Chapter 1-8: ITS and Technology

1) Intelligent Transportation Systems Freight Technologies

MAP-21 requires State Freight Plans to include “evidence of consideration of innovative technologies and operational strategies, including Intelligent Transportation Systems (ITS), that improve the safety and efficiency of freight movement”. ITS are a collection of roadway, communications, and computer technologies that are used to improve the operation of roadway, rail, air and maritime systems. The freight industry has embraced ITS as a means of efficiency, thus competitiveness and reducing impacts, so that the volume and value of freight can increase while system demand decreases. The CFMP embraces ITS and the wide variety of communications related applications intended to increase travel safety, minimize environmental impact, improve traffic management and maximize the benefits of transportation to both commercial users and the general public. This chapter presents actual and projected ITS systems deployed by public agencies and private entities involved in commercial vehicle, rail, air and water operations in California in order to increase and maximize the safety and efficiency of the state's freight transportation system.

ITS technologies can be applied to the vast transportation infrastructure of highways, streets, bridges, tunnels, railways, ports and airports, as well as the associated vehicles, including cars, buses, trucks, trains, aircraft and maritime vessels. ITS can also be applied to mobile freight handling equipment, such as cranes, forklifts, and conveyor belts. Even the containers that goods are shipped in can have ITS applications. Public agencies have recognized the need for a planned and strategic approach to ITS deployment. This approach establishes a direct link between ITS planning and other transportation and strategic planning efforts. Ideally, the outcomes of ITS planning are activities (projects) incorporated and programmed into statewide, regional, and metropolitan transportation plans.

The CFMP recognizes that the freight industry, public agencies and communities can greatly benefit from ITS technology at the local, regional and state levels.

2) What is Intelligent Transportation Systems

Intelligent Transportation Systems are a collection of traditional transportation infrastructure (roads, vehicles, signs), communications, and computer technologies that are used to improve the operation of roadway, rail, air and maritime systems. ITS technologies refer to electronic sensing technologies that continuously monitor the system's operations, computer systems that process system performance data, electronic devices that can
deliver critical information to travelers and communication networks that carry data flows between the field processing points. ITS emphasizes system operations in an efficient and safe manner through integrated management of various components of the transportation system and its services. ITS is being used in different areas related to freight transportation, including: fleet management and control; controlling the position, condition, placement and identification of the freight and vehicles; and city logistics. Such systems have the capability to increase the fluidity of truck traffic, offer seamless border-crossings and ensure adequate levels of control and reporting that leads to higher levels of safety.

3) Freight transportation information types

The following list includes the most frequent used or supported transportation information types by freight ITS in California:

- Infrastructure and traffic, the location of roads, the status of roads (e.g., road quality or temporary construction on the roads), types of vehicles that can utilize the road, limitations (height, weight and length) and congestion, and real-time information regarding collisions or other incidents are related to this type of transportation information.

- Vehicle and freight location of the freight moving through the transportation network. Such information includes notifications regarding arrival of the freight, loading and unloading information, geographical location of the freight on the transportation system via vehicle location and condition monitoring systems, and the location of freight in warehouses, terminals, and ports.

- Freight condition: the physical attributes of the product during the transportation operations including when the product is stored in the warehouse or when it is shipped by the vehicles throughout the transportation network. Real-time information regarding temperature, pressure levels, force impacts, humidity, or the level of light in the vehicle during transportation make up sub-types of this transportation information type.

- Freight positioning: the placement and sequencing of the containers and products when they are stored or being shipped. For example, the information related to the positioning of the products in warehouses presented in three dimensions, x, y and z or information related to the placement of the containers on ships are examples of such information. This provides the exact location of a container within a container yard or ship with thousands of containers. It enables the quick retrieval of the container.

- Warehouse operations and inventory: The number and type of items in warehouses, customers’ orders for different items, loading and unloading times for different orders, and information about the contents of different warehouses. Accuracy of the number
and types of items stored in the warehouses is an important parameter in optimizing the supply chain.

- **Cargo:** Types of shipped items, their attributes (such as model, class, size, color, weight, price, ID number), sender information, receiver information, and information regarding the quantity of shipped items. The information is used by transportation companies, ports and terminals, senders and receivers of the cargo, the authorities such as Customs. Systems for scanning and auto-identifying the products contribute to the support of such information and to decreasing errors and the time it takes to process or clear an item thorough security, intake or loading.

- **Vehicle identity:** The type and class of vehicle, its registration number, and other identification information is used.

### 4) Freight ITS Elements

Most common freight intelligent transportation systems that are applied for the transportation operations are categorized into ten systems. They include: traffic control and monitoring systems, Weigh-In-Motion (WIM) systems, delivery space booking systems, vehicle and container location and condition monitoring systems, route planning systems, driving behavior monitoring and controlling systems, crash prevention systems, freight location monitoring systems, freight status monitoring systems, rail management and rail crossing safety.

- **Traffic control and monitoring systems** are created for controlling and managing traffic flow by providing information regarding collisions, congestion, traffic flow speed, and vehicles on the roads to be used by the authorities or by the logistics service providers. Technologies such as "smart" traffic lights, plate recognition cameras, speed measuring cameras equipped with sensors and variable traffic signs are used in such information systems. Such systems can send updates about vehicle arrival time and delay notifications that lead to supporting efficiency of the truck, ports, and terminal operations. The environmental performance of the transportation operations is increased by decreasing the transportation time and leads to having a more harmonized traffic flow (see Li, et al., 2007).

- **Weigh-In-Motion (WIM) systems** ensure that vehicles are not overloaded beyond maximum allowable weights. They are used to determine the weight of the vehicles as they move, increases safety of transportation and to decrease the damages caused by over-weights loads. WIM systems improve of performance by eliminating truck stop times at static weight controlling systems. Jacob and Feypell (2010) identified the advantages of WIM systems and their importance for improving transportation operations. According to their study, WIM systems reduce the risk of
accidents of over-weighted vehicles, reduce damage to the infrastructure such as roads or bridges and lead to time savings for both the truck drivers and for law enforcement. Broad application of WIM monitoring locations can also provide a wealth of traffic operations and manage network data.

- Delivery space booking systems are used to reserve truck space for parking for a specific vehicle at a specific time and reserve a time to load or unload the freight. These systems are quite useful in urban areas with space limitations like retailers located in large city centers. These systems contribute to environmental and efficiency performance by eliminating the time used to searching for parking spaces. Truck driver can find and identify safe and unsafe parking zones. The application of these systems potentially reduces the total number of vehicle trips during a specific time period (contributing to the environment) and maximizes the utilization of the parking place (contributing to the efficiency of transportation infrastructure).

- Vehicle and container location and condition monitoring systems provide real-time information about the position of vehicles by tracking and transmitting location information via satellite. Information is accessed by users via the web. Sensors on the vehicle can also provide real-time information regarding the condition of the cargo shipment, whether a container’s door is locked or unlocked, and whether a vehicle is off-route. Customs service providers can identify the estimated arrival time of the vehicles and prepare the documentation prior to arrival and thus decrease truck waiting times. Port gate operators can send expected arrival time updates to trucks in case of ship delays. The supported dimensions of transportation after using such systems are effectiveness/efficiency and security/safety. According to Lu et al. (2007), the application of integrated vehicle tracking systems is useful as a part of decision support systems for transportation resource management and logistics management.

- Route planning systems help plan the route selection based on roadway and traffic conditions, which reduces delay potential for shipments and keeps track of already congested traffic, which also results in lower truck emissions. According to Taniguchi and Shimamoto (2004), dynamic vehicle routing and scheduling is beneficial for carriers by reducing their costs, for customers by receiving a better level of service and for the environment by reducing traffic congestion.

- Driving behavior monitoring and controlling systems: The speed and acceleration of the driver is analyzed and feedback for improving driving is given by using such systems. Such feedback leads to reducing the fuel consumption of the vehicles. Also, using technologies for controlling the concentration of the drivers during transportation provides real-time feedback to drivers regarding their driving and it can
help leads reduce accidents and improve of the safety (see Marell and Westin, 1999).

- Crash prevention systems: Sensors are used to decrease the probability of accidents. For example, sensors installed on trucks have the capability of sending signals to the driver when getting close to an object or is approaching too fast. Sensors and communication equipment can be installed on vehicles and roadway infrastructure enabling vehicle-to-vehicle and vehicle-to-infrastructure communication. Automated vehicle slowing or braking systems can also be applied.

- Freight location monitoring systems: Radio Frequency Identification (RFID) tags allow the tracking of freight without the need of direct contact or optical scanning. With RFID readers installed in the vehicles or warehouse doors, freight movement is automatically recorded, saving time and improving accuracy. The system can read a large number of tags at the same time. According to Chow et al. (2006), the application of such systems for warehouse operations leads to improvement of working efficiency, reduction of operations cost, customer satisfaction enhancement, and time savings in resource management activities.

- Freight status monitoring systems: The application of different sensors for measuring physical attributes of the goods such as their temperature, humidity, impact force level, light level, and vibration level can create improvements in transportation operations. This system application for controlling dangerous, fragile and perishable goods such as medicines and fresh food is increasingly being used. A combination of the sensors with auto identification technologies such as RFID provides new opportunities for better controlling and monitoring the flow of material through different portions of the supply chains. Jedermann et al. (2006) shows that the application of RFID technology combined with sensors leads to improvements in the quality of transported food. The technology can also be used to monitor shipments of chemicals, explosives and other dangerous items.

- Rail Management: ITS developments are also proceeding rapidly in the rail industry. Anticipated benefits for its train protection controls for both interstate and state networks are improved network capacity, operational flexibility, service availability, transit times, safety and system reliability and security. Controllers will be able to schedule more trains on the same area of track and will also be able to ‘fleet trains’ heading in the same direction by spacing them behind each other at a safe stopping distance. Developments in this area highlight the need for interoperability with road based ITS technology, particularly at railway crossings.
• Rail Crossing Safety: There is considerable work underway to expand the use of ITS to improve rail crossing safety. Low cost solutions that augment more traditional treatments for crossings, such as signs, flashing lights and boom gates, are being sought. The use of short-range communications between oncoming trains and vehicles or roadside installations to warn drivers will likely require integration with other ITS technologies.

5) PrePass

PrePass is a nationally implemented system that verifies truck weights and credentials while motor carriers travel at highway speeds, allowing pre-credentialed, safe carriers to bypass inspection stations. PrePass is a sophisticated technology that enables qualified motor carriers to comply electronically with state-established weight, safety and credential requirements at highway speeds. By avoiding weigh station stops and idling in queues, motor carriers reduce fuel consumption and the associated pollutants. Launched in California in 1995, PrePass is now operational at more than 280 sites in 30 states. By year 2012 nearly 456,000 trucks in the U.S (Prepass.com) had voluntarily enrolled in PrePass and served approximately 400 million truck trips at PrePass-equipped weigh stations annually. Approximately 125 million of these truck trips, 30% of the total, are transponder-equipped, enabling these trips to be electronically identified on the mainline with a 99.9% accuracy rate. Upon identification, these trips are screened for safety and regulatory compliance against the PrePass system.

By reducing congestion in and around weigh facilities and tolling centers, PrePass improves highway safety. PrePass enables enforcement personnel to concentrate on those trucks most likely to be noncompliant, thus enhancing resources available for other purposes. (http://www.prepass.com/aboutus/News/Pages/PR11_17_2008.aspx) ITS offers the opportunity
to extract more practical capacity from our transportation system by operating the system in a more efficient manner. The Commercial Vehicle Information System Networks (CVISN), is an example of an ITS program specifically designed to improve motor carrier safety, efficiency, and convenience. ITS can also be used to gather useful information to better manage the highway system. Over time, this rich database of operational data could be used to monitor and identify regions and hot spots with congestion and reliability problems. This data could be cross-referenced with the state’s Safety Management System to further determine whether delays are recurring (congestion related) or non-recurring (incident related). This information can be used by the state to further refine its deployment and use of ITS technologies. CVISN is one part of the FHWA’s national architecture for ITS. (The National ITS Architecture is a guideline of the United States Government, for future transportation systems. It was established in 1994 by the United States Department of Transportation. The main goal was the definition of a standard national interoperable ITS structure). Specifically, CVISN is designed to improve motor carrier safety, efficiency, and convenience. It also contains elements that can be used to enhance overall security measures. CVISN touches on three major areas:

• Safety information exchange – automating the input of safety inspections and providing instant recall of historical inspection and safety data.

• Electronic credentialing – of the driver and cargo, providing the motor carrier with efficient ways to apply and pay for permits (i.e., overweight permits) while also adding to the overall security of the freight being moved.

• Electronic screening – making inspections and law enforcement activities more efficient through the interoperability of motor carrier data. The Commercial Vehicle Operations area links carrier, state, and national information networks to facilitate a simple and cost-effective exchange of safety and business data. Commercial processes such as roadside safety inspections, credential checks, vehicle registration, fuel-tax collection and hazardous materials transport are simplified. Electronic screening automates weight, safety and credential screenings at roadside weigh stations. International border clearances are also speeded along by this system. More unsafe drivers and vehicles can be removed from the road by this process, than by conventional methods. ITS technologies can also identify truckers with poor safety records for more frequent inspections, while compliant trucks are allowed to proceed.
6) Freight Bottlenecks

Bottlenecks, situations in which the performance or capacity of an entire system is severely limited by a single component, delay large numbers of trucks and negatively impact the nation’s economy and productivity. As the domestic freight ton-miles traveled by truck is expected to increase by 53% in 30 years, (NCHRP 08-98), reducing truck bottlenecks will be a major solution for increasing truck freight efficiency and reliability. Moving Ahead for Progress in the 21st Century (MAP-21) requires states to report on how they are addressing freight bottlenecks. Consistent methodologies are needed to define, identify, quantitatively measure, and mitigate truck bottlenecks. Often, truck bottlenecks are co-located with automotive bottlenecks, particularly in dense urban areas that also have large freight industry sectors such as Southern California and the San Francisco East Bay Region.

Without such methodologies, transportation agencies will be unable to address truck freight bottleneck issues systematically. Fixing one location may simply shift the bottleneck to another location on the network, with no improvement to the overall corridor performance. Without defining and describing bottlenecks by categories based on causal and contributing factors, decision makers will be unable to develop cost-effective solutions to address different types of truck freight bottlenecks.

There is a need for a comprehensive classification of truck freight bottleneck types that provides a standard approach for state DOTs, MPOs, and other practitioners to define truck freight bottlenecks and quantify their impacts. The U.S. Transportation Research Board (TRB) recognizes that this issue needs to be addressed, therefore is requesting a research to develop a guide that (1) classifies truck freight bottleneck categories based on causal and contributing factors (e.g., roadway geometrics, regulatory constraints, traffic controls, weather, and border crossings); (2) describes quantitative measures for each truck freight bottleneck category to determine bottleneck severity, impact, and ranking; (3) develops a scalable methodology for systematically identifying truck freight bottlenecks and evaluating their impact on local, regional, and national network performance; and (4) describes a range
of options for solving or mitigating truck freight bottlenecks. Results of this study should be available by the end of 2015.

7) **Regional Goods Movement Planning Initiatives**

**Freeway and Arterial Systems:**

- Caltrans has existing detection on most freeways within the region, collecting volumes and occupancy. Most freeway segments feature additional field elements such as ramp metering, CCTV cameras, and changeable message signs (CMS) to support traffic management operations. Caltrans staffs traffic management centers to monitor freeway traffic conditions and share data with other agencies and information providers.
- Arterial networks on which trucks operate are overseen by various agencies. The traffic signal systems in areas near the Ports are managed by local cities, the County of Los Angeles, City of Los Angeles, and the City of Long Beach.
- The POLA/POLB has deployed the Advanced Transportation Management Information System (ATMIS) to monitor truck traffic within the Ports using vehicle detection devices and CCTV cameras. A traffic management center operated jointly by the Ports provides traveler information including real time traffic conditions and incidents on CMS in the vicinity of the Port area.

**Port Logistics and Scheduling Systems:**

- The PierPASS program at the Ports of Los Angeles and Long Beach was established to manage and improve truck movements, to address congestion and improve air quality by reducing the number of idling trucks and driver’s waiting time. PierPASS has an “Off-Peak” program that charges a traffic mitigation fee of $50 per twenty-foot equivalent (TEU) unit container for peakhour pickups or deliveries. The fees are used to fund the additional shifts at the Port to provide service during extended hours. PierPASS officials estimate during 2007 and most of 2008 – prior to the economic downturn – Off-Peak shifts handled an average of 68,000 truck trips in a typical week, or about 40 percent of all container moves at the two ports on days with both peak and Off-Peak shifts. If the Off-Peak shifts were to be eliminated, most of these trips would take place in peak daytime traffic, causing heavy congestion and thus increasing air pollution. In the first quarter of 2009, Off-Peak shifts handled an average of 54,000 trucks in a typical week. As of December 2008, more than 11.46 million truck trips have been diverted out of peak daytime hours since the start of the program in July 2005.
VoyagerTrack is a private service that allows freight companies access to real-time information about when a container is received from the truck at the terminal, delivered to the truck from the terminal operator, or available for pickup. VoyagerTrack allows customers to access their container and shipping information via Internet or by phone. In addition to the container-specific information, VoyagerTrack also has an appointment system for trucking companies to schedule pick-up and delivery times. Three terminals at the Port of Los Angeles and one terminal at the Port of Long Beach currently use this reservation system.

eModal is a private service that provides several services for freight companies including an appointment system, terminal information, and fee payment service. Dispatchers access eModal using a website log-in. The appointment system website interface is different for each terminal based on the terminal’s time schedules and container pick-up area layout. There are currently four terminals at the Port of Los Angeles and five terminals at the Port of Long Beach that use eModal as their appointment system provider.

**Regional Data Exchange Systems:**

- The Regional Integration of Intelligent Transportation Systems (RIITS) network is a multi-modal, web-based communications network that supports information exchange in real-time between freeway, traffic, transit and emergency service agencies. RIITS establishes system-to-system links to automate the exchange of traffic control, work zone, transit vehicle locations and schedule adherence/performance, traffic, and incident information.

- The Los Angeles County IEN Network allows arterial-based traffic management centers with Los Angeles County to share and exchange information to manage and coordinate traffic progression, improve coordination between member agency traffic control systems, track construction, and improve incident response.

- The Performance Measurement System (PeMS) is a database of real-time and historical vehicle detector data collected from Caltrans freeway management centers around the state. PeMS also includes WIM data, incident reports, and lane closure notices from CHP and Caltrans.

- LA Metro/LA SAFE is currently designing an archived data system for the Los Angeles region. This system is intended to allow for archiving of historic freeway and arterial data for use in planning, project development, and operations in the future.
Traveler Information Systems

- Regional traveler information services are provided to the public through the MATIS/Go511 and Inland511 systems. The 511 systems obtain data from RIITS, Caltrans Districts and PeMS to disseminate information from real time traffic condition and incidents to the public through a web site and phone interactive voice response (IVR) system.

Gateway Cities Technology Plan for Goods Movement

The Gateway Cities Technology Plan for Goods Movement program represents the most significant fusion of ITS and freight operations technologies attempted to date in North America. Through the integration of traditional freeway, arterial, and traveler information technologies, with intermodal freight, port, and truck technologies, this project is studying the potential of providing an end-to-end information support system that can improve the efficiency of goods movement in Southern California.

The Gateway Cities Technology Plan for Goods Movement project is composed of five strategies:

1. Data Collection,
2. Transportation Operations and Management,
3. Emerging Goods Movement Technology Applications,
4. I-710 Corridor Advanced Technologies Applications, and

This Plan is being developed by the Gateway Cities Council of Governments and the Los Angeles County Metropolitan Transportation Authority with close involvement from the Ports of Long Beach and Los Angeles, Caltrans, and other key stakeholders.

Freeway Smart Corridor Deployment Plan

This project will complete and update (including filling existing gaps) the basic Caltrans surveillance, data collection, and traveler information infrastructure on key freight freeway...
corridors (lane-by-lane) to support traveler information and traffic management activities in the Gateway Cities area. Along their freeway system, Caltrans currently has deployed ITS to support device control, roadway surveillance, and dissemination of traffic information. ITS devices include ramp meters, CCTV cameras, loop detector stations, CMSs, and highway advisory radio. This project identifies gaps in these existing systems on freeways that service the Ports, rail yards, and major distribution centers. The geographical scope of this project includes freeways and state routes running east-west from I-110 to I-605, and north-south from the I-10/I-5 to the Ports. This includes more than 100 miles of roadway.

In addition to filling unserved ITS gaps, the project will identify malfunctioning equipment on existing corridors and institute a refurbishing program to repair and update equipment to bring it back on-line. The project will include deployment, testing, and integration of the field hardware to the central systems, including the addition of fiber communications, where necessary, to complete the basic infrastructure on missing freeway segments. The data from these systems will be transmitted to the Caltrans ATMS, and be disseminated to the data fusion engine and others through RIITS.

This new ITS infrastructure will include collection of truck-specific data on all freeways. This would include not only lane-by-lane information for trucks, but also the ability to categorize by vehicle classification or vehicle length classification. It is recognized that I-710 will be reconstructed during the life of this project. The designs developed by this project should be coordinated with I-710 construction to ensure that all ITS components are maintained or replaced, and that continuity of data along the corridor is preserved during construction.

**Container Moves Productivity Improvement**

This program, over a period of three to five years, will implement a series of projects that will eventually be fully integrated into an overall Container Productivity Prototype system. These projects are defined in terms of four technology deployments, and an institutional process, as discussed below.

- **Freight-Focused Traveler Information.** To be integrated and disseminated to drayage dispatchers and drivers though multiple methods, including web access and smartphone applications
- **Marine Terminal Queues Information.** To provide key information to trucking companies on the length and time in queues of trucking at marine terminal approaches – queue measurement, alerts, and predictive algorithms for port terminal queue approaches.
- **Container Status Information/Terminal Appointments.** Two-way information exchange between drayage companies and port terminals to schedule appointments for trucking companies to pick up/deliver containers, thereby, spreading out truck trips across time and reducing terminal and port regional truck traffic congestion.
• Predictive Information for Marine Terminal Operators (MTOs) on Dray Truck Arrivals. Real-time predictive information for marine terminals about expected drayage truck approaches, thereby, allowing the terminals to better plan gate staffing and support terminal operations and to assist dispatchers in controlling and updating trucks for pickups.

I-710 Automated Truck Research

This project will implement a staged progression of commercial vehicle technologies in order to transition from current research-based, automated, commercial vehicle demonstration efforts to staged operational testing of a flow efficiency system of trucks along the planned I-710 truck lanes. The project will demonstrate laboratory-proven technologies in a real-world heavily congested truck corridor through a staged test of a flow efficiency system for trucks.

This project will build upon the unique operational environment and potential partnerships of the Gateway Cities region to promote and enhance truck automated commercial vehicle research by bringing together the applications of automated commercial vehicle and automation technologies with the real-world operational realities of a heavily congested truck corridor. Finally, the project will provide for staged operational testing over time with an eye towards understanding the specific design and operational concerns that impact the future development of the I-710 and its approaches. The results of the test could provide valuable inputs to the design approach for a related I-710 freeway development project that will safely increase truck throughput on the proposed I-710 freight corridor, reducing truck volumes and congestion on the adjacent I-710 General Purpose Lanes. A critical component to the success of the I-710 dedicated freight corridor could be how much autonomous vehicle technology increases the overall efficiency of trucks traveling the corridor.

Truck Enforcement Network

Truck Enforcement Network (TENS) is an evolving project that is running in parallel and in coordination with the Gateway Cities Technology Plan for Goods Movement study. This project includes strategies, concepts, and layouts to truck enforcement that works for the needs of the stakeholders within the study area. This Truck Enforcement Network System (TENS) must meet the needs of the California Highway Patrol’s (CHP) daily truck enforcement facilities operations, Caltrans as overseer of the transportation system, including Truck Enforcement Facilities (TEF) design, and also the shippers, receivers, logistic and trucking industries, to process safe trucks from point to point in a timely manner. The current approach and practice of truck enforcement cannot process trucks at a rate that will match the present and future truck volume demands. The challenge is to modify and
add to the existing approach of truck enforcement to meet these ever-growing truck volume demands.

The feasibility study involved finding locations and conceptually developing permanent truck enforcement facilities and bypass screen/sort sites to process the large number of truck movements per day in the Gateway Cities subregion, plus an approach to truck enforcement that could be automated to maximize the effectiveness and efficiency of the enforcement operations. This automation piece was important to this study; it is with the intention that any permanent truck inspection facilities would be safe and not result in trucks backing up onto any adjacent freeways and city streets from these facilities.

These automated functions are to safely process as many trucks as possible through an inspection, weighing, and measuring environment. In addition, there is a need to realign the truck overweight fine structure to be proportional to the damages the vehicles produce to the roadway and bridges.

**Freight Traveler Information Data Fusion and Dissemination Project**

This project is comprised of two interrelated elements detailed in the Concept of Operations: a Freight Traveler Information System (TIS) and Data Fusion and a Freight Traveler Information Dissemination project. They have been combined here because to implement the goals outlined for these projects, these projects need to be integrated and developed in parallel.

Most of the other projects focus on either the gathering or the dissemination of information. This combined project focuses on how that information is collected, processed, and packaged for delivery (Data Fusion); and then the delivery of that information to a variety of stakeholders and who is responsible for ensuring the goods movement community is receiving the most accurate, timely, and useful traveler information possible (Freight TIS).

**Arterial Smart Corridor for Freight**

The Arterial Smart Corridor for Freight project will collect data from roadside equipment and vehicles to determine traffic conditions on key arterials within the Gateway City subregion. This data will be used to estimate arterial corridor travel times, and will enable better freight traffic and incident management on arterials by generating data for real-time traffic information. In order to improve the quality of the data gathered, this project will also identify any gaps in detection devices and communication links, and will install equipment to fill the gaps. The project will also involve the deployment or updating of signal coordination, improved signal systems, additional vehicle detection, CCTV cameras, and changeable message signs (CMS).
San Diego Association of Governments (SANDAG)

State Route (SR)11/Otay Mesa East (OME) Port of Entry (POE) ITS Technology

SANDAG and Caltrans, along with a number of key local, state, and federal agencies in the United States and Mexico, are executing an aggressive plan to self-finance a new border crossing in the San Diego/Baja California region. Annually, $54 billion worth of goods move across the region’s borders, and at each individual vehicle crossing, wait times regularly exceed two hours per vehicle. To sustain vibrant and effective commercial cross border activities, a new port of entry and connecting state highway are being created. The innovative new SR11 and OME POE project will improve the efficient movement of people and goods between the United States and Mexico. A state-of-the-art POE and commercial vehicle enforcement facility (CVEF) accessed via a toll road will provide shorter and more predictable crossing times. This POE and four-lane state highway will connect the United States-Mexico border to key regional, state, and international highways, including SR 125, SR 905, and the Tijuana-Tecate and Tijuana-Ensenada free and toll roads.

The ITS Pre-Deployment Strategies for the border crossing will address innovative operating concepts and technologies that could be deployed to ensure a secure, state-of-the-art border crossing. A major focus of the ITS deployment strategy is to help identify better time and travel experiences for passenger and commercial customers, thereby encouraging them to use the tolled border crossing by offering shorter and more predictable wait times. Compared with the current crossing, shorter wait times will also reduce emissions by preventing extended idling of vehicles waiting to cross the border. Upon construction, ITS technology deployed for the project will collect and provide real-time information on border crossing choices, toll rates, and wait times on both sides of the border for the entire San Diego-Baja California region.
SANDAG and Caltrans are pursuing multiple objectives with the new border crossing, including building additional physical capacity at the border, maximizing the efficiency of the new facility by using state-of-the-art ITS technologies and innovative operating concepts, and financing the facility development predominantly as a self-help project. The data collection will work seamlessly with an advanced traveler information system to provide accurate and useful data to the customer. It is envisioned that ITS will enable six high-level systems functions along the region’s border, including:

1. Data collection/analysis
2. Toll revenue collection
3. Traveler information display
4. Traffic management/monitoring
5. Vehicle safety inspections support
6. Customs and Border Protection (CBP) and Aduanas (Mexican Customs) Operational Assistance.

For further details regarding border freight issues, please see Chapter 1.

8) CA State Goods Movement Freight ITS Initiatives

Smart Truck Parking on California’s I-5 Corridor (Caltrans District-10)

The Smart Truck Parking project is a collaborative implementation and research effort among Caltrans; the University of California, Berkeley; ParkingCarma; Nokia and other partners and is sponsored by the Federal Highway Administration. It is designed to demonstrate the application of real-time parking availability information at truck stops. The premise is that truckers are given access to timely, accurate parking information so they will make better travel decisions. Currently truckers must search for parking after a full day of driving and often do not have adequate or timely information on where they can park, aggravating highway congestion. The lack of information about real-time parking availability may lead to illegal parking, which poses an environmental and safety hazard to both truckers and the public. In some cases, truckers must choose between searching for safe legal parking and impinging on hours of service rules.

This is being done to discourage the use of highway ramp idling, enhance safety, and reduce lost time and fuel while truckers search for available parking. Truck drivers will be able to check on a website or using a mobile device for real-time parking availability at selected truck stops that are participating in this project.

Smart Truck Parking is designed to provide accurate and timely information to truck drivers and fleet operators on available parking, amenities, and guidance including:
• Real-Time Parking Availability Information
• Truck Stop Attribute Information
• Parking Reservations.

The project is currently testing or operating several sensor technologies at truck stops on I-5 in the Central Valley in California. Stakeholder outreach efforts are also underway to recruit early adopters and facilitate expanded deployment.

**Interstate 80 (I-80) Winter Operations MultiState Coalition**  (I-80 Winter Operations Strategic Plan)

The I-80 Coalition brought together state DOT maintenance, traffic operations, and freight planning functions from five western states to focus on improved operations and maintenance coordination on the I-80 corridor. Representatives from California, Nevada, Utah, Wyoming, and Nebraska Departments of transportation are collectively addressing the unique operations and management needs of this corridor, with a particular focus on winter operations and maintenance. California, Nevada, Utah and Wyoming have initiated a single strategic planning effort to reach consensus on how to best link operational processes and data to maximize winter mobility in the I-80 Corridor.

The Coalition will leverage state resources of the partner state DOTs to create innovative solutions to issues that many states share during the winter months and provide a foundation for developing those solutions through Coalition program activities. This coalition program builds on this concept of multi-state coordination and expands it to not only highway closures, but also general road conditions information, consistent traveler information along the corridor, traffic management strategies, maintenance operations and potentially shared use of infrastructure near state boundaries, where applicable.
The states involved with this coalition have various infrastructure and operating methods for managing winter conditions along I-80. Caltrans has set up numerous Dynamic Message Signs along the I-80 corridor in rural California near the Nevada state line to alert drivers about weather. A winter operations center is activated in Kingvale maintenance yard along I-80 to support winter maintenance activities and coordination with other states during closures/restrictions.

A wide range of tools and technologies that Coalition states have either existing or are envisioned to be implemented to support the winter operations objectives of interstate communication and integration.

(For details, please see Appendix I-80 Winter Operations Coalition Fact Sheet)

Ten miles of magnets were installed on the eastbound and westbound of I-80 over Donner Summit, which often gets more snowfall than any other road in the rest of the contiguous country. The magnet sensors installed in the roadway to allow snow removal trucks using infra-red sensors to stay on the road and do their work more efficiently. These have been used by the Kingvale maintenance yard since 1998.

**Freight Tracking EFS Program** (FHWA RITA U.S.DOT Research & Innovative Tech. Admn.)

Freight tracking applications can monitor, detect, and communicate freight status information such as condition and location of goods while ensuring containerized cargo remains sealed within shipping containers while en-route.

Electronic technologies enable significant improvements in supply chain visibility, productivity, and effectiveness through simultaneous data sharing. The USDOT and industry helped develop the Electronic Freight Management (EFM) initiative to address data-related problems inherent in complex supply chains with simultaneous connectivity needed among multiple partners. Many-to-many data relationships are a key characteristic of EFM, and hopefully will help advance the state-of-the-art to replace the more costly and incomplete one-to-one relationships that now exist.

EFM has already provided strong evidence that it enables significant improvements in supply chain visibility, productivity, and effectiveness. The USDOT Research and Innovative Technology Administration (RITA) and Federal Highway Administration (FHWA) have identified EFM as a major initiative because its success would reach beyond freight system efficiencies to help mitigate congestion and support growing freight transportation.
9) **Electronic Freight Management Initiative (FHWA Freight Management and Operations)**

The Electronic Freight Management (EFM) initiative is a U.S. Department of Transportation (DOT) sponsored research effort that partners with freight-related industries to improve the operating efficiency, safety, and security of goods movement. Web technologies that improve data and message transmissions and facilitate business transactions from one end of the freight management supply chain to the other play a prominent role. A service-oriented architecture (SOA) leverages these Web technologies and supports them by setting standards, and the EFM program packages them so that both government and commercial users could use them to support their needs. Potential benefits of using Web services technologies include improved shipment visibility throughout the entire supply chain, a reduction of redundant data entry, improved tracking, simplified interfaces with government authorities, and enhanced security.

Information processing is key to business operations. Most large carriers and shippers use electronic technologies to catalog and track cargo within their systems and to transmit cargo information outside their systems to U.S. and foreign government agencies. Some shippers also establish electronic inventory management systems with their largest suppliers and supply chain partners. FedEx and UPS are two U.S. companies that use the electronic transfer of information to improve the productivity of their supply chains. Because overall system productivity is a major concern for these two companies, the transfer of information from origin to destination across modes is tightly scripted and very efficient, and each transaction is viewed as an origin-to-destination pair.

EFM seeks to provide this same level of efficiency to a broader user community by way of an open system that provides information transfer opportunities similar to a closed system. The EFM team works directly with the freight transportation industry to identify opportunities for implementing the EFM initiative.

FHWA believes the EFM initiative could significantly increase freight movement efficiency by improving information transfer and sharing techniques among supply chain partners. This initiative uses a Web services environment and focuses on developing and implementing international standards for data elements to improve information transfer efficiency. A demonstration deployment of the EFM initiative was completed in successfully completed in 2007.

10) **Positive Train Control Program**

The Rail Safety Improvement Act of 2008 (RSIA) mandates that Positive Train Control (PTC) be implemented across a significant portion of the Nation's rail industry by December
31, 2015. Lines requiring PTC are essentially Class I railroad main lines (i.e., over which 5 million or more gross tons are transported annually) that handle any poisonous-inhalation-hazardous (PIH) materials; and, any railroad main lines over which regularly scheduled intercity passenger or commuter rail services are provided. PTC is expected to be implemented over a total of approximately 70,000 miles of track.

PTC systems are integrated command, control, communications, and information systems for controlling train movements with safety, security, precision, and efficiency. PTC systems improve railroad safety by significantly reducing the probability of collisions between trains, casualties to roadway workers and damage to their equipment, and over speed accidents. The National Transportation Safety Board (NTSB) has named PTC as one of its "most-wanted" initiatives for national transportation safety. PTC systems are comprised of digital data link communications networks, continuous and accurate positioning systems such as Nationwide Differential GPS (NDGPS), on-board computers with digitized maps on locomotives and maintenance-of-way equipment, in-cab displays, throttle-brake interfaces on locomotives, wayside interface units at switches and wayside detectors, and control center computers and displays. PTC systems may also interface with tactical and strategic traffic planners, work order reporting systems, and locomotive health reporting systems. PTC systems issue directives to train and maintenance-of-way crews, track the location of the trains and maintenance-of-way vehicles, have the ability to automatically enforce directives, and continually update operating data systems with information on the location of trains, locomotives, cars, and crews. The remote intervention capability of PTC will permit the control center to stop a train should the locomotive crew be incapacitated.
In addition to providing a greater level of safety and security, PTC systems enable a railroad to run scheduled operations and provide improved running time, greater running time reliability, higher asset utilization, and greater track capacity. They will assist railroads in measuring and managing costs and in improving energy efficiency.

PTC systems will be able to optimize acceleration and/or braking to minimize fuel consumption and train-handling forces. To assist crews, these systems can recommend train-handling instructions based on tonnage, track grade and curvature characteristics, allowable speed, and train-dynamic performance. Simulators can optimize operations by calculating several hundred train-handling alternatives per second and forecasting train velocity several miles in advance.