7TH STREET GRADE SEPARATION AND PORT ARTERIAL IMPROVEMENTS PROJECT

Concept of Operations

Prepared for Alameda CTC

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Final Report

7th Street Grade Separation and Port Arterial Improvements Project

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1. Scope

On March 24, 2016, the Alameda County Transportation Commission (Alameda CTC) approved allocation of Measure BB funds for the Port of Oakland (Port) Improvement projects and authorized the use of its staff and consultant resources to perform certain project development phases so the projects can become eligible for multiple sources of funding. The 7th Street Grade Separation Project (7SGSP) and Intelligent Transportation Systems and Technology (ITST) Master Plan, collectively referred to as the "7th Street Grade Separation and Port Arterial Improvements Project" for this effort (the Project), have been identified as regionally significant investments in several regional and Alameda County plans and studies.

The Port is one of the top 10 busiest container ports in the United States (US) handling approximately 2.4 million twenty-foot-equivalent units (TEUs) in 2016. The Port complex comprises approximately 1,300 acres, including 770 acres of marine terminals, numerous transload/warehouse companies and is served by two Class I railroads. While the Port has available marine terminal and warehouse capacity, it is projected to have significant roadway gateway access and internal circulation constraints. The Port is served by three gateways: West Grand Avenue through Maritime Street from the north, 7th Street from the east, and Adeline Street-Middle Harbor Road from the south. At present, the container terminal gates operate primarily on a first-come, first-serve basis but each of the current marine terminal operators (MTOs) that handle international cargo have initiated an appointment system, starting from import deliveries and pick-up. There are often long truck queues on internal roadways that occur in the morning as trucks line up prior to gate openings but also at other times during the day depending upon the operations of the MTOs (during breaks and lunch), and as a result of other factors.

The Project will dramatically improve the efficiency and reliability of truck and rail access and circulation within the Port. It will also improve the competitiveness of the Port, while also generating benefits that extend beyond the Port area such as reduced regional congestion, emissions, and substantial job creation.

The objective of this document is to describe the existing and planned ITST Concept of Operations (ConOps) for the Port. It provides recommendations of operational objectives to address needs at the Port and the necessary ITST improvements needed to meet these operational objectives. Port needs include Intelligent Transportation Systems (ITS) operations during construction as well as for on-going operations. This document is informed by the ITST Existing Plans and Facilities report which identified the current inventory of Port ITST investments and operations as well as how regional ITS interfaces with the operations at the Port. It is anticipated that the ConOps is a living document intended to be updated as new ITST investments are made or revisions are made to operational procedures.

1.1 Identification

This document is the deliverable as defined under Section 4.2.4 of the scope of work for Jacobs project number W8X92900 named Preliminary Engineering and Environmental Services for the Project. Scope of work document is Alameda CTC – Professional Services Agreement A17-0004.

1.2 Document Overview

- **Section 1 – Scope** defines the intent of this document, identifies the system users and stakeholders and provides a cursory overview of the contents.
- **Section 2 – Current Situation** describes the current technologies utilized by the stakeholders and how they are being used.
- **Section 3 – Justification for and Nature of Changes** identifies the stakeholder and the deficiencies of the existing systems, desired changes to the systems and priorities, and assumptions and constraints.
- **Section 4 – Concepts for the Proposed System** contains a description of the desired system, how it will operate, and how users interface with the system.
- **Section 5 – Operational Scenarios** identifies potential real-world situations at the Port and describes how the new system, operational procedures, and stakeholders respond to each situation. This also informs how the system benefits the users.
- **Section 6 – Summary of Impacts** describes the expected operations benefits and impacts of the essential features of the new systems, organizational impacts, impacts during development, any perceived disadvantages or limitations to the system, and alternatives or tradeoffs considered.
- **Section 7 – Notes** includes any notes regarding the development of this document.

1.3 System Overview

The system of focus is primarily aimed at traffic control and operations of arterial roadways in the Port environment and regional traveler information dissemination to and from the Port. Other transportation and Port functions that can impact traffic operations are also considered in the ConOps. This includes MTOs and railroads operations but this ConOps primarily focuses on improvements and control on Port-owned facilities and operations.

The chief purpose of this ConOps is to define the anticipated Port operations and technologies needed to manage traffic and incidents on the arterials within the Port, as well accessing real-time traveler information and communications needed to improve goods movement efficiency within the Port and to/from regional destinations. This comprehensive transportation technology and congestion management system concept shall be referred to as the Global Opportunities at the Port of Oakland Freight Intelligent Transportation System (GoPort Freight ITS). The GoPort Freight ITS is intended to improve traffic flow and goods movement to and within the Port, reduce congestion, improve safety, provide improved truck traveler information, reduce emissions – and collectively these benefits will

significantly improve Port operational efficiencies, thereby increasing the competitiveness of the Port in the global market.

The GoPort Freight ITS is comprised of six groups of interrelated project improvements to improve goods movement within the Port area and for regional freight travel to and from the Port:

1. Communications and Collaboration
2. GoPort Traveler Information Dissemination (via a multi-platform truck traveler information app)
3. Observation and Detection
4. Traffic and Incident Management
5. Goods Movement Support Systems & Technology
6. Port Traffic Management Center/Emergency Operations Center (TMC/EOC)

Figure 1 presents an operational overview of the GoPort Freight ITS. The improvements are centered towards an enhanced TMC/EOC operating at the Port that observes, monitors, and manages traffic and incidents on Port facilities and compiles, shares, and disseminates freight traveler information and data with stakeholders. These six ITS and technology project improvement groups address many of the user needs identified by the Port Efficiency Task Force (PETF), ConOps Advisory Committee (CAC), and other stakeholders interviewed during this project. **Table 1** summarizes the deployments included in each of the improvement groups. A very broad overview of each group is provided below but with more detailed discussion under Section 4.

Table 1: ITS Deployments by Implementation Group

Implementation Group	ITS Deployments
GoPort Traveler Information Dissemination	• GoPort freight ITS information system/application (app) • Changeable message signs (CMS)
Communications and Collaboration	• Communications (WiFi) • Communications (Fiber) • Center to center (C2C) communications (includes interagency communications and collaboration) • Dedicated short-range communication (DSRC)
Observation and Detection	• Closed circuit television (CCTV) upgrade to high definition (HD) (including new HD CCTV deployment locations) • Radio frequency identification (RFID) readers • Supplemental vehicle detection (speed) • Queue detection
Traffic and Incident Management	• Adaptive signal system • Advanced train detection system • Advanced Traffic Management System (ATMS) (includes centrally controlled signal system) • Freight signal priority • Dynamic lane control
Goods Movement Support Systems & Technology	• Weigh in motion (WIM) technology • Smart parking system • Connected and autonomous vehicles technology

Port Joint TMC/EOC	• Joint Traffic Management Center (TMC) / Emergency Operations Center (EOC)

Figure 1: GoPort Freight ITS Operations Overview

1.3.1 Communications and Collaboration

Improvements under this group include elements that enable real-time modes of information exchange and communication. These would include infrastructure improvements for network communications such as wireless fidelity (WiFi) or fiber optic cable to communicate Port and traffic-related data, information, video, etc. and Dedicated Short Range Communication (DSRC) radios for future connected vehicle technology improvements (i.e. vehicle-to-vehicle and vehicle-to-infrastructure communications). These improvements also include operations that enable better coordination between the Port and other agencies, such as the City of Oakland (City) and California Department of Transportation

(Caltrans). An example is a memorandum of understanding (MOU) that indicates how agencies memorialize their communications protocols.

1.3.2 GoPort Traveler Information Dissemination

Improvements under this group include elements that enable the collection, processing, and dissemination of information to the travelling users of the Port. This includes changeable message signs (CMS's) that could be placed permanently at specific roadside locations as well as the use of existing Caltrans' CMS on freeways. This also includes a GoPort mobile application (app) and web-based platform and dashboard that would provide a consolidated portal of useful truck traveler information and allow users to refine available sources of data to serve their needs.

1.3.3 Observation and Detection

Improvements under this group include any elements used to detect, verify, or observe traffic or incidents in the field. This would include vehicular and queue detection equipment, including video-based and radar-based equipment, and of the addition of high definition (HD) video monitoring capabilities for traffic monitoring on Port streets and terminal access points via closed circuit television cameras (CCTVs). This also includes other types of detection such as train detection equipment. Radio-Frequency Identification (RFID) readers placed at gate entrances and exits, as well as throughout the Port, will provide more accurate information on truck turn times, travel times between readers, and provide the ability for Port security and operations personnel to track vehicles that are involved in incidents at the Port (e.g., trucks crashing into rail arms).

1.3.4 Traffic and Incident Management

Improvements under this group include any elements used to regulate traffic and improve safety through signaling or control. This includes an Advanced Traffic Management System (ATMS), adaptive signal systems, advanced train detection systems, freight signal priority, and dynamic lane control.

1.3.5 Goods Movement Support Systems & Technology

Improvements under this group address any technologies specifically used for improved management and operations of goods movement. WIM would allow truckers to assess the weight of their container before departing the Port to ensure their load is not overweight. In the longer-term, a Connected Vehicle (CV) system installation enables the Freight Advanced Traveler Information System (FRATIS) suite of applications to be utilized. A smart parking system allows truckers to recognize availability of parking in nearby lots with a count of the number of spots available. Use and repurposing of existing Bluetooth reader equipment can provide means to determine truck wait times and turn time monitoring systems utilizing trucker mobile devices.

1.3.6 Port Joint TMC/EOC

Improvements under this group include all elements used to provide a command and control center. This center will have architectural and technological improvements that will enable better situational

awareness of activities at the Port with better response procedures. This center will be located at the Port's Harbor Facilities Center located at 651 Maritime Street with redundancy of some system views remotely located at the Port's main offices located at 530 Water Street.

1.4 Identified System Users and Stakeholders

Primary users of the GoPort Freight ITS will be Port staff, specifically, wharfingers, security and traffic operators. Outside of Port staff, other goods movement system users include MTOs, motor carrier operators and dispatchers, non-vessel operating common carriers (NVOCC), beneficial cargo owners (BCOs), ocean carriers, chassis providers, rail company operators, members of the PETF, and other travelers to the Port. Public sector stakeholders include Caltrans, California Highway Patrol (CHP), Alameda CTC, the City (e.g. Oakland PD), Metropolitan Transportation Commission (MTC), Metropolitan Transportation Commission Service Authority for Freeways and Expressways (MTC SAFE), and other adjacent utility and transportation infrastructure entities. More detailed information on the system users and stakeholders can be found in Section 2.3.

1.5 Referenced Documents

The following is a listing of relevant documents and standards used in preparing this report:

- Alameda CTC and Port ITST Plans and Facilities – Revision 2.0 – March 9, 2017
- Guide to the Preparation of Operational Concept Documents, American National Standards Institute (ANSI)/American Institute of Aeronautics & Astronautics (AIAA) G-043A-2012
- Institute of Electrical and Electronics Engineers (IEEE) Guide for Information Technology - System Definition - ConOps Document Standard 1362-1998 (R2007)

2. Current Situation

This section provides an overview of the current objectives of the Project, the existing ITS and technology systems and facilities, the users and stakeholders for this Port ITS ConOps.

2.1 Background, Objectives, and Scope

The Port is one of the top 10 busiest container ports in the US (based on annual TEUs), handling approximately 2.4 million TEUs in 2016. The Port complex comprises of approximately 1,300 acres, including 770 acres of marine terminals, numerous transload/warehouse companies and is served by two Class I railroads. The Port complex is served by three external roadway gateways: West Grand Avenue through Maritime Street from the north, 7th Street from the east, and Adeline Street-Middle Harbor Road from the South. While the Port has available marine terminal and warehouse capacity, at times it can have significant roadway gateway access and internal circulation issues, such as roadway queueing, long marine terminal turn times, at-grade rail crossings, and recurrent traffic movement and truck parking violations.

To address these constraints, this Project is developing engineering plans for Port's civil infrastructure and ITS/technology improvements. These improvements are intended to improve the efficiency, safety, and reliability of truck and rail access and circulation within the Port and routes to/from major truck destinations. These improvements are also intended to improve the competitiveness of the Port, while also generating benefits that extends beyond the Port area such as improved traveler information, reduced emissions, and job creation.

The focal area for this Project includes the Port and roadways that provide access to Port facilities within Alameda County, the Interstate (I-) 80 segment from Carquinez Bridge to the I-80/I-580/I-880 junction, the I-238 segment from I-580 to I-880 Interchange, the I-580 segment from I-238 to east of the Crow Canyon Road Interchange, and the I-880 segment from the I-80/I-580/I-880 junction to the A Street Interchange.

The ITS and technology components of the Project are intended to improve traffic flow and goods movement to and from the Port. The Project will also reduce congestion, improve safety, provide improved traveler information, and reduce emissions. Some of the key objectives of the ITS and technology components of the Project are to:

- Improve traffic information and management within the Port, its terminals, and access routes
- Improve traffic observation, verification, and monitoring
- Enhance information sharing during an emergency or incident
- Improve transportation communication with the City and Caltrans
- Develop an ITS communication network that serves future needs
- Provide TMC functionality at the Port for better traffic control, management, and monitoring
- Reduce traffic congestion, truck idling, and emissions
- Provide improved terminal wait time and turn time information
- Improve traffic management during construction projects
- Minimize conflicts between transportation modes

2.2 Description of Current Situation

As part of the Project, relevant information describing the existing and planned ITS and technology elements within the Port and the study area were compiled and presented in a separate document deliverable, Alameda CTC and the Port's Existing ITST Plans and Facilities – Revision 2.0 – March 9, 2017. The relevant information on existing and planned ITS elements were extracted from the following sources:

- Port Perimeter Intrusion Detection System Upgrade, Drawing of Record, August 22, 2012
- Port Maritime Domain Awareness Enhancements, Record Plan Set, August 10, 2015

- Port Security Fiber Optic Network Expansion & Redundancy Project Design – Phase 2, Contract Plan Set, February 8, 2016
- Site visits and meetings with Port personnel
- Request For Information (RFI) Response Memorandum, Leidos, October 16, 2016
- Metropolitan Transportation Commission I-880 Integrated Corridor Management (ICM) - Concept of Operations, March 31, 2008
- Alameda CTC I-80 ICM - Concept of Operations, October 14, 2010
- City, ITS Strategic Plan Update, February 2014
- I-880 ICM Project- North Alameda Segment plans, specifications, and estimates (PS&E) Plan, August 3, 2016 (provided by MTC)
- MTC website and telephone conversations with MTC personnel
- MTC, Bay Area ITS Architecture 2011 Update, April 23, 2012 and 2017 Update (draft)
- MTC, Express Lane Network Concept of Operations, May 2013
- MTC and Alameda County Transit Authority (AC Transit), Next Generation Arterial Operations Program AC Transit – South County Corridors Line 97 Project Final Concept of Operations, September 29, 2015
- MTC, *511* San Francisco Bay System Integrator, Data Management & Dissemination, and Interactive Voice Response Phone System Contractor – Proposer's Conference presentation, 2015
- MTC Ramp Metering Status, June 2016
- MTC I-880 Express Lane- ITS Equipment Inventory
- City, 2012 Oakland Army Base (OAB) Project Initial Study / Addendum, May 2012
- Port, Maritime Development Alternative Study (MDAS) Final Report, August 2004

Some of the existing ITS infrastructure and deployments within the Port and the focal area are summarized below.

2.2.1 Within Port of Oakland

2.2.1.1 Maritime Comprehensive Truck Management Program (CTMP)

The Port began the development of the Port Registry comprised of a Drayage Truck Registry (DTR) and Truck Management System (TMS) in 2009 to enhance the Port's awareness of activities and businesses using the Port. In 2010, an imposed Comprehensive Truck Management Program (CTMP) tariff was implemented. More specifically, the tariff stated that the Port has implemented two parts/phases of the CTMP: 1) Secure Truck Enrollment Program (STEP) Agreements and Implementation of the DTR. This was done to address security and the need for MTOs to check compliance by the STEP certificate or decal; and 2) The MTOs have to ensure that all trucks accessing their facilities must comply with California Air

Resources Board (CARB) regulations. Around the time this Port tariff went into place, the Port and terminals concluded that MTOs will check compliance with an RFID tag and *WhereNet* readers. However, the RFID and *WhereNet* system is not a specific requirement imposed by the Port. The Port provides the database for DTR in which the MTOs check compliance.

Consequently, all drayage trucks are registered with *eModal* and equipped with RFID for electronic identification at the marine terminal security gates. In 2012, the drayage truck position data, which is provided by the MTOs, was integrated into the TMS.

As part of the CTMP, the Port implemented the truck registry database and STEP to increase its maritime safety and security domain awareness, enforcement of state air quality mandates, outreach capabilities, and general knowledge of trucking entities and trucking operations conducted on Port property. Each licensed motor carrier (LMC) that dispatches drayage trucks to conduct business at Seaport facilities must file a STEP Agreement with the Port. Only LMCs and trucks associated with those LMCs that have submitted a STEP Agreement are able to serve the Seaport facilities. The TMS software enables users of the system (Port staff and/or consultants), based on permissions, to access STEP Agreements, process STEP applications, truck decal assignments, certificate issuance, as well as, access different types of custom system alerts (violations, exceptions, alarms), access outreach data, call center reporting, etc.

Truck position data is provided in real-time by each of the MTOs to the Port via an RFID based, truck identification system installed by the MTOs at each of the security entrances to the respective terminals. The RFID based, truck identification data is collected at the security entrances and filtered through a marine terminal managed *WhereNet*/*eModal* based system. The transaction data is then sent via the web to a third-party hosting service which is then processed through the Port's TMS to establish truck identification and position information.

The CTMP provides the following key capabilities:

- Ability to capture the identification of trucks and trucking companies/fleets that access the Port
- Ability to identify in real time, and by location, trucks entering and departing Port container terminals
- Secure back-office processing capability for truck, driver and fleet ID and tracking information, that also can serve as a focal point for communication with outside systems, sensors, etc.

2.2.1.2 Terminal Operating System (TOS)

A TOS is utilized at the Port container terminals to organize and control movement and storage of the containers in the yard, to facilitate supply chain management associated with containers being loaded and off-loaded from ships, and for containers being picked up or dropped off by trucks. Additionally, a TOS provides real-time information which allows for more timely and cost-effective decision making. The TOS also provides the following key capabilities to the Port:

- Potential access to real-time container availability in terminal information, which can support improved scheduling and staggering of trucking fleet container pickups

- Potential integration with port truck queues and truck arrival information, to better schedule gate system labor, and support improved terminal operations

2.2.1.3 eModal

The Port MTOs utilize *eModal* for their common Port community system. *eModal* allows the MTOs and the Port community users to manage clean truck programs, appointments (i.e., PreGATE), truck tracking/dispatching, and terminal/drayage fee payments. Through the data feeds that are provided from the Port DTR, *eModal* can identify trucks within the database and automatically collect drayage fees. All of the MTOs operating at the Port currently (Oakland International Container Terminal (OICT), Stevedoring Services of America (SSA), Ben E. Nutter Terminal (Everport) and TraPac) utilize the *eModal* Gate Appointment System. In addition to fee collection and appointment systems utilized by the MTOs, *eModal* also provides cargo status, container and booking inquiries, vessel schedules, information broadcasting tools for notifications to the drayage Port community and dispatch services.

2.2.1.4 Emergency Operations Center (EOC)

The Port's Maritime Division manages a manned 24X7 Port Security Management System (PSMS), located at the Harbor Facilities Center (HFC) to monitor Port activity via a networked CCTV system. Staff at the EOC also monitor Oakland Police Department (OPD)/Oakland Fire Department (OFD) Computer Aided Dispatch (CAD) and radio, and other sources of information such as reports of accidents and spills in the maritime area. The EOC is located on the second floor of the HFC. It is staffed by two operators during normal business hours and one person otherwise. There are two open cubicle workstations as well as two large light-emitting diode (LED) monitors that are wall mounted. The EOC has direct fiber and video conferencing connectivity with the City EOC as well as connections to other offices within the Port.

Operational components of the EOC consist of the following:

- Fiber network connecting the CCTV system to the EOC and Water street
- Video management system (VMS) including approximately 115 cameras and communications (fiber) which have been integrated into a single system running the Genetec Security Center software platform
- Geographic Information System (GIS) – A major system used for domain awareness. It is used as an incident management tool.
- CAD – GIS based CAD is provided to the Port by OPD and OFD to coordinate in the Port beat areas.
- Port radios – System used for communication. It allows Port employees to communicate with other employees within the Port and other agencies. Currently, the Port utilizes EBRCS communications protocols and standards.
- *Send Word Now* – A messaging application that is used for emergency and information notification. It is also used to generate and distribute text, voice, or combination text/voice to distribution groups.

- TMS – Is a system used for fleet vehicle yard asset tracking and management.
- Social media – *Twitter*, *Facebook*, etc. Allows Port employees to distribute information to the public.
- Bay Alarm – Security company responsible for building security for the Port.
- Agency alert systems – In addition to GIS, "D3" is used.

The existing PSMS provides the following key capabilities to the Port:

- Interconnectivity with existing security network equipment and systems that can be integrated into traffic management software and systems
- Existing EOC facilities and capabilities that can be expanded to house new port TMC/EOC facilities, hardware, software, and staffing

2.2.1.5 ITS Field Devices

In addition to the PSMS, the Port has portable CMS's that can be brought out to the field for spot messaging. The CMS's are sometimes use in conjunction with field operators that occasionally may be out on Port arterials directing traffic during incidents or heavy congestion. The Port had previously purchased CMS equipment that was never installed. These permanent signs are considered legacy equipment that will not be utilized for future installations. There are a number of signalized intersections that are controlled and operated by either Caltrans or the City.

2.2.2 Outside of the Port of Oakland

There are several other existing regional ITS and technology infrastructure and systems that support goods movement transportation to and from the Port. Some of the relevant existing ITS and technology outside of the Port property includes:

- **Caltrans District 4 TMC** which compiles, monitors, and disseminates real-time traffic information to minimize impact to the traveling public within the Bay Area. It is located in Caltrans District 4 main office in Oakland.
- **Vehicle Detection** on State Route (SR-) 24, I-80, I-580, and I-880 is performed primarily through inductive loops. Caltrans has 272 inductive loop traffic monitoring stations within the existing ITST plans and facilities report study area. Mainline detectors are generally dual loops in each lane.
- **Ramp Metering** exists along the I-880 corridor (south of I-980) and consists of local traffic responsive metering that help manage the freeway corridor. On the I-80 corridor, adaptive ramp metering has been implemented as a part of the I-80 ICM Project. In addition, I-580 has some meters installed and funded.
- **CCTV** cameras are placed at strategic locations to assist Caltrans District 4 and local agency staff with real-time traffic surveillance and incident verification remotely. Within the existing ITST study area, Caltrans has 22 CCTVs along I-880, 26 CCTVs along I-80, one CCTV on I-238, eight CCTVs along I-580, and one on SR-24. Caltrans typically uses cameras with pan-tilt-zoom (PTZ) capabilities.

- **CMS's** provide motorist information on incidents, closures, environmental warnings, amber alerts, and travel times. Within the study area, Caltrans has several permanent CMS's - five on I-880, five on I-80, two on I-238, three on SR-24, and four on I-580.
- **Highway Advisory Radios (HARs)** are used to advise motorists of incidents via short-range public radio. There are two HAR stations on the I-880 corridor and three HAR stations on the I-80 corridor.
- **ICM** involves institutional collaboration and integration of ITS and infrastructure to manage a corridor as a multimodal system and make operational decisions for the benefit of the corridor as a whole. Within the study area, ICM is implemented along I-80 to monitor and maintain optimum traffic flow with an emphasis on system reliability and efficiency through multi-modal solutions. System components include adaptive ramp metering, CMS, lane use signage, high-occupancy vehicle (HOV) bypass, transit signal priority, traveler information, coordinated traffic signal system, TMC, vehicle detection, incident response plan, diversion management, HAR, and CCTV cameras.
- **City of Oakland** has an ITS Core Network consisting of various hubs and field elements connected into an integrated system. Hubs include the Oakland TMC and EOC. Field equipment include traffic signal control, transit signal priority, CCTV cameras, video detection, CMS, and trailblazer signs.
- **Freeway Service Patrol** is a congestion management program implemented by MTC SAFE. The program consists of approximately 64 trucks patrolling over 470 miles of Bay Area freeways during peak travel periods to detect and clears incidents, pick up dangerous debris from freeways, and make roadways safer. It uses sophisticated communications equipment, including an automatic vehicle location (AVL) system which improves partner agencies' ability to dispatch efficiently, and improves service quality through close fleet monitoring.
- ***511*** phone service and 511.org are the call-to-action and consolidated portal for multiple regional programs (e.g., Freeway Service Patrol, FasTrak, and Bay Area Express Lanes), as well as the Bay Area's transit and paratransit agencies, and linkages to Clipper, FasTrak, Freeway Assist, and other services. The *511* program partners with numerous agencies to collect, aggregate, and disseminate regional static and real-time data, and also shares this data with third party developers who provide public apps and web tools. Travelers can call *511* to listen to information such as driving times for their route, or traffic conditions for a city, highway, bridge, or hotspot. *511*'s Twitter feed, @511SFBay, provides updates on severe traffic incidents/sigalerts and major transit disruptions. Travelers can access these services by telephone via interactive voice response (IVR), the web, or mobile phone. *511* also serves as a regional archived data management system.

2.3 Profiles of User Classes

The following contains a profile for each of the relevant project users and stakeholders, which also summarizes their role associated with the existing systems.

2.3.1 Port of Oakland

The Seaport is one of the top 10 container ports in the U.S. and serves as the primary ocean gateway for international containerized cargo shipments in Northern California. The Port has four container terminals and two intermodal rail yards.

Role: Relevant Port personnel and contracted staff such as wharfingers, port security managers and operators, and contracted field patrol service, are responsible for the day-to-day Port security and traffic operations including security monitoring, traffic management, and incident management on Port property. The Port's PSMS is managed from the EOC located within the HFC where security and traffic conditions at the Port are monitored using video feeds from their network of CCTV cameras, radios, GIS system, and City police and fire CAD. EOC operators also utilize this system to share information with various stakeholders via *Send Word Now* messaging application, social media, and agency alert systems. Elsewhere, Port staff also manage the CTMP including the DTR, TMS, and CSC which utilize the RFID equipment and share information with *eModal*. Port staff maintain and update the Port website containing information useful to their stakeholders such as seaport facilities, seaport resources, trucker resources, and seaport logistics.

2.3.2 Marine Terminal Operators

MTOs offer wharfage, dock, warehouse, or other marine terminal facilities to serve ocean carriers, providing the link for goods between ocean carriers and motor carriers. The Port currently has six marine terminals, four are active and are operated by three MTOs: the OICT operated by SSA Marine; TraPac Terminal (TraPac Inc.); Ben E. Nutter Terminal (Everport); and Matson (SSA). The Port averages approximately 7,000 inbound trucks into the four marine terminals accounting for approximately 10,000 container transactions each day.

Role: MTOs are responsible for the operations that occur at and behind the terminal gates. Each has terminal operating systems which organize, manage, and control the movement and storage of containers. Some information from these systems are shared with the Port, such as truck arrival times at in-bound gates. MTOs also use *eModal* to manage appointments, truck registries, clean truck programs, tracking/dispatching, and fee payments.

2.3.3 Motor Carrier Operators and Dispatchers

Trucking company dispatchers and operations managers are responsible for planning trips and maintaining communications with truck drivers and truck drivers are responsible for picking up, transporting, and delivering the container/freight.

Role: Truck drivers and dispatchers are one of the primary groups of the existing systems. Dispatchers often use a desktop computer to access the information they need for operations including: *511* systems; travel time, directions, and traffic information (e.g., Google); traffic camera feeds; weather reports; terminal operations; *eModal*, and other resources. They also use proprietary vehicle tracking/fleet management software and may use tablet computers or smart phones for fleet tracking,

load status updating, and communication with drivers in the field. Truck drivers interact with the existing systems in a more limited fashion because of regulatory restrictions on what they can do while operating a truck. At a minimum, drivers will almost always have a radio and in most cases a cell or smart phone for communication with other drivers and dispatchers. If drivers have internet access via a smart phone, they use it to access traveler information systems (e.g., *511*, Google, WAZE, etc.) for current traffic conditions and recommended routes, weather, *eModal*, live camera feeds, their company's proprietary systems, and other resources.

2.3.4 Non-Vessel Operating Common Carrier (NVOCC)

NVOCCs provide intermediary logistics planning and coordination between marine terminals and drayage trucks. A NVOCC is a cargo consolidator who does not own any vessel, but acts as a carrier legally by accepting required responsibilities of a carrier who issues his own bill of lading. NVOCCs act as a 'carrier to shipper' and 'shipper to carrier'. A NVOCC can own and operate their own or leased containers. NVOCCs act as a virtual carrier and accepts all liabilities of a carrier legally, in certain areas of operation.

Role: NVOCCs hire motor carriers to pick up containers so long turn times experienced by trucks directly impact NVOCCs.

2.3.5 Beneficial Cargo Owners (BCOs)

BCOs are the importers and exporters of record; who physically take possession of cargo at the destination and include distribution centers, warehouses, and other intermediate locations. They determine when and where containers are moved, how long they are stored, and who receives and moves them. Depending on the size of the BCO, they may either route their imports to one main terminal or distribute them among several terminals. BCOs have several options to procure transportation services. They can procure directly themselves from an ocean carrier, they can contract or supply their own services, or they can work through a third-party logistics (3PL) entity.

Role: Although BCOs generally do not set foot on Port property, they are directly impacted by the long turn times experienced by truck drivers. BCOs are concerned with the accuracy and accessibility of container locations, and availability of appropriate chassis needed to move the containers. BCOs use various sources of information for situational awareness of Port conditions.

2.3.6 Port Efficiency Task Force (PETF)

In 2015, the PETF was formed to identify, develop, and review efficiency improvements and measures that could improve operations for moving cargo through the Port. The PETF is a collective group that includes operational stakeholders from the Port with vested interest in improved efficiency including BCOs, chassis providers, labor representatives, motor carriers, Pacific Maritime Association (PMA), Pacific Merchant Shipping Association, NVOCCs, ocean carriers, Port staff, railroads, terminal operators, and U.S. Customs & Border Protection (CBP).

Role: The PETF was instrumental in identifying user needs for this project, both through stakeholder interviews and detailed archived meeting minutes where a number of issues and concerns were discussed such as vessel arrivals/scheduling, truck turn times, availability of terminal equipment and labor utilization, chassis availability, and data measures to evaluate improvements and track system metrics.

2.3.7 Other Involved Personnel

There are several other entities, or supporting stakeholders, that have an impact on the current system or provide/exchange information to the key users. These entities are briefly described below.

2.3.7.1 Ocean Carriers

Ocean carriers are the primary means by which international containerized freight arrives in the U.S. and therefore influence the volume and timing of container movements. Port staff and MTOs are aware of ship arrival times, ship arrival delays, and the contents of each vessel. Daily email newsletters from the Port notify motor carriers, NVOCCs and BCOs of which ships are anchored or berthed. Numerous alliances, carriers, and services call in Oakland including: Australia National Line (ANL), American President Lines (APL), Compagnie Maritime d'Affrètement- Compagnie Générale Maritime (CMA-CGM), COSCO Shipping, Evergreen, Hamburg Sud, Hapag-Lloyd, Hyundai, Kawasaki Kisen Kaisha, Ltd. (K-Line), Maersk, Matson, Mitsui O.S.K. Lines (MOL), Mediterranean Shipping Company (MSC), Nippon Yusen Kaisha (NYK), Orient Overseas Container Line (OOCL), Pasha, Pacific International Lines (PIL), Polynesia Line, Wan Hai, Yang Ming, and ZIM.

2.3.7.2 Chassis Providers

Chassis providers are Intermodal Equipment Providers (IEPs) who offer intermodal equipment, in this case chassis for transportation in interstate commerce. Chasses can be picked up inside or outside of the terminal gates. A lack of data on real-time inventory and road abilities of the chassis adds to the complexity of achieving efficient turn times. There are three key providers: Flexi-Van, Trac, and Direct ChassisLink, Inc. (DCLI). Some truckers also use private fleets. The Port is trying to establish a gray pool to eliminate chassis/ocean carrier exclusivity issues.

2.3.7.3 Rail Company Operators

BNSF Railway and Union Pacific Railroad (UPRR) own and/or operate lead tracks and intermodal rail yards at the port. UPRR owns their property while BNSF leases their yard from the Port. BNSF uses UPRR right of way to get into the Port. Trains on the at-grade rail crossings impact truck traffic causing delays on Port arterials. The 7th Street Grade Separation will alleviate one of these crossings.

2.3.7.4 California Highway Patrol

The CHP provides safety, service, and security to the people of California by patrolling and responding to incidents and emergencies on state highways. Specific to goods movement, the

CHP also operates and manages California's WIM / commercial vehicle enforcement facilities located on area freeways. CHP also does regular commercial vehicle enforcement in the Port area.

2.3.7.5 Alameda County Transportation Commission

Alameda CTC plans, funds, and delivers transportation infrastructure projects throughout Alameda County. With respect to goods movement, Alameda CTC partnered with MTC to jointly develop the Countywide Goods Movement Plan and the Regional Goods Movement Plan. Alameda CTC is also leading a Bay Area Goods Movement Collaborative which brings together partners, community members and stakeholders from across the county and region in an organized structure to understand goods movement needs and identify, prioritize and advocate for short- and long-term strategies to address these needs in Alameda County and the Bay Area. Alameda CTC is the Project sponsor and implementing agency for this project.

2.3.7.6 California Department of Transportation

Caltrans is responsible for improving mobility across California. They are in charge of operating, maintaining and improving the 50,000 miles of highway and freeway lanes, as well as inter-city rail services, airports, and heliports. Caltrans owns and operates I-80, I-580, and I-880, which are critical Port access routes. Caltrans operates a variety of ITS and technology systems and equipment to help manage traffic including vehicle detection, CCTV cameras, CMS's, communications infrastructure, ramp metering, ICM, and HAR, signals at ramp junctions, and a TMC. They also maintain the *QuickMaps* webpage presenting several types of real-time traffic information layered on a Google Map including traffic speed, lane and road closures due to construction and maintenance activities, incident reports, CMS content, camera snapshots, and active chain control requirements.

2.3.7.7 Metropolitan Transportation Commission

The MTC is the regional metropolitan planning organization (MPO) and is responsible for planning, financing and coordinating transportation for the nine-county San Francisco Bay Area. MTC supports the streets, roads, highways, transit systems, airports, movement of goods, and other transportation resources. MTC works closely with Caltrans and county congestion management agencies to maximize the efficiency of our existing freeway network. Relevant to this effort, MTC provides: *511*® traveler information via phone and the web; manages the Bay Area Express Lanes program; maintains and updates the Bay Area ITS Architecture; and implements the Bay Area Freeway Service Patrol (FSP) as MTC SAFE, a roving tow truck patrol program to respond to incidents, in conjunction with Caltrans and CHP. MTC also prepared a new San Francisco Bay Area Goods Movement Plan in early 2016 which was closely integrated with the Alameda CTC's plan.

2.3.7.8 City of Oakland

The City owns a portion of the land within the greater Port complex and has jurisdiction over connecting arterials between the freeways and the Port. The City owns, operates, and maintains a variety of ITS including signal systems, CCTV cameras, vehicle detection, CMS's, transit signal priority, and emergency vehicle pre-emption. The OPD monitors Port arterials for incidents and enforcement such as red light violations, truck and trailer code enforcement, overturned trucks, sideshows, and protests. Some of these incidents require coordination between Port security personnel and CHP.

3. Justification for and Nature of Changes

The Project is intended to improve circulation, reduce congestion and emissions, improve safety, and support both existing and proposed Port activities. As part of this, Alameda CTC and the Port seek to improve the efficiency of freight transportation through the use of ITS and technology.

This section outlines the problems associated with the current situation, and the desired capabilities that are motivating the proposed ITST projects at and accessing the Port.

3.1 Justification for Changes

As noted, the efficiency of cargo movement within the Port is hampered by traffic congestion and operational issues during peak MTO daytime operating hours, particularly along Maritime Street, 7th Street, and Middle Harbor Road. This is due to multiple factors such as gate downtimes for at-grade train crossings at major intersections, limited terminal gate hours, avoidance of traffic on regional freeways, ship arrival times, increasing size of container ships, ocean carrier changes, chassis fleet ownership, terminals changing from wheeled to decked operations, queuing at MTO gates, MTO operations, etc. In addition, the current annual marine container volume of 2.4 million TEUs is anticipated to reach 4.05 million TEUs by 2035.

The problems and deficiencies associated with the traffic-related situation were sourced from the following:

- **Existing ITST Plans and Facilities Report –** This separate report created for this project identified the current state of existing ITST for the Port and environs. Current operations were also presented with initial findings of user needs.
- **Comprehensive Traffic Study Report –** Traffic study analysis was completed to evaluate the future operational conditions of the existing Port roadway network under future forecasted growth of truck volume and intermodal truck trips. ITS elements such as traffic signal improvements and arterial coordination provide substantial benefits to reduce traffic delay for trucks serving the Port.
- **2016 Port of Oakland Terminal Gate Survey –** This survey was conducted as part of this project and included some questions related to the truckers' use of technology or mobile apps for their travel to or from the Port. They also provided opinions on what technology or infrastructure

improvements could be implemented at the Port to make their operations more efficient. Approximately 350 private sector truckers responded representing motor carriers from within the Bay Area and various parts of the Central Valley or beyond, traveling to the marine terminals, the Roundhouse Property, or the rail yards.

- **PETF –** Archived meeting minutes from the PETF dating back to 2015 were reviewed and relevant travel-related problems, issues, and potential improvements were compiled.
- **Stakeholder Interviews –** One-on-one phone interviews were conducted with several PETF members including BCOs, chassis providers, motor carrier dispatchers and operations managers, an NVOCC, and MTOs. Questions were focused towards identifying features of the current system that has worked well to improve operational efficiencies as well as desired features that would address gaps in the current system. In addition, the CHP was contacted to obtain their input on goods movement challenges and WIM needs and potential improvements both at the Port and along regional highways.
- **Other Relevant Documentation –** As part of the Existing ITST Plans and Facilities documentation effort, a variety of literature was compiled to help identify deficiencies, needs, and opportunities for the efficient movement of goods within and accessing the Port. Relevant information was compiled from a variety of documents including: San Francisco Bay Area Goods Movement Plan, March 2016; Alameda County Transportation Commission Goods Movement Plan February 2016; City of Oakland West Oakland Specific Plan, 2014; City of Oakland ITS Strategic Plan Update, 2014; and Port of Oakland Gate Study, 2016.
- **CAC –** The CAC was developed as a forum to obtain public sector agency stakeholder input. Members include Alameda CTC, Port, MTC, Caltrans, and the City. In-person working sessions were held to provide a platform for stakeholders to review and expand upon the user needs identified through the sources above and provide input on recommended potential ITS and technology improvements and solutions.

3.1.1 Deficiencies of the Existing System

The stakeholder input identified several common threads of deficiencies in the existing system. Some of the key issues are summarized below and grouped under common themes of Port and traveler information, traffic and incident management, safety, environment and emissions, parking, and others.

- **Port and traveler information –** Signage on Port property for traveler information and traffic control is lacking. Many truckers are heavily reliant on information and direction from dispatchers. Dispatchers are monitoring several, separate systems for information on the marine terminals and roadways between marine terminals and BCO drop-off location(s). Little of this information exists in an organized fashion for the portion of the truck trip between the freeway and the marine terminals and intermodal yards. While some traveler information is available via the Internet, sources of information are disparate and need to be consolidated and relevant to the goods movement stakeholders to provide better coordination and time savings. At times, there are issues with information accuracy, timeliness and consistency between sources. Travel time apps do not

provide truck-specific travel times which can be significantly different for longer truck trips (e.g., trucks traveling through the Altamont Pass with grades that dramatically reduce truck speeds compared to autos). Performance metrics, currently available in a limited capacity, are not readily available for trending analysis limiting the ability for trucking companies and Port personnel to perform higher level route planning and optimization and operations. It should be noted that some truckers do not access mobile apps for traveler information.

- **Traffic and incident management –** Delays caused by long gate queues were among the most cited inefficiencies. Chassis lot searches and at-grade rail crossings in the Port further increase truck turn times. Truckers do not have a reliable way to view CCTV video streams of arterial conditions while in the Port unless they have Internet access (which is limited) and can view the available cameras. Only about 25 percent of the CCTV cameras are high-definition (HD) which are needed for effective traffic management and incident detection. Lack of signal coordination and street design features hinder the movement of goods on major truck arterial routes. Port staff uses ad-hoc methods for incident management. There are no internal traffic or incident response and clearance protocols or information on detour options. There are also no communication protocols with the City, Caltrans, CHP, or other stakeholders for major traffic disruptions at the Port on a regional basis.
- **Safety –** At-grade railroad crossings within the Port create queues and modal conflict concerns, as well as the crossings south of the Port along Embarcadero. Increasing rail usage will exacerbate these Port challenges. Stakeholders indicated there is a significant amount of red light, stop sign, and parking violators within the Port with limited resources for enforcement. There are occasions when the truck weight on paperwork is inconsistent with the actual load. Overweight trucks pose additional safety risks to themselves and other vehicles on the road.
- **Environment and emissions –** Emissions from goods movement can create significant health risks and exposure to noise can also adversely affect the health and well-being of residents. Technology and operational strategies can reduce impacts of goods movement activity on the health, safety, and quality of life in neighboring communities. The Port is continuously seeking to take reasonable steps to reduce such environmental risks.
- **Parking –** Illegally parked trucks are a common issue on Port property and there is limited enforcement by OPD. While parking options are available at the Port at the Howard and Berths 20-24 terminals providing daily, weekly, and monthly parking, they have limitations (e.g., no hourly parking or payment options and manual processing). Automation could optimize use of this space, provide flexible time use, payment options, and reduce overhead costs.
- **Other –** Public sector elements of the goods movement system involves different local, regional, state, and federal agencies who must work together to pool resources and implement programs. A formal institutional framework and better communications, cooperation, and collaboration are needed between the various stakeholders. A lack of data sharing between local, regional, state, and federal entities has created disparate systems with data redundancies, inconsistencies, and lack of transparency to both the agencies and the public. Public-Private Partnerships (PPP) should be considered for funding technology improvements, particularly in the future (e.g., connected and

automated vehicles improvements, FRATIS enhancements, etc.). Operations and maintenance costs and resources need to be considered for efficient traffic operations.

3.2 Description of Desired Changes

The desired system needs or capabilities (as developed from the trucker surveys, PETF meetings, CAC meetings, and individual stakeholder interviews) were grouped into specific functional areas, as shown in **Table 2**. System capabilities were ranked according to the following categories:

- High – The need is a "must-have" and should be considered essential to an initial operating system development.
- Medium – The need is a "should-have" or desirable capability for which there is considerable interest, but it not necessarily critical to an initial operating system.
- Low – The need is a "nice-to-have" or not viable in the near-term and may provide extra desirable functionality (these could potentially become add-on features in future system development).

Table 2: GoPort Freight ITS Capabilities and Functional Areas

ID	User Need/System Capability	Priority	Functional Area(s)
1. **Need for CMS to disseminate information**	CMS's, also known as dynamic or variable message signs, are needed within, approaching, and departing the Port to display travel times, traffic control messages, designated truck routes, route choices for specific destinations, incidents, terminal closures, etc. Ideally, information that is relevant to motor carriers traveling into the Port can be displayed on freeway CMS's to provide notice in advance of arriving at the Port. Truckers through the terminal gate survey and stakeholder interviews indicated a need for CMS's, particularly for those not using apps.	High	• Port and traveler information
2. **Real-time and static Port and truck traveler information (local and regional) needs to be consolidated, timely, and easily available**	Motor carriers, dispatchers, NVOCCs, and BCOs can all benefit from timely access to updated transportation-related information at or accessing the Port. Information needs to be consolidated, accurate, consistent, transparent, and instantaneous. Desired compiled/consolidated information includes traffic, ship arrival, custom hold times, turn times, chassis availability, chassis location, truck parking availability, performance metrics, incidents, at-grade rail crossing blockages or delays, truck trip times to major goods movement destinations and truck route options, better and more frequent updates of what is happening during unusual	High	• Port and traveler information

ID	User Need/System Capability	Priority	Functional Area(s)
	events or incidents; trends over time: etc. While the Port staff have some of the information and are informed visually of many issues, functionality is needed so that the information can be disseminated to multiple traveler information sources (e.g., *511*, applicable CMS's). The 2016 terminal gate survey indicated a need for a Port app. The CAC indicated a need for real time and accurate trucker information and information sharing between public agencies. Caltrans would also like trucker feedback to them on roadway conditions and make oversize/overweight routes, bridges, and other information to truckers more readily available. Terminals would like information about traffic delays on the nearby arterials and freeways, and for trucks coming in from the Central Valley.		
3. **Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.)**	Several factors have impacted gate queues such as mega-ships, import growth, additional gate moves from container supply and return rules, chassis supply and relocation trips, stacking and digging, container yard congestion, truckers trying to beat traffic, etc. Truckers previously were making 3-4 turns per day, now they are down to two. The 2016 terminal gate survey indicated a need or desire for more lanes, more digital gate intercoms, computers, RFID processing, traffic control, more card reader pedestals, more gates, improved in-gate and out-gate procedures, queue monitoring, lane management by type, shorter wait times, fingerprint system at pedestals for transactions, etc. in order to reduce turn times. More shifts, longer gate hours, or implementation of new technology is needed to help manage the storage and retrieval of containers. At-grade railroad crossings in the Port further slowdown trucks. Slow turn times at the Port due to truck queueing, uncoordinated drayage trucker arrivals, and blockage of truck access routes by rail lines through the Port pose significant reliability issues that impact the competitiveness of the Port to shippers.	High	• Traffic and incident management
4. **Need for enhanced and expanded traffic**	Truckers and dispatchers need the ability to view CCTV video streams beyond what is available from the Port. All of these	High	• Port and traveler information

ID	User Need/System Capability	Priority	Functional Area(s)
monitoring system near and in the Port	approximately 20 CCTVs need to be replaced and when replaced, they need to be pointed in an optimal position for live streaming. Only about 25% of the CCTV cameras at the Port are HD. There is a need to have all of the cameras upgraded to HD for effectiveness of traffic management, viewing, and incident detection and management. More cameras need to be installed around the Port to fill gaps in surveillance (e.g., between the Port and freeway access ramps, train approach and gate arm areas). Expansion of RFID readers and access of that information to other stakeholders can help provide needed data.		• Traffic and incident management
5. **Need for improved traffic signal systems (e.g., signal coordination, truck signal priority) on roadways accessing and within the Port**	The 2016 terminal gate survey indicated a need for traffic detection signal equipment improvements. MTC and Alameda CTC plans indicated that many of the highway and roadway infrastructure components are dated and structurally obsolete, posing traffic flow and operational issues. Interconnecting the signal system along truck routes can minimize delay, improve traffic flow, and reduce emissions. The CAC is also interested in incorporating signal systems that have bicycle and pedestrian detection and count abilities for monitoring purposes. Need to coordinate with both City and Caltrans signal systems.	High	• Traffic and incident management
6. **Need to establish coordinated enhanced incident management programs for the Port and facilities accessing the Port**	Need to establish defined Port incident management guidelines, protocols, and processes. Need ability to alert truckers of street closures, accidents, and detour options and to disseminate incident related alerts to multiple traveler information sources (e.g., *511*, CMS's, etc.). Incident management needs should also include construction activities, emergency evacuation, and any other disruptions to traffic flow. Incident details need to include location, predicted delay and clearance times, and alternate routes.	High	• Traffic and incident management
7. **There is a need for TMC capabilities and equipment at the Port**	The Port EOC also provides traffic management and control functions without the appropriate TMC facilities, equipment, and protocols to effectively support operations. The 2016 terminal gate survey indicated a need for better traffic management and traffic control. Existing	High	• Traffic and incident management

ID	User Need/System Capability	Priority	Functional Area(s)
	communications and security infrastructure can be used to support TMC and various ITS deployments throughout the Port.		
8. **Need to improve real-time situational awareness of the Port property and operations**	The Port's 24X7 PSMS currently monitors activity in the port via CCTV, OPD/OFD CAD and Radio, and other sources of information such as reports of accidents and spills in the maritime area. The EOC staff currently operate the CCTV cameras and help monitor and manage traffic operations so it is envisioned that any planned TMC capabilities will be connected to the PSMS.	High	• Traffic and incident management • Safety
9. **Need to continue to identify and mitigate environmental and emissions related impacts**	The MTC Goods Movement Plan states that queuing, congestion, and Port operations can lead to air quality and health impacts for neighborhoods near the Port. The region's goods movement facilities tend to be concentrated in close proximity to communities where environmental justice concerns are significant. There is a need to address environmental justice issues while reducing greenhouse gas emissions. The region continues to pursue strategies to address climate change and environmental sustainability. Freight's economic benefits must be balanced with environmental concerns. Technology and operational strategies can reduce impacts of goods movement activities on the health, safety, and quality of life in neighboring communities. In addition, exposure to noise and light also can adversely affect the health and well-being of residents. It is estimated that the Port contributed about 29% of the pollution to the West Oakland community. The West Oakland Strategic Plan states that there is a need to continue, expand and improve the Port's diesel truck replacement program.	High	• Environment and emissions
10. **Need short- and long-term parking solution for trucks**	Some trucks currently park illegally. Truck parking is needed to accommodate extended gates in the long-term if existing terminals being used for parking are used for shipping. There is a need for hourly and overnight parking facilities with the ability to pay a parking fee in real-time as needed. Illegally parked trucks should be cited and towed. Parking is available and utilized now but improvements needed include online reservations, payment flexibility (e.g., hourly	High	• Parking

ID	User Need/System Capability	Priority	Functional Area(s)
	or actual time utilized is not available), and staffing needs. Truckers also need access to a secure parking facility as the Port has been experiencing a number of truck loads being broken into at night while the driver is asleep, when the truck and container are parked in line for the terminal to open.		
11. **Better communications, cooperation, and collaboration is needed between agencies/stakeholders**	One objective of the City ITS Strategic Plan Update is to coordinate transportation operations with other major transportation agencies in the Oakland area, including the Port, MTC, SMART Corridors, and Caltrans. The Alameda County Goods Movement Plan recommends developing a formal institutional framework for coordinating implementation. A formal institutional framework should define the roles and responsibilities of all implementing agencies, specify project priorities and likely timing, identify potential funding sources and responsibility for making applications for funding, and commitment from the participants to implement those elements of the category that are within their jurisdiction. The CAC has also identified the need to add CHP to the stakeholders and for information / collaboration / communications (e.g., WIM facility and info sharing). Also, should consider including Caltrans districts beyond District 4 (e.g., Sacramento, San Joaquin, etc.). Caltrans would also like trucker to provide feedback to them on roadway conditions. Trucking companies indicated that through the PETF communications and collaboration have dramatically improved and that the Port is doing a great job coordinating with the various stakeholders to make improvements. Communication is key for fluidity of truck movement and efficiency.	High	• Other
12. **Need to incorporate ITS elements into other capital improvement projects**	The City ITS Strategic Plan states that it is more cost-effective to incorporate ITS elements into other capital improvement projects, without substantial increase in cost. For example, communications links and signal improvements as part of roadway or interchange/intersection projects. The CAC indicated the need to look for opportunities to do ITS in other capital projects (e.g., I-80 ICM, I-880 ICM, I-580 ICM, MTC PASS	High	• Other

ID	User Need/System Capability	Priority	Functional Area(s)
	projects, transit/carpool improvements at I-880/Grand Avenue, etc.).		
13. **Need complete and improved communications infrastructure within the Port**	Need a direct connection to Caltrans to share information for traffic management purposes. The City is also interested in completing/expanding fiber availability. Need to close the fiber gap between Maritime/17th Street and the Caltrans office in Oakland. The 2016 terminal gate survey indicated there are a number of cellular signal dead spots and trucking companies indicated that voice cell coverage is poor in/near some of terminals, but texting capabilities is adequate. They also need better fiber and coverage to address blind spots. Although, stacks of containers may pose a challenge for WiFi.	High	• Other
14. **New technology or ITS improvements need to include operations and maintenance considerations**	Port staff indicate that in order for technology and ITS improvements to be efficient and successful, operations and maintenance requirements need to be clearly defined and understood prior to project implementation, included In the funding of the improvements and under warranty for extended periods to the extent possible, and part of the standard workflow.	High	• Other
15. **Need for a consolidated system and dashboard to compile and disseminate key performance indicators to measure port-wide efficiency**	Currently, sources of information are disparate. Ideally, they would be consolidated into a single app (some information available in CargoSmart, Port website, Customs). The PETF includes a Performance Metrics working group which recommended key performance metrics to measure port-wide efficiency including: truck wait time outside terminal gates (street-time); truck turn time within the marine terminal; on-time vessel arrival; import dwell time (average time from vessel discharge to out-gate); average rail transit time; percent of import shipments placed on Customs hold; average Customs hold time; and chassis availability (inventory, out-of-service units percentage, number of units idle over 60-days).	High	• Port and traveler information
16. **Need to consider PPP for potential funding and delivery of technology projects**	The MTC Goods Movement Plan states that there are opportunities for funding part or all of potential ITS and technology improvements through PPP (e.g., railroads, terminal operators, technology vendors, etc.). The Alameda County Goods Movement Plan recommends creating a technology	Medium	• Other

ID	User Need/System Capability	Priority	Functional Area(s)
	development collaborative that could involve a public-private collaborative that would ensure that the region's technology innovation sector helps to define application opportunities and is involved in delivering technology in response to public-sector demonstrations and procurements. The CAC recommends exploring options for PPP for smart parking systems.		
17. **Warehouse/distribution facilities in the Central Valley and beyond influence congestion and incidents on regional highways**	An increasing percentage of the region's distribution network has moved to the San Joaquin Valley and northern Nevada exacerbating congestion and incidents on inter-regional highways. Trucks and freight railroads compete with passenger transportation on increasingly congested roads and rail lines. Given projected truck traffic growth, Alameda County will likely continue to see conflicts between trucks and automobiles on its major highways. With the OAB and rail developments at the Port allowing more transloading, it is hoped that most of the growth will go directly to rail eliminating some trips to the Central Valley.	Medium	• Traffic and incident management
18. **Non-recurrent delay is an issue for truckers impacting travel time reliability and on-time performance**	Highly variable travel times due to non-recurrent delay are particularly problematic for truckers because they effect on-time performance and, in some cases, truckers may be penalized by shippers for poor reliability.	Medium	• Traffic and incident management
19. **Consider how construction and maintenance-of-traffic activities impact truck movement, including oversize/overweight**	A trucking company indicated that often construction and maintenance-of-traffic strategies don't effectively take truck movements, weights, lengths, and heights into consideration. For instance, K-rail placed to control traffic needs to consider truck turning radii at both interchanges as well as access driveways. In addition, temporary overhead wires, road closures during peak truck times, information dissemination methods, traffic signal sensors that take lane shifts into consideration, height/location of signals, weights of significant queues on bridges, etc. should be considered for construction.	Medium	• Traffic and incident management • Safety
20. **At-grade crossings introduce safety concerns, traffic delay issues, and noise impacts**	The MTC Goods Movement Plan found that at-grade crossings block traffic creating queues and modal conflicts. Also, train horn soundings at at-grade crossings disrupt quality of life for nearby businesses and	Medium	• Traffic and incident management • Safety

ID	User Need/System Capability	Priority	Functional Area(s)
	residents. The Alameda CTC Goods Movement Plan indicated that increasing traffic on rail lines also will create safety and community impact challenges that will require improvements to at-grade crossings or new rail quiet zones. At-grade railroad crossings in the Port, specifically on Maritime Street, where both at-grade crossings (one near 7th Street and the other near Middle Harbor Road) can simultaneously be blocked by trains. A blockage of the at-grade crossing of Maritime Street near 7th Street also results in significant truck queues that can extend as far back as I-880. Long at-grade crossing blockages need to be communicated via CMS or other notifications. The CAC suggested consideration of an adaptive signal system integrated with railroad crossings. A trucking company would like to have train arrival detection and information. The Port also needs better CCTV camera angles to get license plates for vehicles crashing into rail crossing arms.		• Emissions and environment
21. **Need for safe and efficient truck access to and from the County's industrial corridors**	The Alameda County Goods Movement Plan indicated that freeways and local truck routes in industrial corridors can create sources of conflict between trucks and other modes leading to a growing number of safety issues in corridors with heavy truck use. High levels of truck-involved crashes have been identified at freeway interchanges and approaches on local truck routes, many of which were designed without consideration of the high level of use by heavy trucks they currently receive.	Medium	• Safety
22. **Need for more traffic enforcement within and on roadways accessing the Port**	The 2016 terminal gate survey indicated a need for traffic enforcement for red light and stop sign runners and for safer streets. The West Oakland Strategic Plan encourages the enforcement of truck prohibitions and traffic laws that protect bicyclists and pedestrians and make the streets safer for the surrounding neighborhoods. Both the MTC and Alameda CTC Goods Movement Plans identify traffic violation and enforcement issues.	Medium	• Safety
23. **WIM stations are needed within the Port to allow improved truck operations on the**	PETF member indicated that there are occasions when the weight on the paperwork is inconsistent with the actual container or item. WIM stations installed within the Port	Medium	• Traffic and incident management • Safety

ID	User Need/System Capability	Priority	Functional Area(s)
region's freeways and get weighed 24x7	would allow truck drivers to identify possible weight issues before leaving the Port. Ports of Los Angeles/Long Beach are moving towards WIM stations to speed up processing. It may help safety by identifying and reducing overweight violation issues. The CAC stated that communication with the WIM stations beyond the Bay Area would be useful. A motor carrier wants outbound scales to check weights, particularly over weight loads and the potential for significant fines. CHP also agrees that WIM/scales should be added at the Port and trucks should be weighed before leaving the Port with a load since overweight vehicles are an ongoing issue. A longer-term desire is to change WIM protocol to allow trucks to bypass other weigh stations if cleared at the Port. Weight should not be stored, just posted for the driver to see. The lack of scales also means that some trucks cannot leave the Port area for night gate pickups.		
24. **Need for automated guidance**	The CAC identified the need for autonomous operations. This could be on regional highways in the future within the Port, particularly for intermodal connections.	Low	• Other
25. **Need for sustainable solutions**	The CAC indicated that there is a need for solutions to be more sustainable in nature. "Sustainable" may refer to many aspects of Port operations, for example, using LED lighting, or technologies that can support CV/automated vehicle (AV).	Low	• Other
26. **Connected vehicles are needed for goods movement efficiency**	The MTC Goods Movement Plan states that freight ITS, CV, and zero and near-zero emissions vehicles will be important elements of the future goods movement system in the Bay Area. This represents a PPP opportunity to bring these new technologies to the marketplace.	Low	• Traffic and incident management
27. **There is a need to consider truck-only lanes (TOL) for corridors with high truck volumes**	The MTC Goods Movement Plan proposes studying the potential for TOLs and/or use of existing HOV or express lanes in a managed lane concept where trucks could use during off-peak hours or buy-in to use the express lanes. This may require law/code changes.	Low	• Traffic and incident management

Source: Project team analysis of stakeholder input.

3.3 Priorities among Changes

Table 3 illustrates the features and capabilities of the GoPort Freight ITS that are deemed essential to successful implementation. The table highlights impacts to system effectiveness/usefulness if each feature or application is not implemented. Essential features are defined as the application areas associated with the capabilities described in **Table 2**.

Table 3: Essential Features for GoPort Freight ITS

Essential Feature	Impacts If Not Implemented
Port and traveler information – **CMS's** – **Real-time and static Port and truck-related information via a consolidated website/app** – **Enhanced and expanded traffic monitoring system** – **Fill WiFi and fiber communications gaps** – **RFID readers** – **CCTV cameras** – **Interagency communications and collaboration**	• Lack of Port and traveler information would reduce the usefulness of the system to all Port stakeholders. • Port and traveler information that is not disseminated to the appropriate audience would reduce the usefulness of the system to all Port stakeholders. • Non-real time information is less accurate, and therefore less useful (e.g., terminal queues, adverse weather conditions). • Stakeholders will not use the system if they perceive the information to be inaccurate. • Motor carriers and dispatchers would not be able to use the data to manage goods movement in real time if Port and traveler information is spread across disparate systems. • Lack of key performance indicators would prevent the Port from measuring port-wide efficiency and evaluating which investments are worthwhile. • Without the flexibility to reschedule pick-up appointments, motor carriers will spend time waiting in terminal queues. • Without CMS's, truckers will be unable to make informed decisions about their routes and may not receive important incident related information (particularly those without Internet access). • Without a consolidated website/app, stakeholders will have to continue to obtain information from disparate sources.
Traffic and Incident Management	• Motor carriers' turn times will be extended if they get caught in traffic congestion in around the Port area (e.g., on/off freeways,

Essential Feature	Impacts If Not Implemented
– **Enhanced and expanded traffic monitoring system** – **CMS's** – **Train detection equipment** – **WiFi, fiber and filling in communications gaps** – **RFID readers** – **CCTV cameras** – **Improved signal system** – **TMC/EOC** – **ATMS** – **Interagency communications and collaboration**	signals, rail-crossings, at terminal gates), which severely impacts economic competitiveness for the Port. • Technology investments made now that are not future-proof will become obsolete as connected and autonomous vehicles become ubiquitous. • Traffic signal coordination within the Port will yield minimal benefits if the coordination is not extended to the roadways accessing the Port. • If Port stakeholders are not properly notified of street closures, accidents, and detour options, these unexpected delays will further reduce trucks' travel time reliability and on-time performance, which is critical to the success of the industry. • Surges in traffic delay will continue to be an issue and will grow if roadways and at-grade crossings accessing the Port are not properly managed.
Safety – **Enhanced and expanded traffic monitoring system** – **CCTV cameras** – **Train detection equipment** – **TMC/EOC** – **Interagency communications and collaboration**	• Modal conflicts at rail at-grade crossings and truck queues will continue to grow causing safety and community impact challenges (e.g., noise, truck idling emissions). • Limited traffic monitoring and enforcement for red light/stop sign runners and illegal parking on Port property and roads accessing the Port can cause safety risks for other trucks, passenger vehicles, bicyclists, and pedestrians who share the road with trucks.
Environment and emissions – **CMS's** – **Real-time and static Port and truck-related information via a consolidated website/app**	• Port activities contributed approximately 29 percent of the pollution to the West Oakland community. With anticipated growth in Port TEUs, solutions that address local sources of pollution, as well port-related emission reductions strategies, will be important to implement. ITS and technology improvements have proven reductions in emissions and other environmental impacts.

Essential Feature	Impacts If Not Implemented
– **Train detection equipment** – **Interagency communications and collaboration**	• Trucks will continue to travel to and from the Port in surges and will experience congestion, safety, and reliability issues without real-time Port, goods movement, and incident information that is updated in real-time and easily available.
Parking – **Real-time and static Port and truck-related information via a consolidated website/app** – **Interagency communications and collaboration**	• Motor carriers who cannot find adequate parking options may be forced to park illegally on the side of the road, or may violate hours of service regulations. • Truck loads will continue to be broken into at night when the truck and container are parked in line for the terminal to open and the driver is asleep.
Other – **Interagency communications and collaboration**	• Public agencies may be less likely to collaborate or provide data if they see no direct benefit for them or their stakeholders. • Without interagency communications, collaboration, and agreements, the system cannot operate on a regional basis. • Without information sharing among local, regional, state, and federal agencies, the GoPort Freight ITS Information System/App will not be as comprehensive and efficient for users as desired. • Without exploring public-private collaborations, opportunities to take advantage of the region's technology innovation sector may be forfeited.

Source: Jacobs/Cambridge Systematics analysis of stakeholder input.

3.4 Assumptions and Constraints

The Project team has identified some key assumptions and constraints impacting the functionality that can be included in system development. These are discussed below.

3.4.1 Assumptions

- **System needs to include solutions to handle the maintenance-of-traffic during the 7th Street Grade Separation construction** – While the 7th Street Grade Separation will eventually eliminate some of the modal conflicts experienced by trains and trucks in the Port, congestion within the Port will become worse during construction. The proposed ITS solutions must also be able to help alleviate some of the impacts of the work zones for the grade separation project or any other construction activity within the Port.
- **Technology selected needs to be mature and have a proven track record** – Freight improvement projects can be costly and have a lengthy deployment period. The Port wants the proposed ITS solutions, particularly those in the immediate term, to be comprised of proven technologies that have a track record of being effective, so that funding for the GoPort Freight ITS is used wisely and the improvements can be utilized beyond a "pilot" period. All software will be commercial and off-the-shelf with the exception of the GoPort application which will be developed.
- **High-priority projects will be selected based on the highly desired needs of the wide variety of user groups interviewed** – User needs were collected from a wide variety of stakeholders, which included both public and private sectors. While it will not be possible to address all user needs with the enhanced system design, high-priority projects will revolve around the user needs that are most common between user groups.

3.4.2 Constraints

- **ITS and technology projects under this project should not be focused on the private side of marine terminal gates** – As marine terminals are leased out by the Port, the Port has minimal jurisdiction over the operations behind terminal gates. Many of the proposed ITS and technology projects will be confined to Port property outside of the gates, but could extend past Port property if the proper coordination channels are exercised with local, regional, and state agencies.
- **Center-to-center communications between agencies will be reliant on existing infrastructure** – The project is proposed to utilize existing fiber optic communications between the City and Caltrans to enable the communications link between the Port and Caltrans. The existing link between the Port and City seems to only require the use of a jumper at City Hall to connect through the existing fiber link installed as part of the I-80 Integrated Corridor Management project to Caltrans. There should be adequate bandwidth available through the remaining provisioned agency spares, however, this will be reviewed during the final design. In the event that the communications network is not sufficient, center to center communications would be limited to City and Port only for the transportation management projects.

- **Some of the technology projects may involve financial, regulatory, and policy implications –** Technology projects that involve the placement of technology on private stakeholder vehicles or property may require agreements and/or financial incentives for implementation (e.g., RFID tag or readers, GPS, etc.). Some of the longer-term improvements may also require regulatory changes (e.g., truck only lanes, connected and automated vehicle technology).
- **Projects for inclusion in the immediate term need to be implementable, operable, and manageable by the Port staff –** Projects included in the immediate-term need to be able to be implemented by the Port in a very short period of time to support their immediate operational needs. This puts technology such as connected and automated vehicles, freight signal priority, and dynamic lane control lower on the priority list. Interagency collaboration and data sharing will require time to formalize, so higher priority will be given to ITS projects where all elements fall under Port's jurisdiction.

Below is a list of desired system capabilities indicated by Port stakeholders that are not within the control of this Project.

Table 4: Desired Capabilities beyond the Project Scope

Desired Functionality/Capability	Explanation for Exclusion
1. **There is a need for an enhanced and expanded truck appointment system**	Terminal operators are responsible for the appointment system. However, a link to the appointment system will be provided via the GoPort freight ITS information system/app.
2. **There is a need for more efficient customer service within the terminal areas**	Port does not have jurisdiction over marine terminal operational issues.
3. **Need to improve the adequacy of the chassis fleet**	Chasses are managed by private entities and do not fall under Port's jurisdiction.
4. **There is a need to improve the efficiency of empty container supply and return**	Port does not have jurisdiction over container management.
5. **There is a need for economies of scale to support extended gate and terminal operations long-term (nights and/or weekends)**	Port has taken steps to promote but does not have direct jurisdiction over extended gates. This is not a technology issue.
6. **Ocean carrier business strategies have landside impacts**	Port does not have jurisdiction over ocean carrier business strategies.
7. **There is a lack of deck space for container placement**	Port is not responsible for terminal operations and utilization of deck space. This is not a technology issue.
8. **Some equipment within the terminal area are under maintained, out of service, unreliable, or insufficient for drayage needs**	This is not a transportation technology issue.
9. **There is a need for improved truck flow within the terminals to help reduce gate queues and congestion within the terminal**	Port has limited jurisdiction behind terminal gates. Terminals are responsible for balancing staffing/production with volume.

Desired Functionality/Capability	Explanation for Exclusion
10. **There is an issue with truckers cutting in-gate queue lines**	This is not a technology issue, it is an enforcement issue.
11. **Some shipments are not picked up in a timely manner**	This is not a technology issue.
12. **The rise in e-commerce may lead to more "last-mile" delivery issues**	Port does not have jurisdiction over logistics industry trends.
13. **There is a need to locate new trucking services closer to the Port and away from neighborhoods**	Cities are responsible for land use decisions and trucking businesses determine locations.
14. **Maintain truck routes needed to serve the Port but prohibit additional truck routes in neighborhoods**	City of Oakland is responsible for designating truck routes.
15. **Upgrades to street lights should take truck height and turning movements into account**	This is not a technology issue; this is a design issue that needs to be considered.

Source: Project team analysis of stakeholder input.

4. Concepts for the Proposed System

The identification and planning of the ITS and technology improvements in this ConOps came through outreach, research, and meetings conducted with the Project Development Team (PDT), CAC, Port staff, and interviews with key stakeholders in both the public and private sectors. This section of the document includes: an overview of the background and objectives; key operational policies and constraints; a description of the ConOps essential features, capabilities, and functions; profiles of the user classes; system-level operational environment and processes; modes of operation; and support environment.

4.1 Background and Objectives

The ITS and technology components of the projects in this ConOps are intended to improve the efficiency, safety, and reliability of truck and rail access and circulation within the Port, as well as provide improved traveler information. In addition, they are also anticipated to improve the competitiveness of the Port, while also generating benefits that extends beyond the Port area such as reduced regional congestion, emissions, and job creation.

The GoPort Freight ITS focus is primarily aimed at traffic control and operations of arterial roadways in the Port environment and regional traveler information dissemination to and from the Port. Other transportation and Port functions that can impact traffic operations are considered in the ConOps such as MTOs and railroads, but improvements and control are focused on Port-owned facilities and operations.

Some of the key objectives of the ITS and technology components of the GoPort Freight ITS are to:

- Improve traffic information and management within the Port, it's terminals, and access routes
- Improve traffic observation, verification, and monitoring

- Enhance information sharing during an emergency or incident
- Improve transportation communication with the City and Caltrans
- Develop an ITS communication network that serves future needs
- Provide TMC functionality at the Port for better traffic control, management, and monitoring
- Reduce traffic congestion, truck idling, and emissions
- Provide improved terminal wait time and turn time information
- Improve traffic management during construction projects
- Minimize conflicts between transportation modes
- Provide a platform and data to facilitate improved terminal operations and efficiency
- Improve goods movements along major traffic routes.

4.2 Operational Policies

The following summarizes some of the key operational policies for system development:

- **Data security and privacy** – The systems will comply with any legal requirements for the protection, security, and privacy of data provided by and shared with stakeholders during system development, testing, and implementation**.**
- **Driver distraction laws** – Any applications will be designed in a fashion that prevents potential safety hazards from distracted driving. For instance, notifications will be provided in a format that does not require the driver to take his or her eyes off the road.

4.2.1 Constraints

The following summarizes key operational constraints for system development:

- **ITS projects should not be focused on improvements behind marine terminal gates** – As marine terminals are leased out by the Port, the Port has minimal jurisdiction over the operations behind terminal gates. Proposed ITS and technology projects will be confined to outside of the terminal gates.
- **Center-to-center communications between agencies will be reliant on existing infrastructure** – The project is proposed to utilize existing fiber optic communications between the City and Caltrans to enable the communications link between the Port and Caltrans. The existing link between the Port and City seems to only require the use of a jumper at City Hall to connect through the existing fiber link installed as part of the I-80 Integrated Corridor Management project to Caltrans. There should be adequate bandwidth available through the remaining provisioned agency spares, however, this will be reviewed during the final design. In the event that the communications network is not sufficient, center to center communications would be limited to City and Port only for the transportation management projects.
- **Proposed projects in the immediate-term need to be proven technology** – The Port does not want to implement, operate, and manage “pilot” type improvements that will become obsolete

within a short timeframe; they want permanent, proven technology solutions. This puts technologies, such as connected and automated vehicles and freight signal priority at a lower priority level which is included in the future category.

4.3 Description of ConOps Essential Features, Capabilities, and Functions

The chief purpose of this ConOps is to define the anticipated Port operations and technologies needed to manage traffic and incidents on the arterials within the Port, as well as the traveler information and communications needed to improve goods movement efficiency. This section describes the proposed system and improvements that have been identified based on stakeholder desired changes and identified user needs. The descriptions are provided at a high-level, indicating the operational features and functionalities without specifying design details or technology specific solutions. More detail will be provided in the ITST Master Plan effort under this project.

This effort identified six groups of interrelated project improvements to improve goods movement within the Port area and for regional freight travel to and from the Port including:

1. Communications and Collaboration
2. GoPort Traveler Information Dissemination
3. Observation and Detection
4. Traffic and Incident Management
5. Goods Movement Support Systems & Technology
6. Port TMC/EOC

The improvements are centered towards an enhanced TMC/EOC operating at the Port that observes, monitors, and manage traffic and incidents on Port facilities and compiles, shares, and disseminates freight traveler information and data with stakeholders (see **Figure 2**).

Figure 2: GoPort Freight ITS Operations Overview

These proposed improvements have been categorized into two categories, each with increasing system sophistication:

- **Immediate**
    - Highest priority and need
    - Foundational to subsequent deployments
    - Addresses maintenance-of-traffic challenges during construction of the 7th Street grade separation and other construction projects within the Port

- **Future**
    - Features build upon the Immediate ITS package
    - Important to have but not essential or cannot be completed in the immediate-term.
    - "Nice-to-have" features
    - Technology may still be conceptual or not mature enough
    - Project elements were not identified by many stakeholders through user needs process

Table 5 summarizes the ITS improvement projects included in each of the two categories.

Table 5: Summary of GoPort Freight ITS Improvement Projects

Immediate	Future
• Communications (WiFi) • Communications (Fiber) • CCTV upgrade to HD • Queue detection • ATMS (includes centrally controlled signal system) • Adaptive signal system • RFID readers • CMS's • Joint TMC/EOC • Supplemental vehicle detection (speed) • C2C communication (includes interagency collaboration) • Advanced train detection system • WIM technology • GoPort freight ITS information system/application • Basic smart parking system	• Freight signal priority • Enhanced GoPort freight ITS information system/application • Dynamic lane control • DSRC • Enhanced smart parking system • Enhanced ATMS • Connected and autonomous vehicles

Source: Jacobs

4.3.1 Immediate ITS and Technology Projects

The Immediate category of projects encompasses the highest priority stakeholder needs. These functionalities/capabilities are foundational to subsequent deployments in the Future categories. One critical requirement is the inclusion of ITS and technology projects which have the ability to help address maintenance-of-traffic challenges during the construction of the Project.

Table 6 lists the projects proposed for the Immediate category of improvements, high-level details for implementation, and traces back to the user needs identified in **Table 2**.

Table 6: Immediate GoPort Freight ITS Projects and User Needs Addressed

Functionality/Capability	Description	User Need Addressed
Communications (WiFi)	Add WiFi capabilities as a backup communication system and a means for addressing cellular dead spots – a major issue in parts of the Port. This can enhance security and emergency response functions. Offers amenities to truckers in queue or within the Port (e.g., Port traffic and gate queue videos; improved access to GoPort freight ITS information system/app and *eModal*; enhances driver entertainment/personal communications while parked within Port). Can potentially be leveraged to enhance gate queue time measurements (similar to Bluetooth). Enhances Port staff capabilities to transmit and receive "last mile" data and control.	11. Better communications, cooperation, and collaboration is needed between stakeholders 13. Need complete communications infrastructure within the Port
Communications (Fiber)	Complete the fiber network so technology improvements at the Port are served by a fiber communications network backbone to the greatest extent possible. This will set the foundation for connection and control of all other ITS elements.	11. Better communications, cooperation, and collaboration is needed between stakeholders 13. Need complete communications infrastructure within the Port
CCTV upgrade to HD	Upgrade the existing CCTVs to HD, to fill-in surveillance gaps and deploy vehicle video detection software for speed information. Cameras can address surveillance and traffic needs simultaneously but HD imaging is needed for appropriate traffic and safety analysis. May need to install new poles for cameras focused on vehicle detection. Fiber connected to the greatest extent possible.	4. Need for enhanced and expanded traffic monitoring system near and in the Port 8. Need to improve real-time situational awareness of the Port property and operations
Queue detection	Add automatic queue detection for incidents (i.e., idling vehicles). Additional technology is needed to supplement video detection for	3. Need to refine identification of and better manage traffic queues and surges in and

Functionality/Capability	Description	User Need Addressed
	vehicles. Equipment will be located at known hot spots. The detection of the hot spot locations will be communicated to the trucker community through GoPort app driver alerts, CMS displays, and any applicable traffic operations modifications.	around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 4. Need for enhanced and expanded traffic monitoring system near and in the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts
ATMS (includes centrally controlled signal system)	Upgrade existing signal system to allow connectivity and control by the TMC/EOC. Equipment will be connected to the same fiber network. Signal controllers with networking equipment will be installed. Will involve coordination with the City and potentially Caltrans. Set up software to receive/transmit traffic information, control messages, and control traffic signal systems. Software should be upgradeable to allow further automation and enhancements. Allows for potential connections/collaboration of operations with other public sector equipment and systems.	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 4. Need for enhanced and expanded traffic monitoring system near and in the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts

Functionality/Capability	Description	User Need Addressed
Adaptive signal system	The ATMS software will be upgraded to allow for an adaptive traffic signal system control. Adaptive signal control, unlike conventional pre-programmed time-of-day signal timings, utilizes the intersection vehicle detection and sensor equipment to adjust the timing of red, yellow and green phases for each approach as well as overall cycle lengths. This aims to accommodate changing traffic patterns and reduce congestion by improving vehicle progression. This may include the addition of more video-based vehicle detection cameras or other sensors, as necessary.	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 4. Need for enhanced and expanded traffic monitoring system near and in the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts
RFID readers	The existing RFID network will be expanded to allow the Port to improve the accuracy and reliability of the calculation of turn times and acquire refined information on truck movements. Allows for growth into FRATIS or other technology deployments.	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 4. Need for enhanced and expanded traffic monitoring system near and in the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts
CMS's	Informs truckers on regional conditions as they leave the Port and Port incidents or Port information as they enter. May provide dual-faced CMS installations to limit equipment infrastructure requirements. CMS's will be fiber connected and connectivity to the TMC/EOC will allow access and control by the traffic management system. Mounting options include overhead and roadside but need to consider construction activities and geometric considerations (e.g., oversize loads for both height and turn radius).	1. Need for dynamic CMS's to disseminate information 3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.)

Functionality/Capability	Description	User Need Addressed
Joint TMC/EOC	New ITS elements will integrate with existing security equipment, functions, and EOC at this facility. Will establish the ability to have situational awareness of Port operations in one room. A "home" for control of the ATMS and where Standard Operating Procedures (SOPs) and business process plans will be created and centered around. Provides basic communication/connections to other public agencies to coordinate transportation and incident management (e.g., Caltrans, CHP, City, MTC, U.S. Coast Guard (USCG), and Department of Homeland Security (DHS)).	4. Need for enhanced and expanded traffic monitoring system near and in the Port 6. Need to establish coordinated enhanced incident management programs for the Port and facilities accessing the Port 7. There is a need for TMC capabilities and equipment at the Port 8. Need to improve real-time situational awareness of the Port property and operations 9. Need to continue to identify and mitigate environmental and emissions related impacts 11. Better communications, cooperation, and collaboration is needed between stakeholders 14. New technology or ITS improvements need to include operations and maintenance considerations 22. Need for more traffic enforcement within and on roadways accessing the Port
Supplemental vehicle detection (speeds)	Non-intrusive midblock detection would fill in gaps from video detection and also provide speed information. Speed information can help identify potential traffic queues or incident issues, at Port entry and exit locations. SVD will provide the additional data to the ATMS to provide 'gateway'	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.)

Functionality/Capability	Description	User Need Addressed
	classification, speed and volume counts at each entrance to the Port of Maritime Street, 7th Street and Adeline Street. It can also be presented on speed maps on video monitors at the TMC/EOC through the ATMS, as well as estimate travel times along Port arterial routes.	4. Need for enhanced and expanded traffic monitoring system near and in the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts
C2C communication (includes interagency collaboration)	Deploy new communication interfaces among the public sector agencies. Establish C2C policies. Essential for signal control and messaging. Begin the process of formal interagency communications and collaboration using the CAC involvement as a foundation for developing MOUs. MOUs will be needed as part of the design development process. Develop deployment plan for C2C communications. Interagency communications and collaboration are essential for signal control and messaging.	6. Need to establish coordinated enhanced incident management programs for the Port and facilities accessing the Port 11. Better communications, cooperation, and collaboration is needed between stakeholders 12. Need to incorporate ITS elements into other capital improvement projects 13. Need complete communications infrastructure within the Port 17. Warehouse/distribution facilities in the Central Valley and beyond influence congestion and incidents on regional highways
Advanced train detection system	Non-intrusive train detection can be used to provide warnings of long-trains and delays at at-grade rail crossings via CMS, GoPort freight ITS information system/app, and voice messaging.	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 9. Need to continue to identify and mitigate environmental and emissions related impacts

Functionality/Capability	Description	User Need Addressed
		20. At-grade crossings introduce safety concerns, traffic delay issues, and noise impacts
WIM technology	WIM technology would be located on Port property as a courtesy to trucks leaving the Port with new containers. This could initially start with a portable system. Can be done at slow speeds but smooth road surface is needed. Potential WIM information sharing and coordination with CHP. Future goal is to eliminate or reduce the need for trucks to go through additional weigh stations if cleared at WIM at the Port.	23. WIM stations are needed within the Port to allow improved truck operations on the region's freeways and get weighed 24x7
GoPort freight ITS information system/application	The GoPort traveler information app will be a multi-platform system (e.g., web, mobile app, email, etc.). It will be a consolidated portal of useful truck information and web tools. It will disseminate static and real-time Port messages and information regarding travel times, parking, incidents, wait times, terminal turn times, terminal information, etc. As a result, this application will be developed specifically for this project.	2. Real-time and static port and truck traveler information (local and regional) needs to be consolidated, timely, and easily available 3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 10. Need short- and long-term parking solution for trucks 15. Need for a consolidated system and dashboard to compile and disseminate key performance indicators to measure port-wide efficiency
Basic smart parking system	Provide system that monitors parking availability that can be shared via GoPort freight ITS information system/app and CMS's. Parking payment options would be available.	9. Need to continue to identify and mitigate environmental and emissions related impacts

Functionality/Capability	Description	User Need Addressed
		10. Need short- and long-term parking solution for trucks 22. Need for more traffic enforcement within and on roadways accessing the Port

Source: Jacobs/Cambridge Systematics

4.3.2 Future ITS and Technology Projects

The Future ITS category of projects includes projects or features which build upon the Immediate category functionalities and capabilities or stakeholders have suggested as projects that are recommended further down the timeline, but not essential to initial system functionality. Some of these technologies are still in their conceptual phases, or are not mature enough for the Port to implement as these technologies are not yet proven. These projects will need to be re-evaluated for their relevance to contribute to Port efficiency before implementation.

Table 7 lists the projects proposed for the Future, high-level details for implementation, and traces back to the user needs identified in **Table 2**.

Table 7: Future GoPort Freight ITS Projects and User Needs Addressed

Functionality/Capability	Description	User Need Addressed
Freight signal priority system	Upgrade existing adaptive signal system. Can also support "ramp metering-like" function to stagger trucks into/out of the Port during congested periods.	5. Need for improved traffic signal systems (e.g., signal coordination, truck signal priority) on roadways accessing and within the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts
Enhanced GoPort freight ITS information system/application	Add truck turn times to the system/app if not already incorporated in the Immediate category. Can potentially pull in functions from other applications. Add ability to make parking reservations. Could include potential future improvements such as some or all of the performance metrics,	2. Real-time and static port and truck traveler information (local and regional) needs to be consolidated, timely, and easily available 3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.)

Functionality/Capability	Description	User Need Addressed
	automation such as notifications, etc. Add in PPP procured eco-driving apps. Add in real-time performance metrics (e.g., as desired by PETF). Increase automation capabilities (i.e., automatic notifications). Add truck-specific travel times.	9. Need to continue to identify and mitigate environmental and emissions related impacts 10. Need short- and long-term parking solution for trucks 11. Better communications, cooperation, and collaboration is needed between stakeholders 15. Need for a consolidated system and dashboard to compile and disseminate key performance indicators to measure port-wide efficiency
Dynamic lane control system	Overhead gantries to be installed within the Port to direct appointment traffic or queues to manage travel flow. This is very infrastructure intensive.	1. Need for CMS's to disseminate information 3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 24. Need for automated guidance
DSRC (i.e. radios and infrastructure)	Deploy in preparation to communicate with future DSRC-equipped trucks (expected to be ubiquitous on trucks by the mid-2020s). Needed to support connected vehicles and can be used for a variety of other ITS and technology solutions (e.g., turn times, wait times, ATMS, performance metrics, etc.). DSRC radios will be tied into the fiber backbone and the ATMS. This feature may be dependent on federal mandates.	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 4. Need for enhanced and expanded traffic monitoring system near and in the Port 13. Need complete and improved communications infrastructure within the Port 25. Need for sustainable solutions 26. Connected vehicles are needed for goods movement efficiency

Functionality/Capability	Description	User Need Addressed
Enhanced smart parking system	System ties in with ATMS. Features include vehicle detection at parking spots, reservation system, and payment system.	9. Need to continue to identify and mitigate environmental and emissions related impacts 10. Need short- and long-term parking solution for trucks 16. Need to consider public-private partnerships for potential funding and delivery of technology projects 22. Need for more traffic enforcement within and on roadways accessing the Port
Enhanced ATMS	Expand upon ATMS capabilities implemented in Immediate phase. Automates and connects to the various systems from both the Port and other stakeholders, to the extent possible.	3. Need to refine identification of and better manage traffic queues and surges in and around the Port area (on/off freeways, signals, rail-crossings, at terminal gates, etc.) 4. Need for enhanced and expanded traffic monitoring system near and in the Port 9. Need to continue to identify and mitigate environmental and emissions related impacts 11. Better communications, cooperation, and collaboration is needed between stakeholders
Connected and autonomous vehicles	Deployments of connected and/or automated vehicle technologies are still in the early stages of development, testing, and implementation. Projects are to be determined based on the advancements in technology over the Immediate term. Solutions could include truck platooning, crash-avoidance, automated notifications based on real-time data (e.g., long train approaching), automated	9. Need to continue to identify and mitigate environmental and emissions related impacts 11. Better communications, cooperation, and collaboration is needed between stakeholders 16. Need to consider PPP for potential funding and delivery of technology projects 24. Need for automated guidance 26. Connected vehicles are needed for goods movement efficiency

Functionality/Capability	Description	User Need Addressed
	rubber-tire gantries, inter-terminal container movers, etc.	27. There is a need to consider truck-only lanes (TOL) for corridors with high truck volumes

Source: Jacobs/Cambridge Systematics team

4.4 User Class Profiles and Other Involved Personnel

The user classes are the same as those outlined in Section 2.3 for the "Current Situation".

4.4.1 Primary User Classes Profiles

The primary user groups that will be impacted from this project and how they will use the proposed ITS and technology improvements are summarized below:

4.4.1.1 Port of Oakland Staff

The Port will be the lead project manager for the GoPort Freight ITS overseeing the design, development, testing, and operations for projects implemented at the Port and will ultimately be responsible for the success of the project. This includes WiFi and fiber communications, CCTV upgrades, queue detection, train detection, ATMS, signal improvements on Port property, RFID readers, CMS's on Port property, TMC/EOC, GoPort freight ITS information system/app, vehicle detection, rail grade crossing system, WIM, smart parking system, freight signal priority on Port property, dynamic lane control, DSRC, and connected and autonomous vehicle technology improvements at the Port. They will directly coordinate with the other relevant stakeholders for data sharing and for project improvements defined in this effort that are not on Port property to ensure the user needs are met. This includes signals, information for the GoPort freight ITS information system/app, C2C communications, rail grade crossing systems, WIM, CMS and other ITS elements that are off Port property but affect access to the Port, and smart parking (if private partner is involved). Port staff will also take the lead on establishing and formalizing interagency communications, cooperation, and collaboration activities with the various stakeholders.

4.4.1.2 Alameda County Transportation Commission

As the Project sponsor and implementing agency for the GoPort Freight ITS project, Alameda CTC will provide administrative support services for managing the Project. Alameda CTC will provide input, support grant application preparation for potential funding, continued oversight, management of consultants, and provide some funding. Alameda CTC is the implementing agency and will have ultimate responsibility of meeting performance measures. Alameda CTC will also assist the Port in leading the establishment and formalization of interagency communications, cooperation, and collaboration (e.g., MOUs). The purpose of the MOU will be to formalize the operational functions and commitments to the project for each agency. These are still under development with the various stakeholders.

4.4.1.3 Concept of Operations Advisory Committee

The CAC should continue to participate in meetings with the Project team and review and comment on this ConOps report, the upcoming ITST Master Plan and possibly through final design and implementation. They should also review and comment on any other planning and engineering projects or grant applications related to the GoPort Freight ITS project. Members may also be involved in starting to formalize communications and collaboration efforts such as MOUs, letters of support, SOPs, data sharing, etc. CAC members are the GoPort Freight ITS project lead within their organization and should involve other personnel as needed.

4.4.1.4 Motor Carrier Operators and Dispatchers

Motor carrier operators and dispatchers will be one of the most significant users of the GoPort Freight ITS. Their input and review of the planning of many of the projects will be important to the success of the deployments. They will use WiFi, CCTV live video feeds, turn time and queue wait time information, WIM, smart parking, GoPort freight ITS information system/app, CMS's, and benefit from the more efficient traffic control and operations accessing within the Port. Conversely, motor carriers can provide data and information to the GoPort freight ITS information system/app (e.g., real-time incident information that can be shared with Caltrans).

4.4.1.5 California Department of Transportation

Caltrans should be engaged in the planning and design of the various systems that need to connect with Caltrans systems to ensure integration with its TMC. These would include communications, signal systems at gateway freeway ramp junctions, CMS's, ATMS, and WIM. Caltrans could share and/or receive data to and from the GoPort freight ITS information system/app such as video feeds, travel times, CMS messages, CHP incidents, road closures, etc. Caltrans will also need to be involved with the establishment and formalization of interagency communications, cooperation, and collaboration efforts associated with links to or use of Caltrans systems (e.g., MOUs).

4.4.1.6 City of Oakland

The City should be engaged in the ITS planning, design, implementation, and operations of systems connecting to or on City facilities to ensure integration with the City TMC. These include communications, detection, ATMS, signal systems, CMS's, and connected and autonomous vehicle technology. The City could share and/or receive data from the GoPort freight ITS information system/app and ATMS that could be used to manage traffic flow on arterials. The City will also need to be involved with the establishment and formalization of interagency communications, cooperation, and collaboration efforts associated with links to or use of city systems (e.g., MOUs).

4.4.1.7 Metropolitan Transportation Commission

MTC will be engaged to ensure ITS components integrate with the regional ITS architecture and traveler information systems. MTC could share and/or receive data from the GoPort freight ITS information system/app such as travel times and incidents. Information obtained through the GoPort Freight ITS will be sent to the 511 system. MTC will also need to be involved with the establishment and

formalization of interagency communications, cooperation, and collaboration efforts associated with links to or use of MTC systems (e.g., MOUs).

4.4.1.8 California Highway Patrol

The CHP should provide review and comment on the WIM improvement and coordinate with the Port on the potential for information sharing and clearance at the port facility. Computer Aided Dispatch (CAD) information could potentially be shared also, in the event that this information is unavailable from Caltrans.

4.4.1.9 Port Efficiency Task Force

This stakeholder group can provide key advice and review pertaining to all aspects of Port operations and efficiency, and should provide review and comments on the planning of the projects.

4.4.2 Other Involved Personnel Profiles

There are several other entities, or supporting stakeholders, that will use or support the proposed GoPort Freight ITS. These entities are described below.

4.4.2.1 Marine Terminal Operators

MTOs could have the option to share and/or receive data with the GoPort freight ITS information system/app. They could also provide review and comments on the planning of the GoPort Freight ITS projects through participation in the PETF.

4.4.2.2 Rail Company Operators

BNSF and UPRR could have the option to share static and real-time train information to the GoPort freight ITS information system/app and the TMC/EOC such as train schedules, anticipated delays due to trains blocking intersections or roadways, and or real-time train information. MOUs or agreements may be needed with rail operators as part of project deployment and operations. They could also provide review and comments on the planning of the projects.

4.4.2.3 Non-Vessel Operating Common Carrier

NVOCCs would use the data from the GoPort freight ITS information system/app such as turn and wait times and ship arrival information. They could also provide review and comments on the planning of the GoPort Freight ITS projects through participation in the PETF.

4.4.2.4 Beneficial Cargo Owners

BCOs would use the data from the GoPort freight ITS information system/app such as turn and wait times and ship arrival times. They could also provide review and comments on the planning of the GoPort Freight ITS projects through participation in the PETF.

4.4.2.5 Ocean Carriers

Ocean carriers could have the option to share and/or receive data with the GoPort freight ITS information system/app. They could also provide review and comments on the planning of the GoPort Freight ITS projects through participation in the PETF.

4.4.2.6 Chassis Providers

Chassis providers could have the option to share and/or receive data with the GoPort freight ITS information system/app. They could also provide review and comments on the planning of the GoPort Freight ITS projects through participation in the PETF.

4.4.2.7 San Francisco Bay Area Rapid Transit District, Pacific Gas and Electric, East Bay Municipal Utility District and AT&T

San Francisco Bay Area Rapid Transit District (BART), Pacific Gas and Electric (PG&E), East Bay Municipal Utility District (EBMUD) and AT&T own adjacent utility and/or transportation infrastructure to the Project. These property owners will be proactively engaged to ensure that the design does not negatively impact their assets and to identify utility relocation costs early in the design process.

4.4.2.8 Involved National Agencies

USCG and CBP are agencies that are communicated with under certain incidents that occur on marine and landside areas, respectively.

4.5 System-Level Operational Environment and Processes

Figure 3 illustrates a high-level conceptual view of the GoPort ITS.

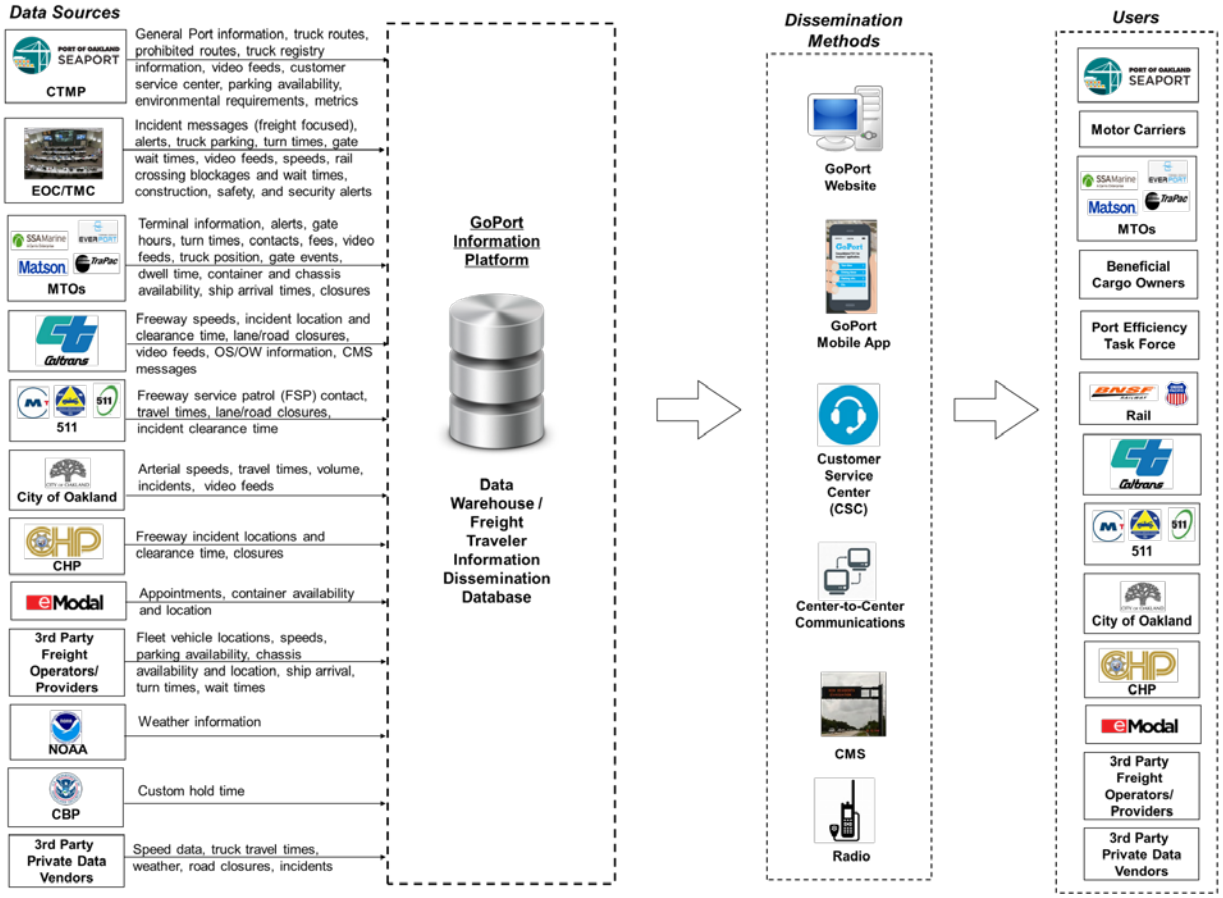

Figure 3: GoPort Freight ITS Information and ATMS Data Integration Approach

Deployment of the proposed ITS technologies will allow collection and integration of data from sources within the Port and outside of the Port. Through the GoPort Freight ITS Information System/App integration approach, the data created by the ITS technologies will be integrated and managed – and then fused into a defined set of GoPort Freight ITS user applications (e.g. real-time traffic alerts, CMS messages, terminal queue times, truck parking reservations, etc.). GoPort Freight ITS information delivery services include a mobile application, a website, CMS notifications, and C2C communications. Additionally, with the website targeted to trucking fleet dispatchers, it is expected that dispatchers will also relay information directly to truckers via cell phone, and that many truckers will also share information initiated from dispatchers with each other through Citizens Band (CB) radio, which is still an important communications method for today's Port truckers.

How this system is realized in the physical world can be shown in a systems diagram. The overall ITST systems diagram is shown in **Figure 4**.

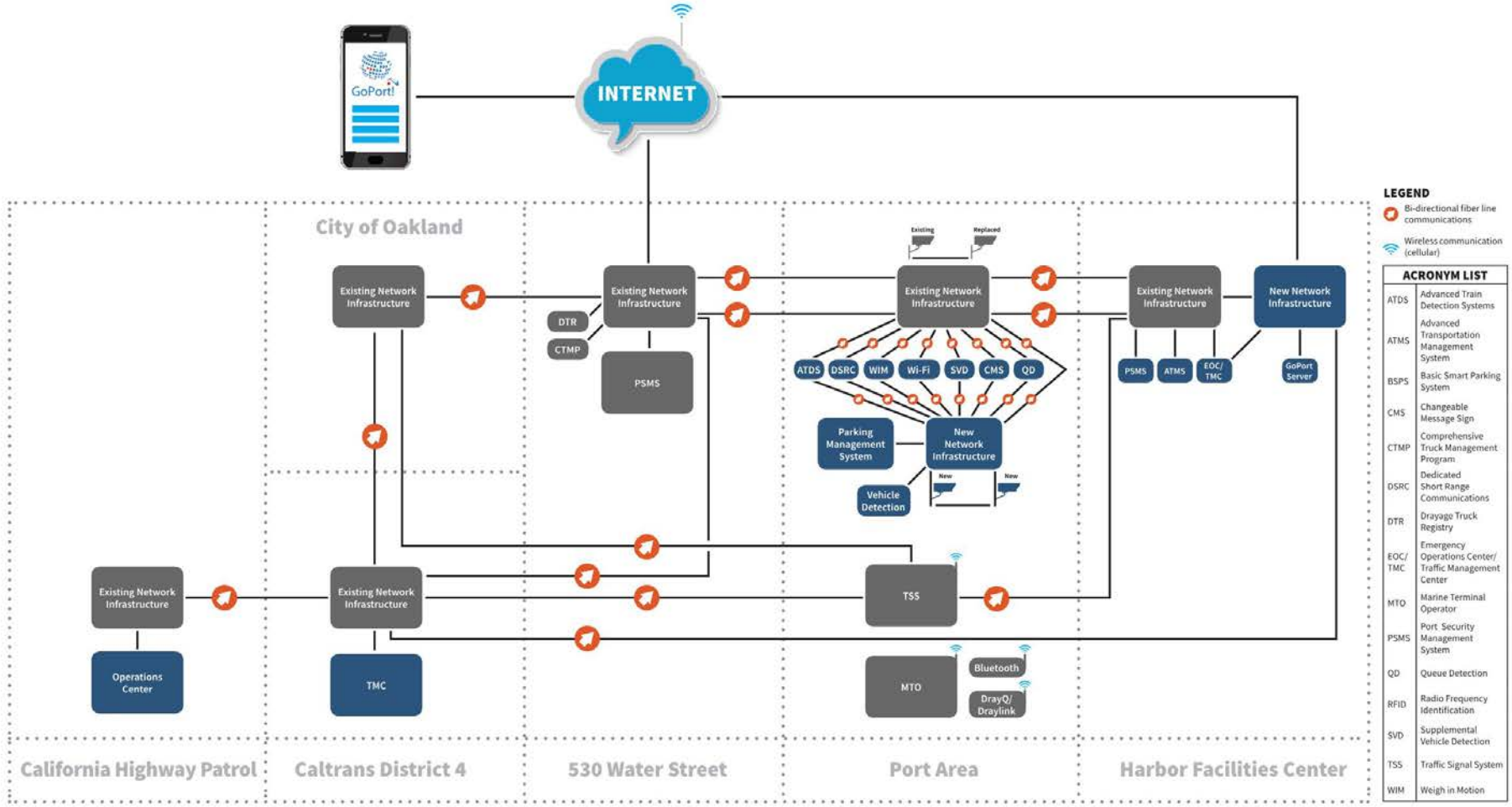

Figure 4: GoPort ITS Systems Diagram

This diagram illustrates the interconnectivity and system elements of all of the facilities and agencies that are integral to the operations of the GoPort ITS. Starting with the interface to the public, the GoPort mobile and web-based app will present information to interested truckers and dispatchers. This information will be able to be customized based on the Port user's interests and needs.

The connectivity to the public will be made traditionally through the Internet. Access to the Internet can be made through private networks or from the Port provided WiFi network that is proposed on the Port arterials.

Information will be provided to the GoPort app through a combination of the existing fiber and proposed additional fiber networks. Currently this concept has not yet determined if the app will be served up through Port provided servers or through a hosted cloud (the diagram as shown now shows a server located at the HFC. Regardless of how that application will be served, information essential to the app will originate on the Port's fiber network.

The Port's fiber network connects the following items all together: the City, Caltrans District 4, 530 Water Street, field elements located on the Port property, and the HFC. The existing PSMS, DTR and CTMP are all connected and accessible through the existing fiber network. The ITS field elements will connect to this network as well as to additional new fiber network that will expand the current system.

Parallel to the Port controlled and operated ITS elements are the Traffic Signal System (TSS) which is connected to the City and Caltrans networks. The TSS may have operational priority given to the Port through the ATMS and will do so through the established network connectivity made between the Port and each of these agencies.

The existing MTO operations do not have direct network connectivity to the Port operations but could ultimately do so via WiFi and the Internet.

The central location for Port operations on this system will be the TMC/EOC. This will be composed of a video wall and command/control consoles. This will pull information from the ATMS, PSMS, RFID, etc. systems and display them for the TMC/EOC operators.

4.6 Modes of Operation

The primary mode of operation for GoPort ITS will be the Normal Operational Mode, which is focused on the application of traffic management operations. Primary users of the system will be trucking company dispatchers and drivers. Transportation TMC operators, and routing/fleet management private sector companies are also of import to the normal operational mode. In the Normal Operational Mode, these entities will communicate data and information to each other seamlessly and automatically. Normal operations would consist of a standard day with no incidents, peak operations, construction activities, closures, events, or emergencies. The MTOs would be operating normally. Port employees would be passively utilizing the improvement groups.

A secondary mode of operation for GoPort ITS will be the Peak/Degraded Operational Mode. For this mode, the functionality is the same as for the normal operations mode, except that the system is

expected to have significantly more resource usage based on certain recurring and nonrecurring events. For example, the unloading of two 12,000 TEU megaships at the Port at the same time may generate hundreds of truck trips per hour, which will provide an increased resource load on the GoPort ITS. A requirement derived from this mode is that GoPort ITS shall be designed to anticipate and respond to these peak/degraded conditions, such that no visible delay in GoPort ITS functionality is apparent to trucking company dispatchers and drivers. Incident management operations would occur when an incident has developed in the Port. Port employees would use the Observation, Detection, Communications and Collaboration improvements to monitor and gather information on the situation. They could then use the GoPort Traveler Information Dissemination systems to spread the information to the public and the Traffic and Incident Management to help alleviate the incident.

Terminal closure operations would occur when a terminal has shut down. Port employees could utilize the GoPort Traveler Information Dissemination systems to spread the information to the public and the Traffic Incident Management to direct patrons around the closed terminal.

Special Event operations would occur during a special event that impacts Port operations. Port employees would use the Observation, Detection, Communications and Collaboration improvements to monitor and gather information on impact to the Port. They could then use the GoPort Traveler Information Dissemination systems to spread the information to the public and the Traffic and Incident Management to direct patrons around the event. A subset of these operations would be construction operations – which will be anticipated at the Port due to the 7SGSP. Construction may require the enactment of specific maintenance-of-traffic plans enacted by the Port or its contractors. The Evacuation operations would occur when an evacuation of the Port is necessary. Port employees would use the Observation, Detection, Communications and Collaboration improvements to monitor and gather information on situation and evacuation status. They could then use the GoPort Traveler Information Dissemination systems to spread the information to the public and the Traffic and Incident Management to direct patrons out of the Port.

4.7 Support Environment

The GoPort Freight ITS will initially be a combination of automated and manned systems that will gradually be migrated to differing levels of additional automation. Some systems are dependent on connectivity to third party systems through the Internet. The Video Management software requires licenses on a per camera basis that will need to be continued. The improvements will need to continue to support the DTR and CTMP.

The expected IT environment can currently be defined as follows:

- GoPort Freight ITS apps utilize data and/or connect to databases from both public and private sources through application programming interface (API) and/or Web Services software technologies

- GoPort Freight ITS apps will utilize some form of automated data integration functionality – this could potentially take the form of a physical server, or could also take the form of a virtual

system concept with many disparate elements linked over the internet through a series of virtual application servers

- The GoPort Freight ITS user interface will consist of both Web-based apps and apps that will function on Application Enabled Devices such as Smartphones

The GoPort Freight ITS is expected to utilize communication and reporting systems according to accepted industry practices. This may include regularly scheduled maintenance along with accepted capital replacement cycles. GoPort Freight ITS will function 24 hours per day and 365 days per year.

It is recognized that GoPort Freight ITS deployment will entail ongoing operational costs. At a minimum, the TMC/EOC will operate 24/7 and will operate during standard business hours (8:00 a.m. to 4:00 p.m.) and as needed for special situations. Personnel will initially consist of two daytime operators and one evening operator.

5. Operational Scenarios

This section presents three scenarios, summarized below in **Table 8**, that describe situations in which the proposed ITS projects could significantly improve Port and truck operations. The scenarios focus on recurring daily operations and non-recurring incident management/evacuation instances. The user groups that play a role in the operational scenario, along with the ITS tools at their disposal are identified. Each scenario presents a step-by-step description of how the GoPort Freight ITS should operate and interact with its users under a given set of circumstances. The scenarios will tie together the system, the users, and other entities by describing how they interact. For each of the three scenarios, the proposed system evolves through the two phases (Immediate and Future), illustrating the increasing effectiveness of each user groups' response to the situation at hand that can be achieved.

Table 8: Summary of Operational Scenarios

Scenario	Frequency	User Groups	Perspective
Daily Port Operation	Recurring	Port staff, terminal operators, truck operators/dispatchers	Port staff
Daily Truck Operations	Recurring	Truck operators/ dispatchers	Truck operators/ dispatchers
Incident Management / Major Road Closure	Non-recurring	Port staff, truck dispatchers, Caltrans, City of Oakland	Port staff & truck dispatcher

5.1 Daily Port Operational Scenario

Expected actors on a typical day at the Port for this scenario are the following:

- Wharfingers' management personnel
- TMC/EOC manager

5.1.1 Immediate ITS

The ITS tools and operations at the actors' disposal and included under the Immediate ITS deployment scenario include the following:

- Communications (WiFi)
- Communications (Fiber)
- CCTV upgrades to HD
- Queue detection
- ATMS (includes centrally controlled signal system)
- Adaptive signal system
- RFID readers
- CMS's
- Joint TMC/EOC
- Supplemental vehicle detection (speed)
- C2C communication (includes interagency collaboration)
- Advanced train detection system
- WIM technology
- GoPort freight ITS information system/app
- Basic smart parking system

On a Monday morning, at 7 a.m., a wharfinger arrives at one of the terminal docks. Using the new WiFi network, he immediately checks remote video to get a sense of the traffic at the Port and sees a queue on 7th Street. He calls the TMC/EOC operator at the new joint TMC/EOC located on the second floor of the HFC at 651 Maritime Street. The TMC/EOC operator fills the wharfinger in on the previous night's activities. The wharfinger takes note that the queue detection systems have detected that the current queue began at 7 a.m. and is continuing to grow.

The TMC/EOC operator is just completing her overnight shift which started just past midnight. She was the sole operator of the TMC/EOC but was primarily on duty to observe security cameras. The two day-shift TMC/EOC operators are just now arriving and she will provide them with a briefing as she did with

the wharfinger. One of the TMC/EOC operators will act primarily as a security operator and the other primarily as traffic operator.

A TMC/EOC operator enters a manual message into the software that will disseminate the information to both the Port's new GoPort freight ITS information system/app as well as to CMS's installed on the Port's property. The app will be accessible by truckers and dispatchers using cellular, the free Internet provided by the Port, or via the web. He enters the message "QUEUE FORMING ON 7TH FOR OICT WEST GATE." Back at the wharfinger's office, the monitors present this message with a timestamp.

At 10:00 a.m., according to data from the queue detection system, the queue is now approaching the new elevated intersection at Maritime which has been confirmed by TMC/EOC operators utilizing the new HD CCTV cameras. A TMC/EOC operator video conferences with a wharfinger to discuss the situation and both agree the traffic situation is severe enough that incoming truck traffic approaching the Port should be advised to use Adeline Street. The traffic operator contacts the Caltrans District 4 TMC to request the following message to be posted on applicable area CMS, "PORT TRAFFIC USE ADELINE."

Around 11:30 a.m., a new queue is forming on Middle Harbor Road for access to OICT's West Gate. This has been picked up by the queue detection system and has been confirmed by TMC operators viewing cameras in the vicinity. It can also be observed through the data and video that traffic signals along Middle Harbor Road are impacting traffic westbound – causing delays. Also, the advanced train detection system has indicated a long BNSF train moving at 5 mph towards Middle Harbor Road and Maritime Street.

With this new information, the TMC/EOC operators set out on a new traffic operations plan. The TMC/EOC operator will drive out on the Port property to communicate and direct traffic from both directions to the OICT West Gate. Meanwhile, the security operator will enter a new message that will be disseminated to the Port CMS's, "OBSERVE FLAGGER AT OICT WEST GATE." Following these actions, one of the operators places a new message in the GoPort freight ITS information system/app to cycle with the previous message, "TRAIN AT MIDDLE HARBOR/MARITIME."

After lunch break, the TMC/EOC operator in the field returns to support the TMC/EOC operator back at the TMC. The TMC/EOC operator pulls up the ATMS software on the video wall which displays traffic speeds on the Port's arterials using green, yellow and red on a map to indicate regular speeds, speeds slower than the posted speed limit, and congestion, respectively. This additional speed information is available to the TMC/EOC through the implementation of the supplemental vehicle detection and enhanced ATMS improvements. He observes that with the operational changes and messages deployed in the morning, traffic is easing up and is changing from red to yellow along Middle Harbor Road.

He does notice an exclamation point inside a triangle on the map on 7th Street just east of the TraPac terminal gates. This is an indicator in the ATMS software that there is a queue. A queue detector in the field has identified stand-still traffic on the shoulder for a minimum of a user specified time (e.g., 10 seconds). The detector has sent an alert because the queue was present for a predetermined duration

and distance. He clicks on the indicator within the software and is given an option to verify through video. He clicks on that option and an image from a nearby camera verifies the queue.

At 4 p.m., traffic conditions at the Port have improved. However, the rail grade crossing system at Middle Harbor Road and Maritime Street has detected a westbound BNSF train at 5 mph. The adaptive signal system automatically makes adjustments to traffic signals to perform traffic preemption phasing to clear the southbound traffic from this intersection. The GoPort Freight ITS also creates an automatic message for the Port's CMS's, "TRAIN AT MIDDLE HARBOR/MARITIME."

Second shift comes in at 4:00 p.m. and after a debrief one TMC/EOC operator is now on duty. At 4:30 p.m., the new operator observes an alert on the ATMS software which is projected on the video wall. This alert came automatically from the Caltrans District 4 TMC via C2C communications. The alert indicates severe traffic on eastbound I-80, which is typical for weekday rush hour. The alert informs the ATMS software to put a low priority message on the Port's CMS's; that is, the message will have lower priority to any other alerts more specific to the arterials on the Port's property. The message, "HEAVY TRAFFIC EB I-80" is disseminated to the appropriate outbound CMS's as well as the GoPort freight ITS information system/app.

Due to the heavy traffic on eastbound I-80, the Port anticipates truckers may decide to wait out the traffic and wish to park on Port property. RFID readers located at the entrance and exit of a Port truck parking facility informs the availability of spaces to truckers through the GoPort freight ITS information system/app. Using this app, truckers can reserve and pay for a parking space.

5.1.2 Future ITS

The ITS tools and operations at the actors' disposal and included under the Future ITS deployment scenario are the following:

- Freight signal priority
- Enhanced GoPort freight ITS information system/app
- Dynamic lane control
- DSRC
- Enhanced smart parking system
- Enhanced ATMS
- Connected and autonomous vehicles

After 5 p.m., some truckers are still coming to the Port to take advantage of extended gate hours. As truckers with appointments arrive at the Port, CMS's state "TRAPAC APPTS USE "A" LANE." Truckers coming in on 7th Street will then see an overhead gantry with lane indicators over each lane – otherwise known as a dynamic lane control system. The right lane has an "A" above it. Truckers with DSRC radios in their cabs will also receive these messages through their in-vehicle, up front display. Truckers with these radios also will enact freight signal priority at all intersections through communication with

roadside DSRC radios. These are automatic, unstaffed activities available via the dynamic lane control, advanced ATMS, freight signal priority, and connected vehicle improvements.

Back at the TMC/EOC, the operator is monitoring perimeter video and periodically reviewing the ATMS messages that pop up on the computer monitor. At 5:30 p.m., the TMC/EOC operator is notified that parking is full except for those with confirmed appointments. The operator is given an option to push out a message on this event. He confirms the message, "LOT FULL" to be placed on Port CMS's and out through the GoPort freight ITS information system/app. Also, trucks equipped with DSRC radios are notified of this message. In this enhanced parking system, the RFID readers confirm the times in and out which in turn informs the amount to be charged to the truckers account.

Meanwhile, as truckers leave the Port property, the freight signal priority deployment provides green signals to trucks approaching signalized intersections minimizing truck idling at signals, improving travel reliability, and reducing emissions within the Port area.

5.2 Daily Recurring Truck Operations Scenario

Expected actors on a typical day for this scenario are the following:

- Truck operator/driver
- Trucking company dispatcher

5.2.1 Immediate ITS

The ITS tools and operations at the actors' disposal and included under the Immediate ITS deployment scenario include the following:

- Communications (WiFi)
- Communications (Fiber)
- CCTV upgrades to HD
- Queue detection
- ATMS (includes centrally controlled signal system)
- Adaptive signal system
- RFID readers
- CMS's
- Joint TMC/EOC
- Supplemental vehicle detection (speed)
- C2C communication (includes interagency collaboration)
- Advanced train detection system
- WIM technology

- GoPort freight ITS information system/app
- Basic smart parking system

Frank is a truck driver working for a local trucking company based in Richmond, CA named ABC Transport, Inc. ABC Transport has a fleet of 50 trucks, specializing in local and regional freight movement serving the Port. Karen is an ABC Transport's dispatcher who is responsible for scheduling, routing, and communicating with the truck drivers to ensure safe, efficient, and productive operations. Frank's first trip involves picking up a full container from one of the terminals at the Port and transporting it to a warehouse in Tracy before noon. Just before his departure from Richmond, Frank utilizes the GoPort freight ITS information system/app to verify the real-time terminal gate and turn time information available from the RFID readers to ensure he will be able to pick-up and deliver the container to Tracy before noon.

At the Port, construction activities associated with the 7th Street Grade Separation project results in regular lane closures and detours. As Frank arrives at the Port, he reads on the CMS to use Gate B to access the terminal he has made an appointment with. This CMS information ensures he utilized the correct gate and doesn't waste time waiting in a queue or using the incorrect gate. Even with all the construction activity, Frank's travel through the Port is relatively smooth since they implemented the initial ATMS to improve traffic flow, and he picks up his container as planned. As Frank is about to leave the terminal with his container, since he is in a cellular dead spot, he uses the Port's free WiFi to access the GoPort freight ITS information system/app to check driving times and to see if there are any incidents along his route.

Sal, another truck driver for ABC Transport, was stuck in an excessively long queue at another terminal and notifies Karen that he is not going to be able to make his second appointment. Through ABC Transport's truck dispatching system, Karen noticed that Frank has completed his Tracy trip early. Also, the queue lengths back at the Port reported on the GoPort freight ITS information system/app are shorter than normal making it feasible for Frank to make it back to the Port terminal for Sal's second appointment. Karen swaps Frank's and Sal's assignments and their dispatch system sends the information to both of the truck's audio systems and to their Smartphones to look at when they are not moving.

As Frank is traveling northbound on I-880 a few miles from the Port, a CMS on the freeway has a message "PORT TRAFFIC USE ADELINE". Frank heeds this message and ends up saving several minutes of travel time getting to the terminal. The queue Sal experienced, and a long at-grade train crossing had generated significant congestion along 7th Street. The message posted on the CMS was implemented as a result of the advanced train detection system, TMC/EOC operators input and Port coordination/communications with Caltrans.

Frank picks up his second container of the day and delivers it to a facility near the Port. After Frank delivers the container, Karen and he use the GoPort freight ITS information system/app to see if he might be able to fit in another load. Based on the driving times, CCTV camera feeds from the updated

CCTV camera to HD showing conditions at the Port, and gate queue information, they determine it is feasible and Frank is able to make an extra turn, carrying one more load than originally planned.

The next day, Frank is departing the terminal with his first load of the day and he notices the weight of the container on his paperwork is within 500 pounds of being classified as overweight. In order to verify his weight before his drive to Fairfield, and to eliminate the potential for any fines or delays at the WIM/inspection facility in Cordelia, Frank utilizes the new automated, unmanned WIM facility located at the Port. Frank drives over the WIM scale and a message with the weight is displayed on a nearby sign. The weight matches that on the paperwork, so Frank continues on his way.

After Frank delivers his first container and he is arriving back at the Port, he receives a radio call from Karen and a text notification via the GoPort freight ITS information system/app notifying him that the part of the terminal that his container is located in has been closed off and is inaccessible. It is anticipated to reopen in two hours which would still allow him to complete his plan for the day. Frank pulls over to a safe location to use the Port's free WiFi to access the GoPort freight ITS information system/app to check traffic conditions. Due to heavy traffic on I-80 in both directions between the Port and the home facility in Richmond, Frank decides to use the GoPort freight ITS information system/app to connect to the Port Smart Parking webpage where he registers for a parking spot and waits to receive notice of the terminal area reopening. One and a half hours later, Frank receives a text message and call from Karen letting him know the closed terminal area is now open.

5.2.2 Future ITS

The ITS tools and operations at the actors' disposal and included under the Future ITS deployment scenario are the following:

- Freight signal priority
- Enhanced GoPort freight ITS information system/application
- Dynamic lane control
- DSRC
- Enhanced smart parking system
- Enhanced ATMS
- Connected and autonomous vehicles

The next day, Frank has picked up his container and is driving towards the terminal at the Port to drop it off. Using the voice activation function on his smartphone, Frank says "travel time" and the real-time truck travel time for his trip to the Port is reported from the GoPort freight ITS information system/app. The travel time reported will allow him to meet his scheduled appointment time.

Through interconnections with ABC Transport's systems and the Port's systems and applications, including DSRC and CV technology, the GoPort freight ITS information system/app knows where Frank's status of his daily itinerary minimizing the effort to search and report information. As Frank is

approaching the Port he says “queue” and the GoPort Freight ITS information system/app is able to infer from his itinerary which terminal he is going to and provides audible queue time and length information, so he knows wait time and where to expect the end of the line.

Due to light traffic and a shorter than usual queue time, Frank will arrive too early for his appointment. Frank says “parking” and receives an audible message “checking parking availability”. Frank is presented with a few options for parking time, so he verbally accepts “Option A” and he is directed to a parking space in the Port’s parking lot. The RFID system is able to determine his in and out times to the lot and will deduct the cost for parking from his account associated with his tag.

When his appointment is ready, Frank exits the parking lot and he sees the “TRAPAC APPTS USE “A” LANE” message on the CMS. He also receives an automated message informing him to use lane “A” based on his itinerary. Since Frank has DSRC in his vehicle, he is provided with freight signal priority through the Port to his terminal to minimize stops and idling. As Frank approaches the terminal, he sees the “A” on the overhead gantry of the dynamic lane control system and drives his truck into this lane to avoid queue delays from non-appointment gates.

The load Frank needs to move is exceedingly long and high requiring assistance from the Port, City, and OPD staff to safely travel through the Port and one intersection in particular where the signal mast arms are too low. Frank must travel on the opposite side of the roadway to navigate around the signal mast arms, and it will take longer than a typical signal cycle to get through the intersection. With the ATMS, centrally controlled signal system, fiber communications network, and interagency coordination/communication improvements, the Port and City are able to observe and control the signals in real time as Frank safely and smoothly travels through this intersection and out of the Port area.

5.3 Non-recurring Port and Truck Operations Incident Management/Major Road Closure Scenario

Expected actors on a typical day for this scenario are the following:

- Port of Oakland operations, safety, security, and TMC/EOC personnel
- Field traffic management personnel (including City OPD, OFD, etc.) and roving contract security personnel)
- Trucking company dispatcher
- Truck operator/driver
- Terminal Operations Manager

5.3.1 Immediate ITS

The ITS tools and operations at the actors’ disposal and included under the Immediate ITS deployment scenario are the following:

- Communications (WiFi)
- Communications (Fiber)
- CCTV upgrades to HD
- Queue detection
- ATMS (includes centrally controlled signal system)
- Adaptive signal system
- RFID readers
- CMS's
- Joint TMC/EOC
- Supplemental vehicle detection (speed)
- C2C communication (includes interagency collaboration)
- Advanced train detection system
- WIM technology
- GoPort freight ITS information system/app
- Basic smart parking system

It's 8:15 a.m. on a rainy Thursday morning, and Diane, the day-shift TMC/EOC operator at the Port, has a major problem on her hands. She just received an alert from the new queue detection system that there is a major surface street traffic queue in both directions on Middle Harbor Road, in the vicinity of the primary in-out gate to the Matson terminal.

Diane, who is being assisted by Mike, the assistant day-shift TMC/EOC operator, uses the Port's new expanded CCTV HD camera system to get a view of what is happening. An overturned tractor trailer with 40-foot container lies in front of the Matson gate. Another truck, having been jack-knifed, is still upright, but the tractor and chassis are bent and severely damaged, and has been rendered immobile. More critical, the trucks 20-foot container has been ruptured, and pallets of retail goods from the ruptured container have spilled onto both sides of the road, and various liquids and small parts are strewn across the pavement.

Diane's and Mike's next steps, performed between 8:15 and 8:25 a.m. are conducted according to the Port of Oakland Incident Management Protocol Guidance (i.e. guidance that details what actions to take and what internal and interagency communications to implement during different types of incidents), which was developed based on recommendations under the interagency communications & collaboration improvements (this protocol is yet to be planned and developed). This guidance includes Scenario Checklists for twenty different types of potential incidents. Diane accesses the online checklist for "Incident at Matson Gate," and begins following the guidance.

Figure 5: Incident Overview at Matson Gate

Diane and Mike's implementation of this Scenario Checklist results in interagency communications (beginning with a phone call, and then sharing video and other information over a secured internet connection) with the City, which subsequently dispatches emergency response units, including a HAZMAT team, to the location. Additionally, the Port informs DHS (to assess any potential Port security concerns), National Response Center (for issues related to water pollution), and the USCG (to assess/prevent potential leakages into the storm drain system which could flow into the Bay). Additionally, in consultation with the City, field staff is sent out to close off Middle Harbor Road between Maritime Street and 3rd Street, and to redirect trucks held up on this section of Middle Harbor Road, back to Maritime Street or 3rd Street. Note here that despite a cell phone coverage hole which exists on this segment of Middle Harbor Road, communications (e.g. photos/video, text messages, Skype/Facetime/VoIP phone calls, etc.) between the Port TMC/EOC with field personnel are not affected, as the Port's recently installed WiFi network is used by all Port and City personnel. Finally, through new communications links, both Caltrans and MTC are notified of the road closure since it impacts the freeway exits leading to the Port – this information is pushed directly to MTC (via operations@511.org) and to the Caltrans – District 4 TMC via fiber communications.

It's 8:25 a.m. now, and Diane is focusing on the necessary traffic management procedures to allow for Port truck operations to bypass this incident, which is expected to take many hours to clear. She

determines that she can work with the OICT gate for temporary emergency re-routing of trucks, which can allow access to the Matson docks through the OICT terminal.

Diane is now ready to use the ITS functions of the TMC/EOC and ATMS to provide re-routing information to trucks and trucking companies that will be using the Port today. This encompasses the following:

- The Port's permanent CMS's at the intersections of Middle Harbor Road and Maritime Street, and at 3rd Street and Middle Harbor Road, are messaged: "ROAD CLOSURE; ACCESS TERMINALS AT 7TH STREET"
- The Port permanent CMS's at the I-880 exits of 7th Street, Market Street, and West Grand Ave, are messaged: "ROAD CLOSURE; ACCESS TERMINALS AT 7TH STREET"
- Communications request to the Caltrans TMC to provide CMS "ROAD CLOSURE; ACCESS TERMINALS FROM 7TH STREET" notifications on regional freeway approaches to the Port on I-880 and I-80.
- An Information Alert is provided on the Port's GoPort freight ITS information system/app, describing the temporary closure and the alternate routing guidance.

It's now 8:30 a.m., and in Woodland, CA, Jeff, a dispatcher for Acme Produce is overseeing the delivery by truck of 20 refrigerated containers of produce to Matson terminals. This produce needs to be delivered to the terminal by 5:00 p.m., which will allow the terminal the necessary time to load containers onto the SS Matsonia, which will sail out on Friday for Honolulu. Missing this sailing is not an option, as the next Matson line ship to Hawaii will not sail until Tuesday the following week, and the $4 million of refrigerated produce would spoil. Even delays of several hours are costly to Acme's operations, with each hour of idling costing between 1.5 and 2 gallons of diesel fuel per truck per hour, covering both truck fuel and fuel to power the refrigeration system.

Jeff was made aware of the incident on Middle Harbor Road through one of his drivers, who was stuck in the queue near the accident location at the Matson gate. In fact, Jeff has five of his 20 trucks stuck in the accident queue on Middle Harbor Road. Jeff has 20 terminal deliveries planned for his trucks to deliver these refrigerated containers at the Port today – five planned for an 8:00 a.m. arrival, five for 10:00 a.m., five for 11:00 a.m. and the final five for 1:00 p.m. His second group of trucks is currently passing through Vallejo; his third group approaching Davis; and his final group is now completing loading at the Acme Produce terminal in Woodland.

Jeff is keeping tabs on the situation through the Port's GoPort freight ITS information system/app and is also receiving email alerts through his account with the Port's TMS. At 10:00 a.m., Jeff receives a new alert through the Port's GoPort freight ITS information system/app that the OICT Terminal will be accepting all Matson deliveries for the day, and Jeff's trucks have been provided twenty OICT extended appointment windows for deliveries between noon and 3:00 p.m. Jeff sends out an Acme alert notification to his fleet management system, that alerts his twenty drivers of the appointment conditions, as well and listing the Port access routing from I-880 and 7th Street, where his trucks will need access to the terminal.

Back at the Port's TMC/EOC, beginning at 8:45 a.m., Diane had implemented a customized signal control plan on 7th Street, Maritime Street, and the open sections of Middle Harbor Road – to allow for improved traffic flow given the diversion around Middle Harbor Road at the primary Matson gate. Additionally, she has coordinated with the City and Caltrans to support extended green lights for the increase in truck traffic exiting I-880 onto 7th street.

Between 10:00 a.m. and 3:00 p.m., while experiencing longer than usual congestion, the above steps facilitate adequate access by Acme Produce and other trucks to the Matson terminal within the extended appointment time ranges that OICT provided in response to the incident. Additionally, in addressing the cleanup, the Port's WiFi system proves invaluable to the HAZMAT monitoring team in sharing photographs of spilled liquids in real-time with their office personnel and the truck company headquarters, which assisted in quickly resolving that no HAZMAT Level 1 or above response was required.

At 3:00 p.m., Middle Harbor Road in front of the Matson terminal is re-opened. At the TMC/EOC, Diane put out information updates to the Port's CMS's that the road is re-opened and alerts the City and Caltrans as well. Additionally, both with Port's GoPort freight ITS information system/app and with automated email alerts, updates are sent to the registered trucking companies such as Acme Produce, informing them of the lifting of the closure and alternate routing restrictions.

5.3.2 Future ITS

The ITS tools and operations at the actors' disposal and included under the Future ITS deployment scenario include the following:

- Freight signal priority
- Enhanced GoPort freight ITS information system/app
- Dynamic lane control
- DSRC
- Enhanced smart parking system
- Enhanced ATMS
- Connected and autonomous vehicles

In the future, it is possible that the operational scenario as described above would not even occur, as the advent of future truck safety technologies, including vehicle to vehicle safety communication, and connection to public sector roadside DSRC applications (e.g. "pavement is wet" warning to drivers on this rainy day), could have prevented this two-truck major accident from happening in the first place.

The signals would have additional ATMS features in future allowing the Port, Caltrans, and the City to better manage any traffic queues and surges that may occur through interagency communication and collaboration. Additionally, in the future it can be expected that Matson will deploy a container appointment system. Given this development, real-time information can be exchanged between the

GoPort freight ITS information system/app back office data (e.g. real-time current travel times and projected delays for the day due to re-routing around the accident) and the Matson and OICT terminal operating systems (with integration with *eModal* or a similar system). Technology for the Matson and OICT would allow automatic re-scheduling of those 20 appointments with Acme Produce over to OICT, while ensuring that the containers will be able to be loaded in time for departure the next day. Note here that this would be considered a private sector "inside-the-gate" technology development, but the GoPort freight ITS information system/app traffic/queue and incident information/forecasting and enhanced ATMS would provide this sector transaction with needed information to plan for the timing to move and reschedule the appointments.

6. Summary of Impacts

6.1 Operational Impacts and Benefits

The anticipated operational impacts of the proposed GoPort Freight ITS are summarized according to the interrelated project groupings.

6.1.1 Communications and Collaboration

Communication and collaboration between the Port and Stakeholders (Caltrans, the City and others) will allow interagency collaboration and data sharing to enhance the operations at the Port and within the vicinity of the Port. Installation of a complete fiber optic network will form a foundation for connection, control and operation of ITS field elements (CCTV, and CMS), traffic signals and data sharing of relevant information to assist in traffic management, incident management, information dissemination, and enhance safety.

Installation of WiFi within the Port, will provide a backup communication system for fiber, provide additional last-mile connectivity to field devices, and also provide a means for addressing cellular dead spots within the Port.

The TMC/EOC will provide situational awareness of Port operations in one room. Operations at the TMC/EOC will be result in data collection, command and control of ITS devices, incident response, information dissemination and communication with the truckers through ITS field elements. Operations centered at the TMC/EOC will provide an opportunity for the Port and other jurisdictions to communicate and share data to effectively manage traffic, incidents, and disseminate traffic in real time. It is anticipated that a staffing and business process plan will be developed along with SOPs. In order to communicate with other agency TMCs or EOCs in the vicinity of the Port, MOUs will need to be developed that will include C2C policies essential for signal control and messaging for information dissemination.

The following is the list of the benefits that are expected from the Communication and Coordination projects:

- Assist in traffic and incident management in real time
- Assist in management of parking
- Assist in Port and traveler information
- Enhance safety at the Port
- Assist in freight mobility along the freeway and arterials
- Assist in travel time reliability
- Assist in the management of traffic and ramp signals
- Assist in the implementation and operation of connected and autonomous vehicles on the Port premises

6.1.2 GoPort Traveler Information Dissemination

The GoPort Traveler Information Dissemination projects will collect and compile Port and freight related traveler information and disseminate static and real-time traveler information that is useful to the Port users and stakeholders via a website, mobile app, and CMS's. The data warehouse will allow Port staff to compile, process, disseminate, and ultimately report performance metrics of interest to the PETF and Port. Dispatchers and motor carrier operations managers will likely interface with the GoPort Freight ITS using the web application, whereas truck drivers would likely use the app and be restricted to stationary access only. It is anticipated that audible alerts capabilities would be developed in the future which would allow truck drivers to receive information en route. MTOs would be able to enter and disseminate key information specific to their terminal to truck operators and dispatchers through this central website and app. Port TMC/EOC operators would be able to enter and disseminate real-time incident and other important truck traveler information via the website, mobile application, and CMS's.

The following is a list of the benefits that are expected from the GoPort Traveler Information Dissemination projects:

- Consolidated, one-stop location for Port and freight traveler information
- More efficient drayage operations from the improved availability of real-time, freight-specific traveler information
- Improved freight mobility on freeway and arterial routes serving the Port
- Improved travel time reliability due to the availability of improved freight traveler information
- Improved safety on freeways and arterials serving the Port
- Improved dissemination of static freight information for the Port area (e.g., parking, oversize/overweight, gate hours, etc.)

- Time and convenience savings by having Port and freight traveler information available from a single source
- Reduced turn times and gate queues due to truck operators and dispatchers having better information for planning their trips and daily schedules
- Reduced traffic congestion downstream of CMS's

6.1.3 Observation and Detection

In order to effectively manage incident and traffic within the Port and its immediate vicinity, implementation of ITS field elements such as CCTV cameras, and detection for queues and speed are necessary. Deployment of ITS field elements will enhance the operations within the Port and along the travel corridors. Deployment of queue detectors will provide determination of the queue lengths and waiting time at the terminals, which will allow the dispatchers and drivers to alter schedules and avoid extensive waiting time at the gates. Implementation of RFID readers throughout the Port will provide the ability to collect and report turn and travel times, detect traffic, track vehicles for safety and security purposes, and support connected and autonomous vehicles on the Port, detect traffic, and collect travel time. Some of the benefits that are expected from the deployment of the observation and detection system are:

- Observe and monitor real time traffic conditions within the Port and along the travel corridors
- Detect incidents quickly
- Reduce the response time to manage and clear the incident
- Assist with parking management within the Port
- Support connected and autonomous vehicles within the Port
- Enhance the appointment system (if desired by terminal or other 3rd party vendors)

6.1.4 Traffic and Incident Management

Traffic and Incident Management is the most significant ITS strategy because most traffic delay is the result of recurring congestion and incidents on the roadway network. Traffic accidents are the most time consuming of these incidents and usually need more time to clear. To successfully manage traffic incidents and recurring congestion, the ITS deployed observation and detection technologies will allow detection of incidents quickly in real time. Upon detection and verification of the incidents, using the ITS field elements and the TMC/EOC, communication and collaboration systems, travelers can be informed about the incident and relevant valuable travel information. Traffic incident management programs are typically implemented concurrently with freeway management programs and arterial management programs. The traffic and incident management system improvements will provide the capability to appropriate staff to control signals, utilize the rail crossing system, lane control, better manage traffic during incidents, use freight signal priority, etc. Traffic and incident management programs have shown significant benefits as shown below:

- Assist incidents quickly

- Reduce incident response time
- Reduce duration of traffic incidents
- Enhance traffic safety by reducing likelihood of secondary incidents
- Improve travel time reliability
- Assist in parking management
- Reduce duration of recurring congestion
- Assist in traffic management

6.1.5 Goods Movement Support Systems & Technology

The trucking companies are responsible for approximately two-thirds of the goods valued in the United States. Traffic conditions and operational factors result in unreliable delivery times at the Port. As a result, the freight industry is increasingly turning to information technologies, such as WIM, Smart Parking, connected and automated vehicles, to improve freight system efficiency and productivity, increase global connectivity, and enhance freight system security. Connected and automated vehicles with advance technologies also help to improve the traffic safety and travel time to the Port. The following is a list of the benefits that are expected from the Goods Movement Support Systems and Technology projects:

- Reduce waiting time at the Port
- Reduce time to look for parking in the vicinity of the Port
- Reduce operating expenses for the freight industry
- Improved vehicle utilization by reducing empty carry miles

6.2 Organizational Impacts and Benefits

Deployment of GoPort Freight ITS will allow the Port, the City and Caltrans to collect relevant data to utilize this information in managing traffic, incidents and information dissemination. GoPort Freight ITS will support real-time traffic information within the vicinity of the Port, provide a platform for integrating with traffic operating systems, and also allow analysis of relevant data to support future transportation planning and investment. The impact of GoPort Freight ITS would be primarily focused in the following two areas:

- Use of ITS sensor data and performance measures on freeways and arterials that are key to freight movement in the region
- Active management of traffic and incidents along the freeways and arterials within the vicinity of the Port would necessitate staff, training, direct communication, maintenance and operations of the ITS field elements and systems

Some of the benefits that are envisioned from the deployment of the GoPort Freight ITS are:

- Reducing the time required for pre-trip planning

- Automatically rerouting drivers around congestion and incident areas
- Facilitate and automate load matching
- Optimize the operations of the transportation infrastructure

The ITS field elements and systems should be deployed at the regional level to achieve maximum benefits and at the same time allow stakeholders to utilize the infrastructure to assist in congestion and incident management along the transportation infrastructure. The stakeholders may include transportation public agencies, transportation data, routing, fleet management companies, and local/regional drayage trucking companies.

6.3 Impacts during Development

Impacts to stakeholders during the GoPort Freight ITS development and testing phase are projected to be minimal: limited primarily to reviewing and providing feedback to the ConOps, ITST Master Plan documents, technical scoping meetings to refine the system, establishing roles and responsibilities, participating in vendor showcases or meetings, testing and monitoring of the system.

6.4 Disadvantages and Limitations

Some of the disadvantages and limitations of the proposed GoPort Freight ITS include:

- Majority of benefits limited to Port roadways – As mentioned previously, the majority of the GoPort Freight ITS improvements, particularly related to traffic and incident management, are limited to the roadways outside of the terminal gates as the scope of this effort and does not include goods movement technology improvements within the terminals.
- User learning curve – Stakeholders such as dispatchers and truckers will have to learn how to use the GoPort freight ITS information system/app and navigate the website. Also, Port staff will need to get up to speed on the operations and controls of the new ITST elements implemented.
- Geographic coverage – The static and real-time freight traveler information will not be available for every possible roadway in Alameda County; it will need to focus primarily on critical and major freight facilities.

6.5 Alternatives and Tradeoffs Considered

Over the course of this Project, some alternatives and tradeoffs were discussed which affected the ConOps including:

- Port efficiency improvements under the Port's control versus private stakeholders (e.g. MTOs) - While goods movement efficiency issues apply behind the terminal gates or on other private property within the Port area, the PDT and CAC determined that the proposed ITS and technology projects will be confined to Port property outside of the gates, but could extend past Port property if the proper coordination channels are exercised with local, regional, and state agencies. As marine terminals are leased out by the Port, the Port has minimal jurisdiction over

the operations behind terminal gates. Technology improvements originally considered in this Project such as appointment system improvements and a chassis pool control system were removed. The Port will continue to work with the PETF to make efficiency improvements throughout the Port property.

- Pilot/demonstration ITS and technology investments versus proven effectiveness – While some new ITS and technology systems (e.g., connected and autonomous vehicles) have the potential to improve goods movement, the Port wants the proposed ITS solutions, particularly those in the immediate term, to be comprised of proven technologies that have a track record of being effective. Freight improvement projects can be costly, have a lengthy deployment period, or involve regulatory changes so the Port wants to implement systems known to work, that can be implemented quickly, and last beyond a "pilot" period.
- Signal operations, ownership, and maintenance – Most signals on the Port property are owned, operated, and maintained by the City. In order for the Port to efficiently and effectively manage and control traffic within the Port area, TMC/EOC operators should have the ability to monitor and control the signals and other field devices as needed. However, the Port does not have the resources or capabilities to own or maintain these devices so the tradeoffs and alternatives are still under consideration. This will continue to evolve as the signal upgrades, MOUs, and ATMS plans, designs, and implementation move forward under consultation with the PDT and CAC which includes the Port, ACTC, City of Oakland, MTC, and Caltrans.
- Data processing within the GoPort Freight ITS or by 3rd party vendor(s) – The PDT is considering whether some of the key data and information in the GoPort Freight ITS information system/app should be completely compiled and disseminated through the Port or by 3rd party vendors. For example, turn and wait time data at the terminals is was being provided through DrayQ, a preliminary Bluetooth based travel time system developed by Leidos, which has been discontinued by the Port.

7. Notes

This ITST plan is following a systems engineering approach documented in the U.S. Department of Transportation's (USDOT) *Systems Engineering for Intelligent Transportation Systems* (January 2007) publication. The USDOT recognized the potential benefit of the systems engineering approach for ITS projects and included requirements for a systems engineering analysis in the Federal Highway Administration (FHWA) Rule/Federal Transit Agency (FTA) Policy that was enacted in 2001. The Rule/Policy requires a systems engineering analysis to be performed for ITS projects that use funds from the Highway Trust Fund. Systems engineering is defined as:

- An interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem.

- Integrating all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

Figure 6 presents the systems engineering approach.

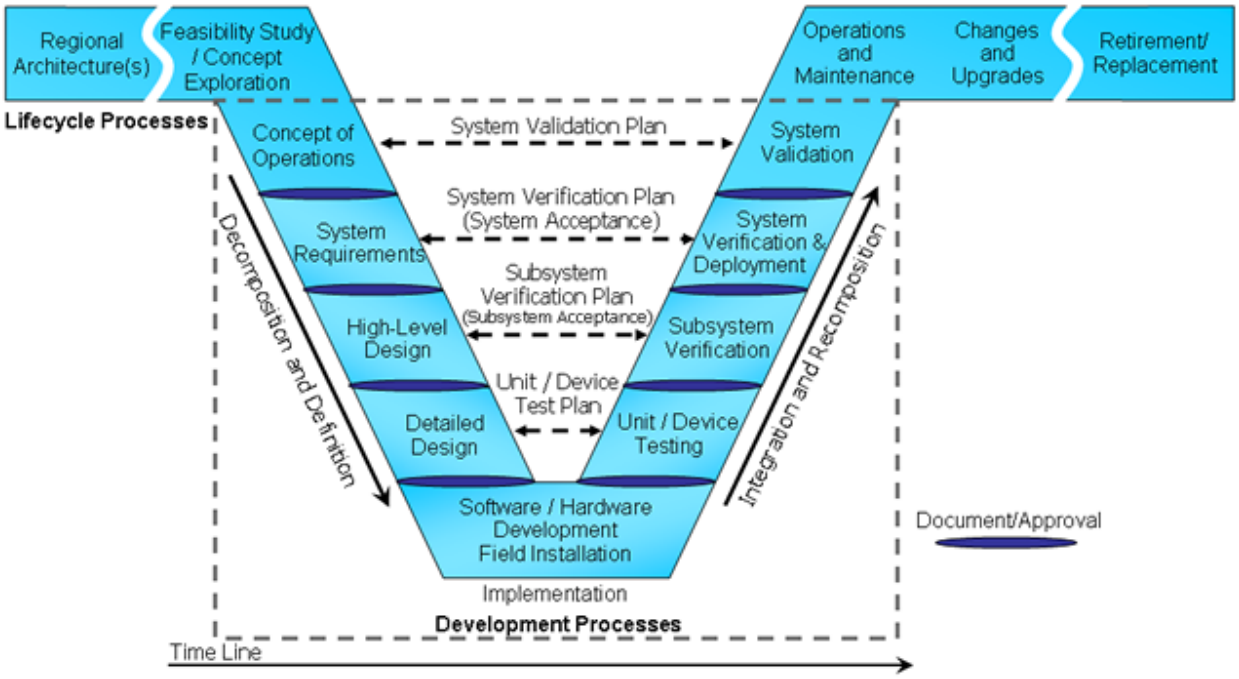

Figure 6: Systems Engineering Lifecycle Processes

Specific to the development of this ConOps, the Project team relied extensively on the USDOT's FRATIS ConOps which was based on another example, StarTran AVL ConOps, documented in the USDOT's Research and Innovative Technology Administration (RITA) ITS Lessons Learned Database. This ConOps focused on using Systems Engineering practices to define needs. The best practices and lessons learned guidance from this ConOps were analyzed and documented in the RITA ITS Lessons Learned database, in summary:

- A ConOps is a useful tool for the initial definition and justification of ITS projects. A ConOps needs to be prepared properly in order to serve its intended purpose. Users need to make sure that the ConOps is written so that the systems engineer, or developer will understand precisely what problems users are trying to solve and their purpose for solving them. A ConOps should not include descriptions of system design components or prescribe technology solutions to address users' problems. A ConOps needs to stay focused on "what" the users need, rather than "how" to design systems to solve user problems. It should remain focused on the operational system without dictating design features. It should ensure that the needed functionalities of the system are easy to identify. Avoid assumptions about the internal content and structure of the

eventual system. This is done to avoid getting lost in details, avoid premature feasibility misjudgments, and preclude the early insertion of pet design concepts.

Appendix A: Acronyms and Abbreviations

Term	Definition
3PL	third-party logistics
7SGSP	7th Street Grade Separation Project
AC Transit	Alameda County Transit Authority
AIAA	American Institute of Aeronautics & Astronautics
Alameda CTC	Alameda County Transportation Commission
ANL	Australia National Line
ANSI	American National Standards Institute
API	application programming interface
APL	American President Lines
app	application
AT&T	AT&T Corp.
ATMS	advanced transportation management system
AV	automated vehicle
AVL	automatic vehicle location
BART	San Francisco Bay Area Rapid Transit
BCO	beneficial cargo owner
BNSF	BNSF Railway Company (formally known as Burlington Northern–Santa Fe Railroad)
C2C	center-to-center
CAC	ConOps Advisory Committee
CAD	computer-aided dispatch
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CB	Citizens Band
CBP	Customs & Border Protection
CCTV	closed circuit television
CHP	California Highway Patrol
City	City of Oakland
CMS	changeable message sign
CMA-CGM	Compagnie Maritime d'Affrètement- Compagnie Générale Maritime
ConOps	Concept of Operations
CTMP	Comprehensive Truck Management Program
CV	Connected Vehicle
DCLI	Direct ChassisLink, Inc.
DHS	Department of Homeland Security
DSRC	dedicated short-range communication

Term	Definition
DTR	Drayage Truck Registry
EBMUD	East Bay Municipal Utilities District
EOC	Emergency Operations Center
Everport	Company operating at the Ben E. Nutter Terminal
FHWA	Federal Highway Administration
FRATIS	Freight Advanced Traveler Information System
FSP	Bay Area Freeway Service Patrol
FTA	Federal Transit Agency
GIS	Geographic Information System
GoPort Freight ITS	Global Opportunities at the Port of Oakland Freight Intelligent Transportation System
GPS	global positioning system
HAR	highway advisory radio
HAZMAT	hazardous material
HD	high definition
HFC	Harbor Facilities Center
HOV	high-occupancy vehicle
I-	Interstate
ICM	integrated corridor management (or for I-80 ICM, integrated corridor mobility)
IEEE	Institute of Electrical & Electronics Engineers
IEP	Intermodal Equipment Provider
ITS	Intelligent Transportation Systems
ITST	Intelligent Transportation System and Technologies
IVR	interactive voice response
K-Line	Kawasaki Kisen Kaisha, Ltd.
LED	light-emitting diode
LMC	licensed motor carrier
MDAS	Maritime Development Alternative Study
MOL	Mitsui O.S.K. Lines
MOU	memorandum of understanding
MPO	Metropolitan Planning Organization
MSC	Mediterranean Shipping Company
MTC	Metropolitan Transportation Commission
MTC SAFE	Metropolitan Transportation Commission Service Authority for Freeways and Expressways
MTO	Marine Terminal Operator
NVOCC	non-vessel operating common carrier
NYK	Nippon Yusen Kaisha
OAB	Oakland Army Base

Term	Definition
OFD	Oakland Fire Department
OICT	Oakland International Container Terminal (operated by SSA at Berths 55-59)
OOCL	Orient Overseas Container Line
OPD	Oakland Police Department
PDT	Project Development Team
PETF	Port Efficiency Task Force
PIL	Pacific International Lines
PG&E	Pacific Gas and Electric
PMA	Pacific Maritime Association
Port	Port of Oakland
PPP or P3	Public-Private Partnership
Project	7th Street Grade Separation and Port Arterial Improvements Project
PS&E	plans, specifications, and estimates
PSMS	Port Security Management System
PTZ	pan-tilt-zoom
RITA	Research and Innovative Technology Association
RFI	Request for Information
RFID	Radio-Frequency Identification
SOP	standard operating procedure
SR-	State Route
SSA	Stevedoring Services of America
STEP	Secure Truck Enrollment Program
TEU	twenty-foot-equivalent unit
TMC	traffic management center
TMC/EOC	Traffic Management Center/ Emergency Operations Center
TMS	Truck Management System
TOL	truck-only lanes
TOS	Terminal Operating System
TSS	Traffic Signal System
UPRR (or UP)	Union Pacific Railroad
US	United States
USCG	United States Coast Guard
USDOT	United States Department of Transportation
VMS	video management system
WiFi	wireless fidelity
WIM	Weigh-In-Motion