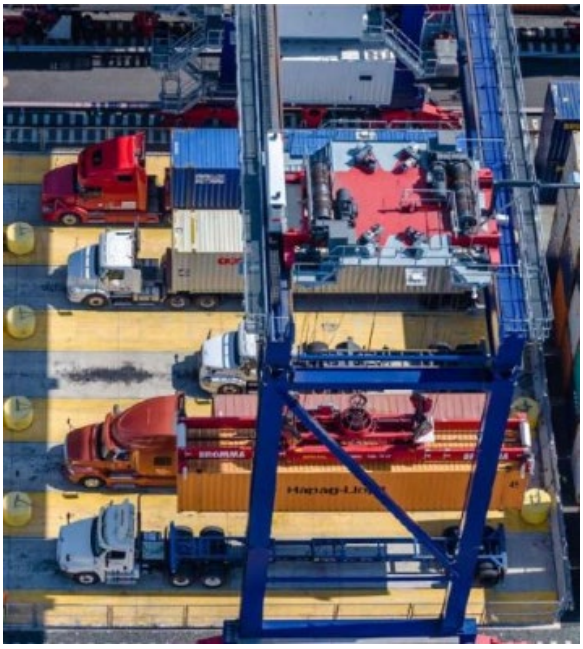
double-turn (arriving and departing the facility with a container) results in net increases in cargo throughput and profit-per-trip as well as mitigates environmental issues from idling emissions.

Port terminals in Seattle, Oakland, Los Angeles, Long Beach, and New Jersey were among the first in the U.S. to adopt TAS, built-on cloud-based services, mobile applications, and other technologies for the purpose of booking container pickup and delivery appointments.

4.3.2 Port of New York and New Jersey Global Container Terminals Appointment System

The Environmental Protection Agency (EPA) conducted a case study for appointment systems at the Global Container Terminals (GCT) facility at the Port of New York and New Jersey (PANYNJ)[14]. The GCT facility at PANYNJ estimated that it handled approximately 25% of the port's volume (1.7 million TEUs) during 2017. This facility was the first on the East Coast to implement a TAS in conjunction with significant infrastructure upgrades to accommodate the largest ships arriving from both the Suez and Panama Canals. The final product was the result of a multi-year collaboration between GCT, Sustainable Terminal Services (STS), and the Council for Port Performance (CPP). The Council is comprised of the six container terminal operators at the PANYNJ. STS provided funding, ensured stakeholder collaboration, and is the owner of the TAS. In January 2017, GCT introduced the TAS in a phased strategy to ease user acclimation and acceptance over time. During phase one, reservations were only mandatory at the terminal for transactions occurring between 6:00AM and 8:00AM. As the number of system subscribers increased, reservation mandates were phased in, one hour at a time.

Figure 4-10: Trucks Entering GCT Terminal Gate at PANYNJ



Source: Environmental Protection Agency

Success of TAS at a given facility is largely dependent on the ease of use and dependability users experience when interacting with the system. During initial program roll-out, and throughout subsequent enhancements, GCT improved the system's versatility as a real-time response to the feedback received from carriers, increasing predictability for truckers by standardizing and lowering turn times. With this level of consistency, GCT is better able to meter and manage traffic within its terminal. The gate appointment system at the GCT terminal has positively influenced supply chain dynamics, resulting in economic growth, and improved environmental performance. The EPA case study at GCT Bayonne provides quantitative measures of success for TAS implementation:

[14] https://www.epa.gov/ports-initiative/gct-bayonnes-drayage-truck-appointment-system

- Drayage truck turn times during appointment hours improved more than 40%;
- Turn times improved for transactions occurring outside of the mandatory reservation window;
- More than 70 percent of total truck transactions at GCT are appointment-based;
- At the time of the case study, ninety percent of reservations made with the GTC TAS are fulfilled;
- Fuel cost savings of $5.3 million/year for all peak hour traffic;
- Based on reduced idling times, carbon dioxide emissions have been reduced by 21,000 tons/year; the equivalent of taking 4,500 passenger cars off the road; and
- Air pollutants have been reduced by 61,000 kg/year, also due to reduced idling times.

4.3.3 Applicability to BCD Region

Appointment systems enhance the realized benefits of terminal operators seeking increased efficiency in handling containers through optimized crane utilization, eliminating unnecessary moves, and reducing distance traveled on terminal and truck dwell times. Implementing or integrating a TAS at the Port of Charleston to help manage terminal truck flows could improve overall operating efficiency while reducing truck turn times and emissions. However, the port would need to conduct analysis to determine whether deploying such a system would be financially viable.

Implementing a TAS requires extensive outreach with the trucking community, including education on how to use the system. Planning and implementation of the GTC TAS relied heavily on a robust outreach and stakeholder involvement strategy that engaged carriers and improved flexibility within the system. Through a phased approach, users of the GTA TAS were able to acclimate and succeed under the new system. Such outreach will be needed should the Port of Charleston elect to deploy a TAS, and BCDCOG could partner with the port to host outreach events and help manage introduction of the system.

5. PLANNING FOR ITS AND EMERGING TECHNOLOGIES

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.

Figure 5-1: Variable Message Sign

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.

Many of the technologies profiled in this report (e.g., Connected Vehicles/V2X, terminal automation, gate appointment systems, 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:

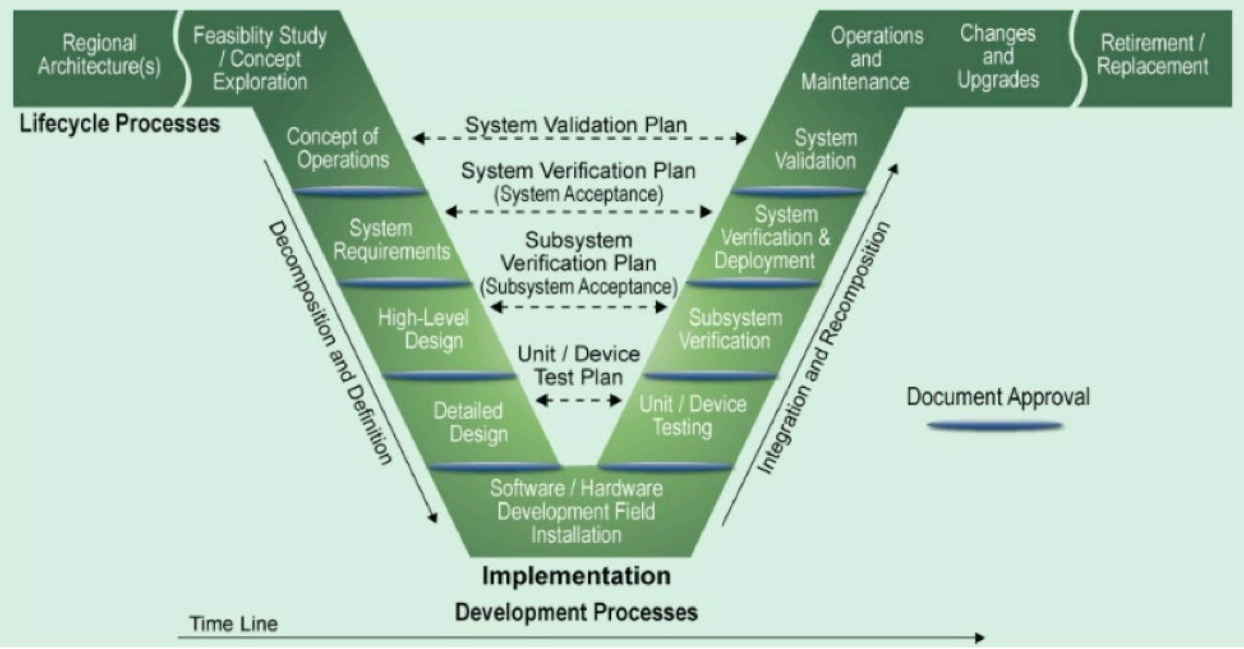
- National ITS Architecture
- Various stakeholders including highway agencies, public safety agencies (e.g., police, fire, emergency/medical), transit operators, federal lands agencies, state motor carrier agencies, and other operating agencies necessary to fully address regional ITS integration
- Description 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.[15]

For instance, the SCDOT developed and continues to maintain the South Carolina Statewide ITS Architecture which accommodates the FHWA rule.[16] 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**).

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

Figure 5-2: Systems Engineering Approach



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.[17]

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

[17] Ibid

transportation infrastructure, but in 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 and outreach tools to help BCDCOG 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 BCDCOG and its partner agencies and 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. 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, BCDCOG 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 considering 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 BCDCOG 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 Framework for 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. Therefore, 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 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. This should include considerations for all modes of transportation using the system. Suggested modes include auto, transit vehicles, emergency vehicles, freight vehicles, bicycles, and pedestrians.

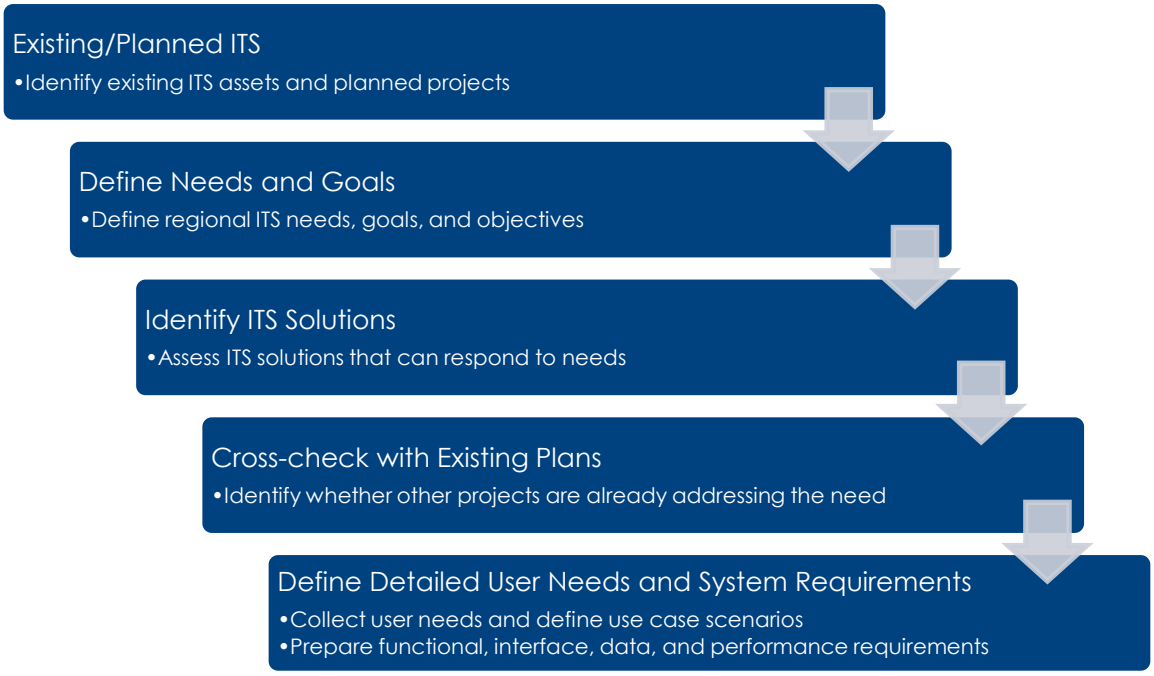
- The next step is to define the regional transportation needs, goals, and objectives that could be addressed with ITS. This can build upon existing planning efforts that have already identified issues and needs.

- 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. PUBLIC-PRIVATE PARTNERSHIP OPPORTUNITIES

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.[18] 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 port-related intermodal rail capacity needs.

6.2 CASE STUDIES

6.2.1 Truck Parking

The economic impact of the time spent looking for parking equates to almost $7 billion annually, and thus creates a need for state, regional, and local governments to address.[19] 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 at locations without truck amenities, 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 should they be robbed at these unmonitored locations.

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

To ensure that safe truck parking continues to be supplied throughout freight corridors, the Golden Glades Truck Travel Center in South Florida public-private-partnership (P3) is explored to highlight efforts being taken today to increase truck parking supply.

Golden Glades Truck Travel Center

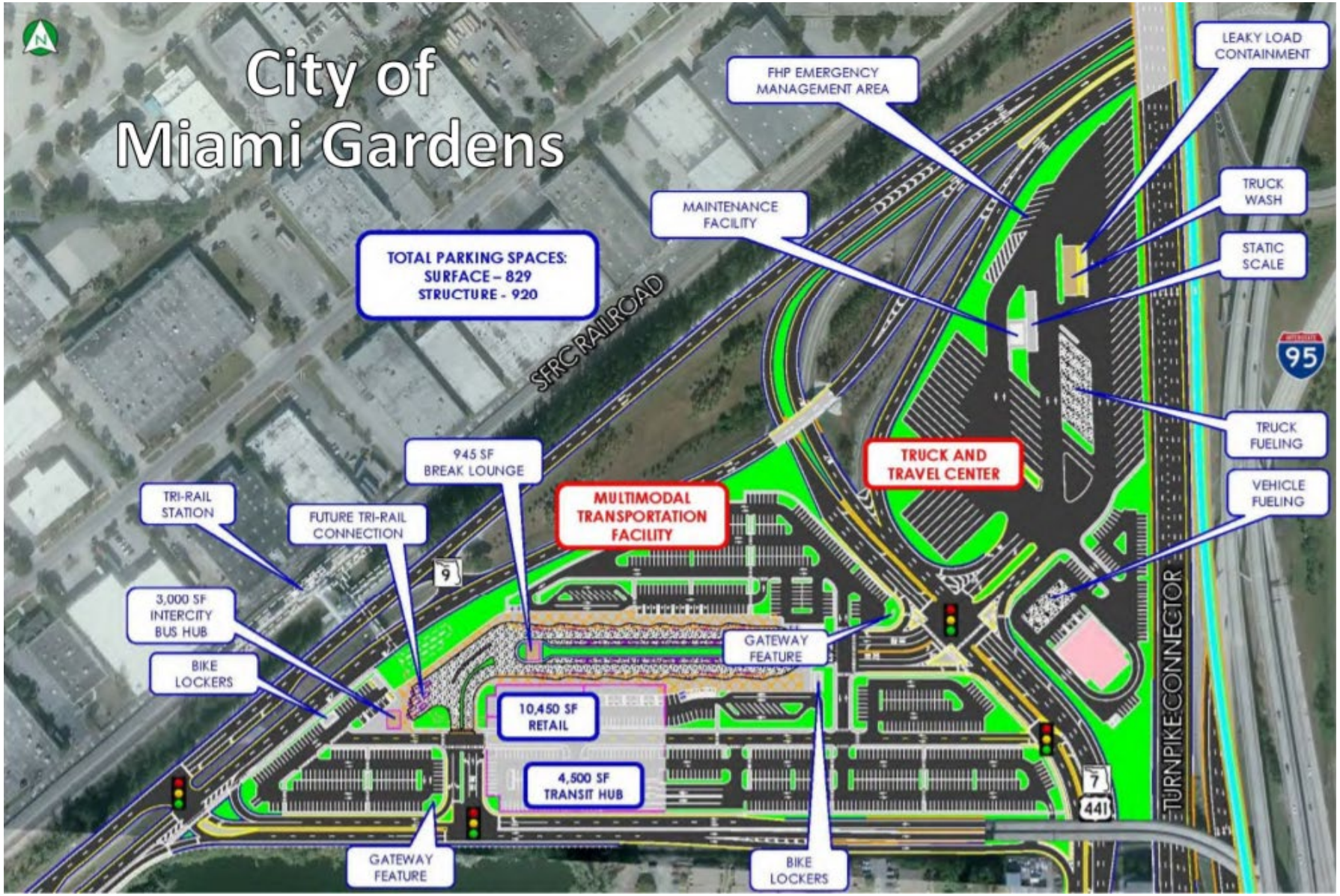
The Golden Glades Interchange connects US 441, Florida's Turnpike, State Road 826, State Road 9, and I-95. The project is a multimodal facility featuring extensive truck amenities that is to become a gateway for Miami-Dade County and incorporate various modes of transportation, including bicycles, cars, buses, and commuter rail.

The truck travel center, which spans 10 acres, is on the east side of the lot. The proposal includes room for a maintenance facility with 53 truck parking spaces, a truck wash, and a gas station. The west plot of land in which the multimodal transportation facility is to be built, currently housing the park-and-ride, stretches 15 acres. The facility will encompass 2,150 general parking spaces, a 4,500 square foot transit hub, direct access to the Tri-Rail Station from the new parking garage, new multi-bay bus terminals, and upgraded and new bicycle paths, sidewalks, walkways, and platforms. **Figure 6-1** gives an overview of the facility.

The project used the Design-Build-Operate model. The concessionaire designs and builds the facility, while financing the Truck Travel Centers (TTCs). The land is leased from the Florida Turnpike Enterprise (FTE) and Florida Department of Transportation (FDOT), which also provide management of the project. The Multimodal Transportation Facility (MTF) will be financed through FDOT, while the private concessionaires will pay a portion of their revenues to operate and maintain the TTCs and another portion of their revenues going to FDOT. Miami-Dade County Department of Transportation and Public Works (DTPW) and Miami-Dade Transit (MDT) are responsible for the MTF's operation. The hierarchy of this model is shown in **Figure 6-2**. (Note the Dolphin site is another parcel in Miami-Dade County that was assessed for new truck parking capacity but was found to be infeasible for access reasons.)

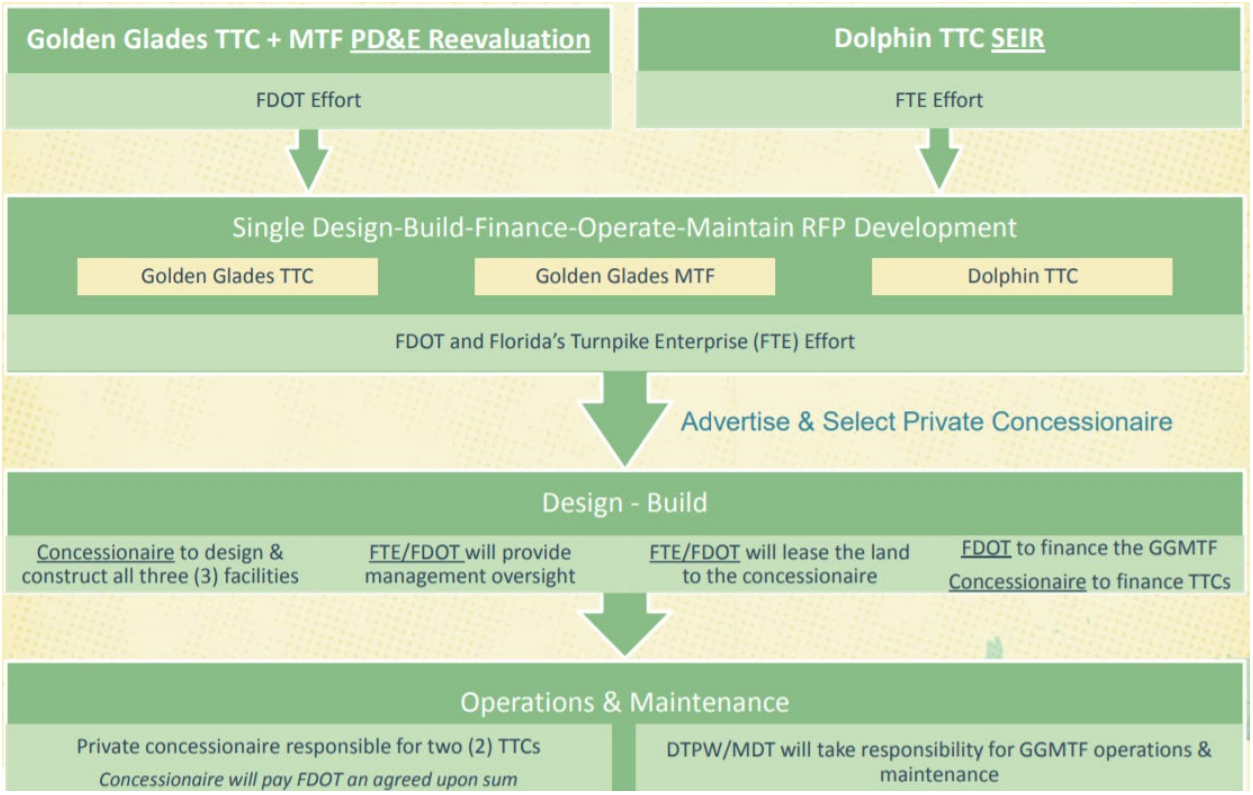
The project improves freight mobility while complimenting other freight investments in the Miami-Dade region. In addition, it addresses a severe truck parking shortage in the south Florida area, which benefits the industrial and warehousing businesses in the region. Finally, the project enhances overall multi-modal connectivity for the region while improving corridor safety, security, and aesthetics.

Figure 6-1: Golden Glades Truck Travel Center



Source: Miami-Dade MPO – CTAC

Figure 6-2: Truck Travel Center Design Build Operate Model



Source: Miami-Dade MPO - CTAC

6.2.2 Port-Related Intermodal Rail

- Reduced highway congestion;
- Increased economic development;
- Reduced fuel consumption and greenhouse gasses;
- 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.[20]

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[21]. 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[22].

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 BCD Region

Partnerships between public and private entities help to not only share the costs of projects, but the risks of constructing them as well. Through successful implementation, all parties can benefit. For the BCDCOG, leveraging SCDOT, county, or city owned land that is located at desirable areas for truck parking can help attract private entities that wish to build there.

These areas can also tie-into future transportation infrastructure projects within the region, such as welcome centers or rest areas, transit stations for the Lowcountry Rapid Transit (LCRT) Bus Rapid Transit system, or park and ride lots. Leveraging participation from multiple agencies can lower the costs for each entity through shared amenities.

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

7. FREIGHT SAFETY AND SECURITY

Freight safety and security processes and strategies for US port and railroad owners are intended to protect personnel, property, and the environment, and to prevent operational disruption. Ports and railroad entities have safety and security plans in place that are preventative and responsive. The safety and security plans should provide for unified command structure that allows quick access to obtain expertise to address incidents and restore operations. While the topics of safety and security are vast, the emphasis will focus on discussing any enabling legislation, oversight agencies, and strategies to reduce incidents and modal conflicts.

7.1 MARINE TERMINAL SAFETY

Terminal automation, as referenced in the Future Technology Trends and Application Section, enhances safety for marine terminals 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. These OSHA guidelines are not regulated but provide recommendations for employees to reduce the number of accidents. The Centers for Disease Control (CDC) shows that workers for marine terminals and ports have higher injury and fatality rates than other industries:

- Between 2011 and 2017 fatal injuries occurred at a rate 5 times that of the entire US workforce (15.9 per 100,000 workers); and
- Between 2011 and 2017 injuries happened at a rate double that of the entire US workforce (4,916 nonfatal injuries per 100,000 workers per year).[23]

Many such 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, yard tractors, utility tractors, hostlers, automobiles, vans, pickup trucks, and semi-trucks.[24] **Table 7-1** shows examples of factors that have the potential to create accidents and ideas on how to prevent them.[25] Similar prevention tools are also widely implemented at rail yards to prevent Federal Railroad Administration (FRA) reportable incidents and OSHA incidents.

7.2 MARINE TERMINAL SECURITY

The Maritime Transportation Security Act (MTSA) was passed by the US Congress and signed into law by then President George W. Bush in 2002. The intent of the MTSA was to protect the US maritime industry and the Marine Transportation System (MTS) from any threat. The MTSA conforms to the International Ship and Port Facility Security Code. The Department of Homeland Security (DHS) is the agency that is responsible for ensuring compliance with the MTSA by way of

[23] https://www.cdc.gov/niosh/programs/cmshs/port_operations.html
[24] https://www.osha.gov/Publications/3337-07-2007-English-07192007.html
[25] Ibid.

the US Coast Guard (USCG). A MTSA Security Plan is a critical component that ensures the MTS is secure.

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 for all employees
Substance abuse	Drug and alcohol use	Develop, implement, and monitor a drug-free workplace program

7.2.1 MTSA Security Plan

The MTSA Security Plan enables risk-based decision making and the USCG suggests that it include:

- Responsibilities and duties for a Facility Security Officer and a Vessel Security Officer;
- Training requirements;
- Transportation Worker Identification Credential (TWIC) requirements;
- Drill and exercise requirements;
- Record keeping requirements;
- Maintenance of security and communications equipment;
- Declaration of security procedures; and
- Requirements for audits.[26]

A MTSA Security Plan is divided into two parts, a Facility Security Plan (FSP) and a Vessel Security Plan (VSP). The FSP is based upon the number and type of vessels that interface with the facility. For instance, if the facility receives cargo vessels that are greater than 100 gross registered tons, they would be required to have an FSP. Likewise, a cargo vessel is required to have a VSP if it weighs more than 100 gross registered tons.[27]

7.2.2 Transportation Worker Identification Card (TWIC)

A TWIC is an identification card that is required for unescorted access within an MTSA regulated facility. Examples of persons that can be approved for unescorted access are truck drivers, longshoremen, or contractors. A TWIC is a card that is tamper resistant and contains biometric fingerprint information so that it can be linked to the card holder. The Transportation Security Administration (TSA) manages the process for an individual to obtain a TWIC.[28]

7.3 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 crossings. At-grade crossings present the greatest opportunity for people, automobiles, and trains to collide. An at-grade crossing, as shown in **Figure 7-1**, is the intersection of a roadway and a rail line that are on level ground. PTC and quiet zone safety information is referenced in the Future Trends and Applications Section.

According to the FRA, 97 percent of all rail-related fatalities and injuries occur at railroad crossings or are caused by trespassing.[29] Federal law states that grade crossings and tracks are the responsibility of individual railroads.[30] The FRA has undertaken measures to improve safety for at-grade crossings by developing the Highway-Rail Crossing Safety Business Plan.

[26] https://www.cisa.gov/sites/default/files/publications/2019-CSSS-USCG-MTSA-101-508.pdf
[27] Ibid.
[28] Ibid.
[29] https://railroads.dot.gov/sites/fra.dot.gov/files/2020-02/Grade%20Crossing%20Business%20Plan.pdf
[30] https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title49/49cfr234_main_02.tpl

Figure 7-1: At-Grade Crossing Ashley Phosphate Road

Source: NearMap

7.3.1 FRA Highway-Rail Crossing Safety Business Plan[31]

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

- Enhancing partnerships and expand 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.[32]

7.3.2 Quiet Zones

Official regulations governing the use of locomotive horns at public highway-rail grade crossings are established within the 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.

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) (**Figure 7-2**). 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

[31] https://railroads.dot.gov/sites/fra.dot.gov/files/2020-02/Grade%20Crossing%20Business%20Plan.pdf
[32] https://railroads.dot.gov/sites/fra.dot.gov/files/2020-02/Grade%20Crossing%20Business%20Plan.pdf

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.

Figure 7-2: Quiet Zone Roadway Signage

Source: Petaluma pressdemocrat.com

Quiet zones are established to reduce noise and promote/improve the quality of life in each locality, without compromising the safety of motorists, pedestrians, or the train. A 2017 study conducted by the United States General Accountability Office33 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.

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 and require written submittal and FRA approval as to their efficacy regarding risk reduction. Examples of SSM strategies include:

[33] 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.

8. FEDERAL DISCRETIONARY GRANT PROGRAMS

All the best practices and future technologies outlined herein require funding to execute projects, whether infrastructure or technology related. Hence, 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 six of these grant programs including information regarding the purpose of each grant, eligible project types, and specific information for each grant type. The six grants 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)
- Port Infrastructure Development Program (PIDP)

8.1 AUTOMATED DRIVING SYSTEM

Automation offers the potential to improve safety conditions for vehicle occupants and other travelers sharing the road. To address this potential, the USDOT appropriates funding for the ADS Demonstration Grants Program for a "highly automated vehicle research and development program".[34] 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 the industry stakeholders with clear information on how to safely implement and benefit from ADS-equipped trucks, as an example.

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;

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

- 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.[35]

The USDOT has identified ADS program focus areas 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 a lack of 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.
- 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"
- DriveOhio – "Deploying Automated Technology Anywhere"

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

8.2 Advanced Transportation and Congestion Management Technologies Deployment

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 that 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.

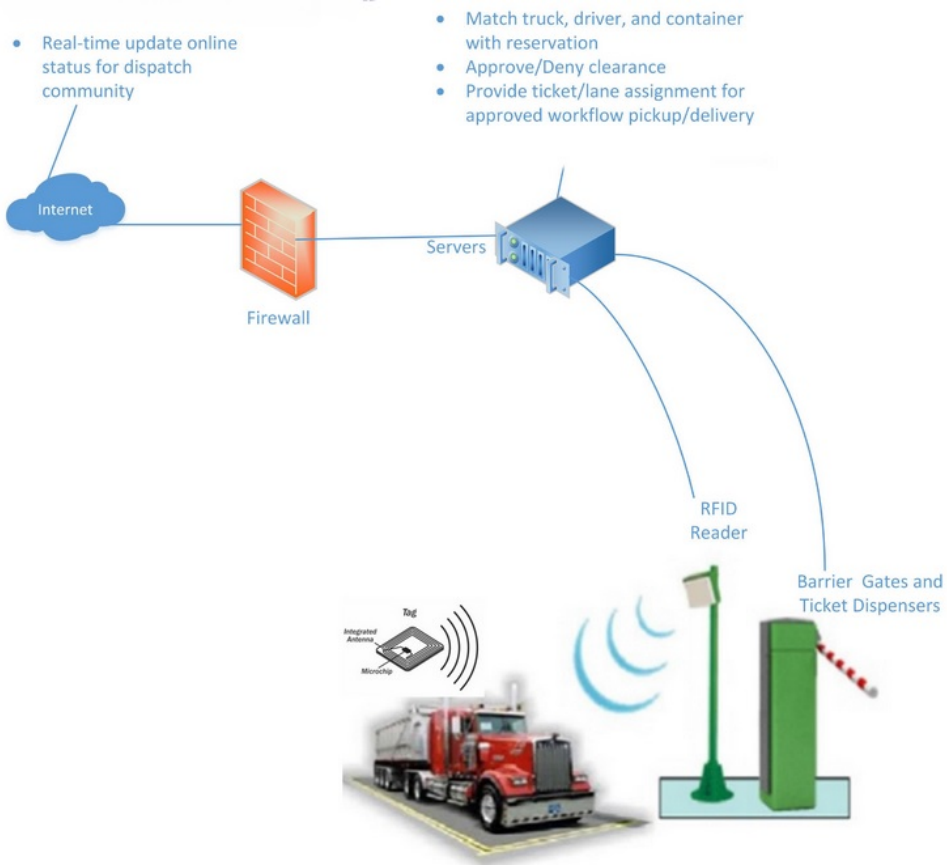
Eligible project types under the ATCMTD grant program include the following examples:

- 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 8-1**)
- City of Seattle DOT – "Multimodal Integrated Corridor Mobility for All"

Figure 8-1: VPA Truck Reservation Architecture



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

8.3 Better Utilizing Investment to Leverage Development

The 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.

The City of Charleston recently received an award of grant funding in fiscal year 2019. While not freight related, the Ashley River Crossing project is an example of a local and recent success of the application process to increase modal connectivity within the region.

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

- Massachusetts Port Authority – "Conley Terminal Container Storage and Freight Corridor Project"
- Delaware River Port Authority – "PATCO Franklin Square Station Reopening Project"

8.4 Consolidated Rail Infrastructure and Safety Improvements

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 Railroad Upgrade Project"
- Vermont Agency of Transportation – "Vermonter Amtrak Safety Project for Passenger and Freight Rail Service"

8.5 INFRASTRUCTURE FOR REBUILDING AMERICA

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.

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

- Port Tampa Bay – "Capacity Improvements at Port Tampa Bay's Hooker Point"
- Port of Houston Authority – "Wharf Restoration and Strengthening and Barbours Cut Container Terminal Upgrade"

8.6 PORT INFRASTRUCTURE DEVELOPMENT PROGRAM

The PIDP grant appropriates funding for improvements to facilities within, or outside of, and directly related to the intermodal-infrastructure and operations of coastal seaports, inland river ports, and Great Lakes ports. PIDP funds are awarded for projects that will improve the safety, efficiency, or reliability of the movement of goods into, out of, around, or within a port. Under the National Defense Authorization Act FY 2020, $225 million has been appropriated for PIDP grants. The USDOT Maritime Administration has identified projects that support the following objectives as potential candidates for PIDP Grant funding:

- Advance technology-supported safety design efficiency improvements;
- Bring facilities to a state of good repair and improve resiliency;
- Promote efficient trade in energy resources;
- Promote exports of manufacturing, agriculture, or other goods; and
- Support the safe flow of agricultural and food products, free of pests and disease, domestically and internationally for the top 15 coastal ports.

The U.S. relies heavily on its maritime services and infrastructure. Ports deliver numerous economic benefits, both directly and indirectly, providing countless jobs for Americans. PIDP funding supports efforts by ports and industry stakeholders to improve facility and freight infrastructure to ensure the freight transportation needs, both present and future, of the U.S. are met. The grant program allocates capital funds and project management assistance to improve the capacity and efficiency of the Nation's ports.

Eligible applicants under the PIDP Grant program include the following: port authority; a commission or its subdivision or agent under existing authority; state, local, and tribal governments; a public agency or publicly chartered authority established by one or more states; a special purpose district with a transportation function; a multistate or multijurisdictional group of entities; or a lead entity described above jointly with a private entity or group of private entities.

Recognizing that the efficient movement of goods through ports and accompanying intermodal connections depends on rural transportation networks, the USDOT will consider how projects will address the challenges faced by rural areas when selecting PIDP Grant-funded projects.

In addition to the funding of the Wando Welch Terminal Wharf Toe Wall and Berth Deepening Project, the following are examples of past, industry relevant PIDP Grant award recipients:

- Duluth, Minnesota – "Duluth Port Logistics Hub 2020 Revitalization and Expansion"
- Long Beach, California – "Alameda Corridor South Access: Terminal Island Rail Junction Project"

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