Technical Memorandum

Truck Parking ConOps Companion

Software Architecture and System Requirements

Version 1.4

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Name		**Date**
Created By:	Clay Packard, Atkins	10/15/2015
Reviewed By:	Derek Vollmer, FDOT	11/04/2015
	David Chang, Atkins	11/04/2015
	Karen England, Atkins	11/18/2015
	Tucker Brown and Roger Strain, SwRI	12/11/2015
	Josh Reichert, FDOT District 2	12/21/2015
	Chris Birosak, FDOT District 1	1/4/2015
	Mark Laird, FDOT District 6	1/7/2016
	Karen England, Atkins	1/28/2016
Modified By:	Clay Packard, Atkins	11/05/2015
	Clay Packard, Atkins	11/09/2015
	Clay Packard, Atkins	12/14/2015
	Clay Packard, Atkins	1/20/2016
	Derek Vollmer, FDOT	11/29/2016
Completed By:		

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List of Acronyms and Abbreviations

C2C .... Center-to-Center

CCTV .... Closed-Circuit Television

ConOps .... Concept of Operation

CVS .... Connected Vehicle Subsystem

DA .... Data Archive

DMS .... Dynamic Message Sign

FL511 .... Florida's 511 System

ITS .... Intelligent Transportation Systems

PTZ .... Pan-Tilt-Zoom

RSE .... Roadside Equipment

TMC .... Transportation Management Center

TPAS .... Truck Parking Availability System

TPS .... Truck Parking Subsystem

1 Overview

1.1 Identification

This document is a companion document to the Florida Department of Transportation's *Truck Parking Availability System (TPAS) Concept of Operations (ConOps).* The *TPAS ConOps* discussed the TPAS at an architecture and transportation system level. Responsibilities of operators, SunGuide® software, and Florida's 511 system (FL511) were introduced as software components in the overall TPAS. This document will fill in the details of how the SunGuide software and FL511 will operate to accomplish the objectives introduced by the *TPAS ConOps* and will include system requirements.

1.2 Project Overview

The purpose of the TPAS is to enhance highway safety by informing commercial vehicle drivers of parking availability at public parking facilities. Information is collected for parking facilities by two types of instrumentation, vehicle presence detection sensors for individual parking spaces or by vehicle passage detection sensors deployed on the entrance and exit of a parking facility. This information is collected by a new module in SunGuide software called Truck Parking Subsystem (TPS). TPS then processes the information for the quantity of truck parking spaces available, and provides the information to motorists via dynamic message sign (DMS) segments and FL511. Historical availability will also be available for exporting from SunGuide software for later analysis. More details of the overall TPAS project can be found in the *TPAS ConOps*.

2 Reference Documents

- *Truck Parking Availability System Concept of Operations (ConOps),* Florida Department of Transportation, State Traffic Engineering and Operations Office, version 1.0, September, 2015

3 Transportation Management Center User Interaction

There are a few different transportation management center (TMC) user interactions, including system configuration, periodic verification, and low availability alerting, detailed in the following sub-sections.

3.1 System Configuration

SunGuide software system administrators will input each truck parking facility and its associated devices and configuration into the system. Each facility will have the following configuration values:
- Facility name,
- Facility location description,
- Roadway,

- Roadway direction(s),
- Total number of parking spaces,
- Minimum number of parking spaces before showing facility as full,
- Associated DMSs,
- Associated cameras,
- Associated presence or passage detection devices but not both types,
- Low availability alarm threshold, and
- Low availability recovery threshold.

3.2 Periodic TMC Operator Verification of Truck Parking Facilities

TMC operators will periodically verify the operational status and accuracy of the available truck parking facilities and their availability. The interval an operator needs to perform this check will depend on the accuracy of the facility parking availability detection information and in accordance with local TMC operating procedures. The operator will click on the facility icon on the map to launch a truck parking facility list window. From there, the operator can click on each facility to bring up the details and video to visually count the number of available spaces and compare it to what SunGuide software is reporting as the number of available spaces. If the number of spaces is incorrect, the operator can enter the correct value and click on the "Send Count Correction" button to correct the number of spaces reported by SunGuide software for that facility.

3.3 TMC Operator Handling Alerts for Low Truck Parking Availability

TMC operators will be alerted by the system when the available truck parking spaces initially goes below the low availability threshold. The operator will handle the alert by clicking on it to access the truck parking facility status dialog. This dialog will show the operator the facility information as well as video from the associated cameras. The operator can invoke the associated preset for the camera and visually verify the number of available spaces to ensure accuracy when the value is low. If the number of reported spaces is inaccurate compared to what is observed through the camera video, the operator can correct that number. The operator can then dismiss the alert.

If truck parking availability for a facility goes below the low availability alarm threshold, the operator will only be alerted with the first instance. These alerts will be suppressed in a manner consistent with other SunGuide software alert types. Each facility will have a recovery threshold configured by the system administrator, used to indicate how many parking spaces need to become available before the facility is considered to be recovered. Once recovered, a facility is again eligible to produce another low availability alert to the operator if the available spaces go below the low availability alarm threshold.

3.4 Minimum Parking Availability Presented to Motorists

If truck parking availability for a facility goes below the configured minimum number of parking spaces before showing the facility as full, the system will report and display zero spaces available. This is to prevent showing availability to motorists that may not be available between the time of receiving the availability notice and arriving at the facility.

3.5 Facility Under Maintenance

During times when the facility, its sensors or DMS, or the TPS software is under maintenance, the TMC operator can disable the facility so that truck parking availability will not be calculated and will not be sent to DMS, persistent storage, or FL511.

4 Software Architecture Description

SunGuide software will be the central component facilitating TPAS operations and interfacing with each of the other components. SunGuide software will collect information from the instrumentation, calculate truck parking availability, interface with operators allowing them to override the current available parking spot quantity value for facilities, and disseminating the information to intelligent transportation systems (ITS) devices and to FL511. Figure 4.1 shows these components and their relationships. The following sections describe each of the components within the SunGuide software and FL511 systems and their functionality.
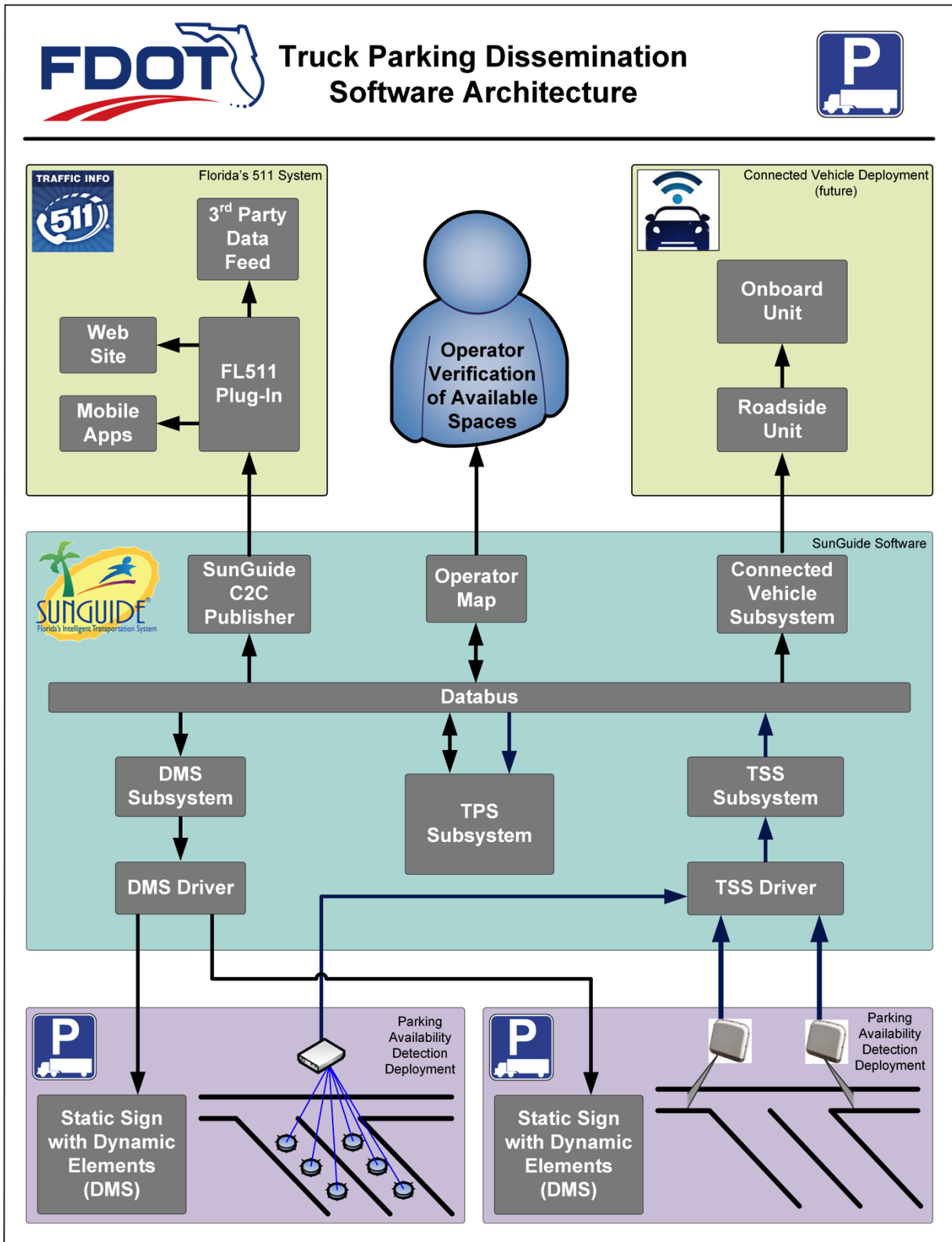
Figure 4.1 – Truck Parking Availability Software Architecture Diagram

4.1 Truck Parking Availability Subsystem

The new TPS in SunGuide software will contain and execute a new set of business logic. TPS will subscribe to the traffic sensor subsystem detection data or will have SunGuide TPS drivers built for each type of parking availability information sources.

Truck parking facilities will be configured within the TPS with a name, geographical location, roadway, one or more roadway directions, and total number of spaces. Presence and passage detection devices will be associated with each facility in such a way that current availability can be calculated. Presence devices will detect vehicle presence for each parking spot within the parking lot and will be counted. Passage devices will count the number of vehicles that pass the entrance and the exit of the lot and TPS will add or subtract, respectively, to calculate the currently available parking spaces. Cameras already configured in the closed-cicuit television (CCTV) subsystem can also be associated with a facility so the software knows which camera's video to present to the operator during verification of availability. Static signs with embedded DMS can also be associated with the truck parking facility. The TPS can send parking availability to these signs.

TPS will calculate current truck parking availability for each facility from the TPS detection information associated with the facility. It will store this information in persistent storage to be used for historical analysis and prediction. TPS will also calculate a predicted truck parking availability for the future through a configurable duration at a configurable interval. Before implementing predictability, the algorithm would be tested and verified for accuracy and the findings would be presented to the Change Management Board before incorporating predictability into SunGuide software.

TPS will post the available number of truck parking spots onto DMS modules embedded in a static sign. TPS will blank the DMS embedded module when parking availability information is not available. TPS will show zero parking spaces available before showing the facility is full if the number of spaces available is less than the configured minimum number of spaces.

4.2 SunGuide Software Operator Map – Graphical User Interface

The SunGuide software operator map is the component that interfaces with the TMC operators. The map will depict the truck parking facilities with an icon shown in Figure 4.2. Operators will be able to hover on the icon to reveal a brief table of truck parking availability information and click on the icon to open a detail status window of the facility and access associated devices and cameras.

Figure 4.2 – Truck Parking Icon

The truck parking facility detail status window dialog will contain the list of truck parking facilities. The selected truck parking facility will have its detailed status information and parking availability override control shown below the list. Below the detailed status, an embedded video on desktop panel can be revealed to show video from all associated CCTV cameras with on-screen pan-tilt-zoom (PTZ) controls if the camera supports PTZ.

As previously indicated in section 3.3, the operator will select a facility from the list, click the show/hide video button, and use the cameras to perform visual verification of the current available parking spaces. If the visually confirmed count of spaces does not match the value detected and calculated by the TPS and presented in the detail status window, the operator will be able to override the currently available spaces from this detail status window. Figure 4.3 shows an example of the truck parking status dialog.
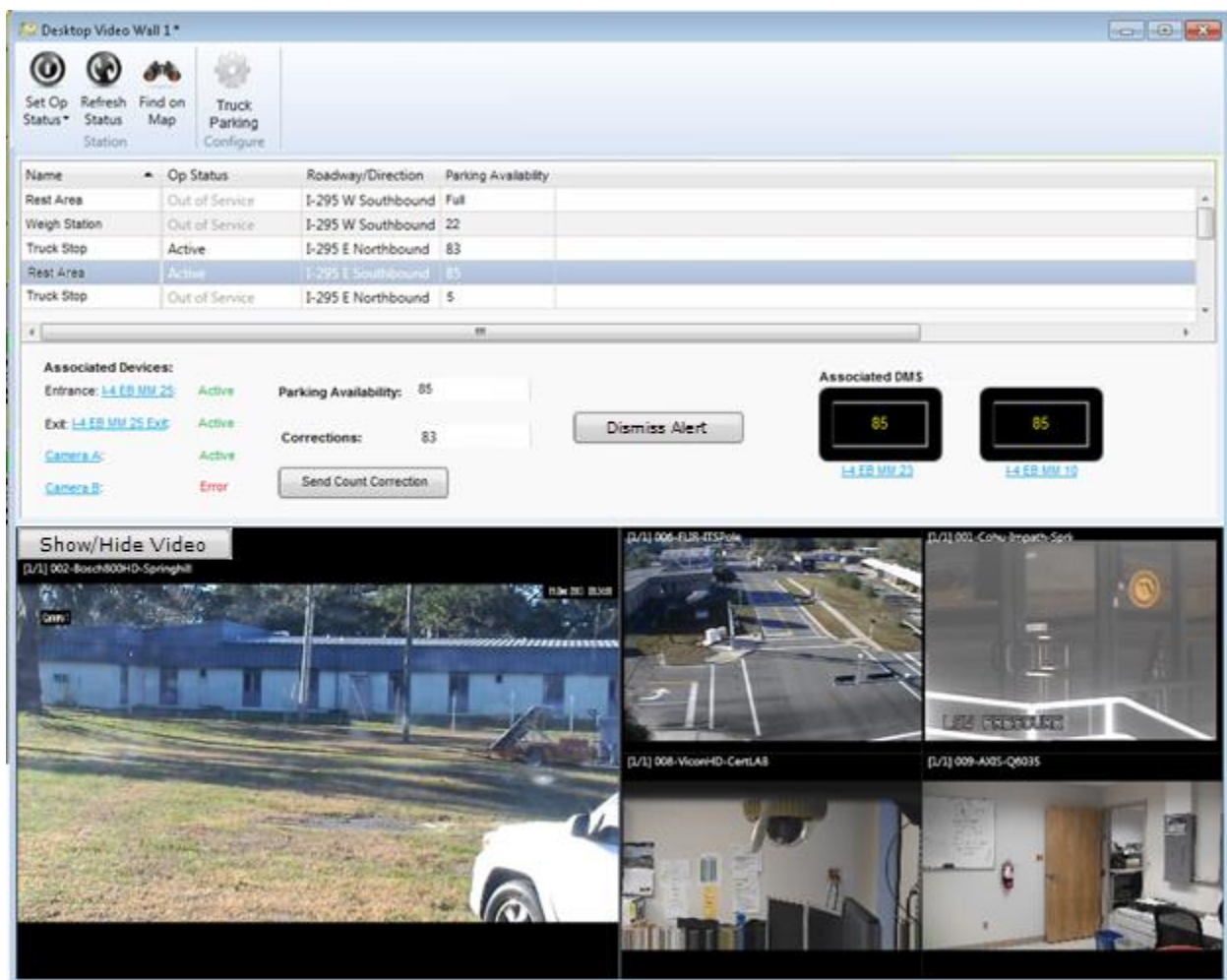

Figure 4.3 – Truck Parking Detail Status Dialog with Video Pane Expanded

4.3 Data Archive

Data Archive (DA) is a SunGuide software component responsible for subscribing to data produced by other subsystems and storing the information in persistent storage. DA will be

modified to include storing TPS-produced data, including a historical account for each of the following:

- Added and deleted truck parking facilities,
- Modifications to truck parking facility properties, and
- Current truck parking availability at facilities.

Data stored by DA will be used by the reporting subsystem to generate reports from report templates.

DA is not shown in Figure 4.1, but is connected to databus and the database to retrieve data and store data, respectively.

4.4 Dynamic Message Sign Subsystem

The DMS subsystem contains all of the business logic related to DMS device communications. TPS will use DMS to send messages to the embedded DMS segments within the static message sign. This will appear to motorist as shown in Figure 4.4.

Figure 4.4 – Truck Parking Availability Embedded DMS Module

4.5 Connected Vehicle Subsystem (Future)

The Connected Vehicle Subsystem (CVS) is a SunGuide software component responsible for communicating with roadside equipment (RSE) and containing and executing connected vehicle application logic. In a future phase, CVS will subscribe to truck parking availability information

and implement an application to provide this information to motorists with on-board units able to communicate with the RSE connected to the CVS through the District ITS network.

4.6 SunGuide Software Center-to-Center Publisher Plug-in

Center-to-center (C2C) Publisher is an existing SunGuide software component responsible for publishing information to external systems via the C2C infrastructure. C2C Publisher will request and subscribe to all TPS information from databus, package it in the C2C XML structure, and publish it to a C2C provider. The C2C provider is the entry point for publishing information into the C2C infrastructure. Once information is available in the C2C infrastructure, it can be requested by additional downstream C2C infrastructure components and external systems including FL511.

4.7 FL511 Plug-In

The FL511 Plug-In will receive truck parking availability information published by the SunGuide software C2C Publisher plug-in for everything needed by FL511.

4.8 FL511 Web Site

The FL511 web site will receive truck parking facility and availability from the FL511 plug-in and display it to users on a map. The facilities will be represented by the same truck parking icon as shown in Figure 4.5, and when hovered over, will display a table showing the current and predicted parking availability for that truck parking facility.
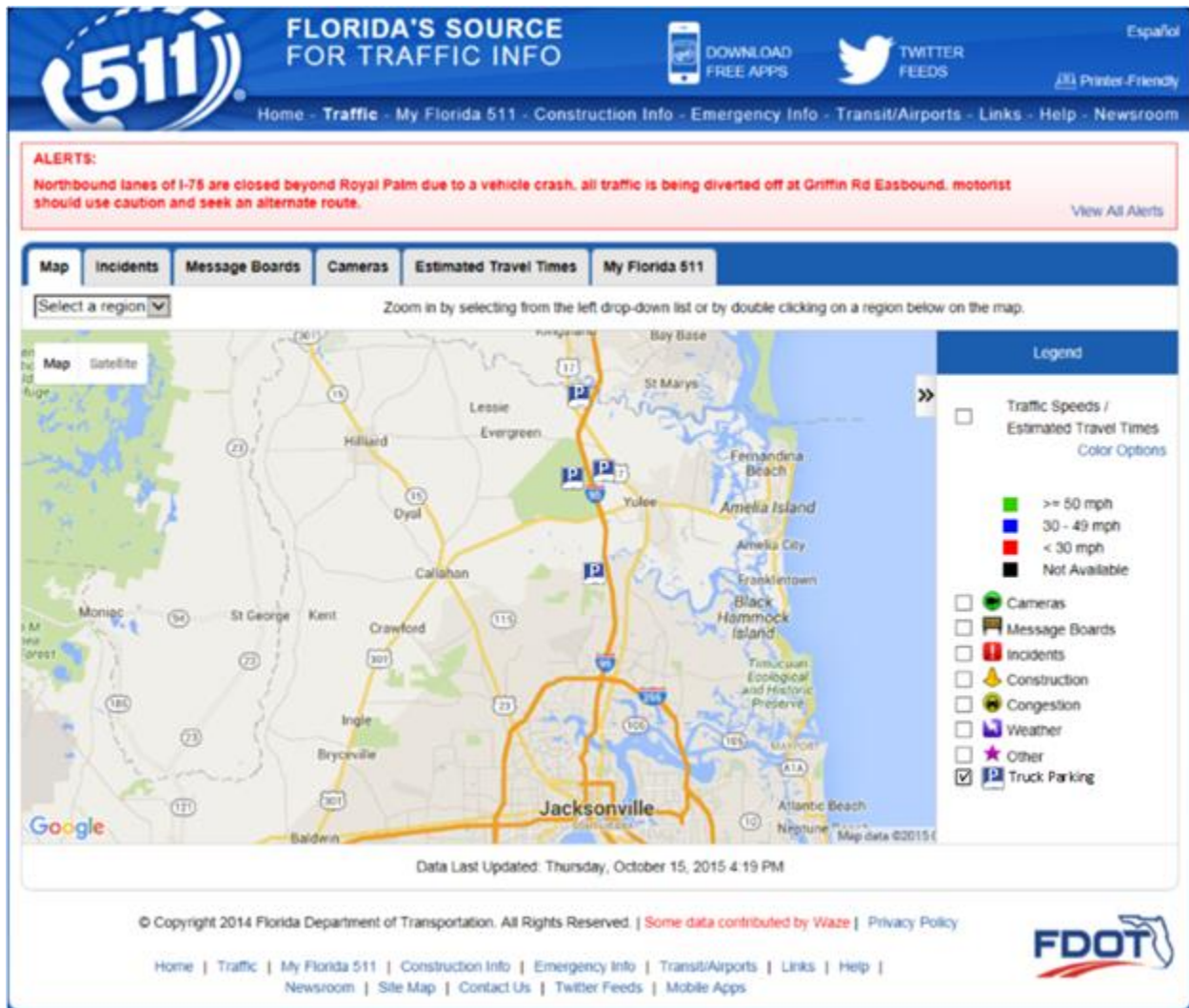
Figure 4.5 – Truck Parking Availability Icons on FL511 Web Site Map

4.9 FL511 Mobile Apps

iPhone and Android mobile apps will also display truck parking information to the user similar to the web site. Figure 4.6 shows how truck parking facilities will be displayed on the 511 map with a push pin that the user can tap to display information including parking availability at the facility. Figure 4.7 shows a driver view that lists the nearest facilities at the top of the list followed by the next nearest facility with detailed status information. Figure 4.8 shows a full list view of truck parking facilities.
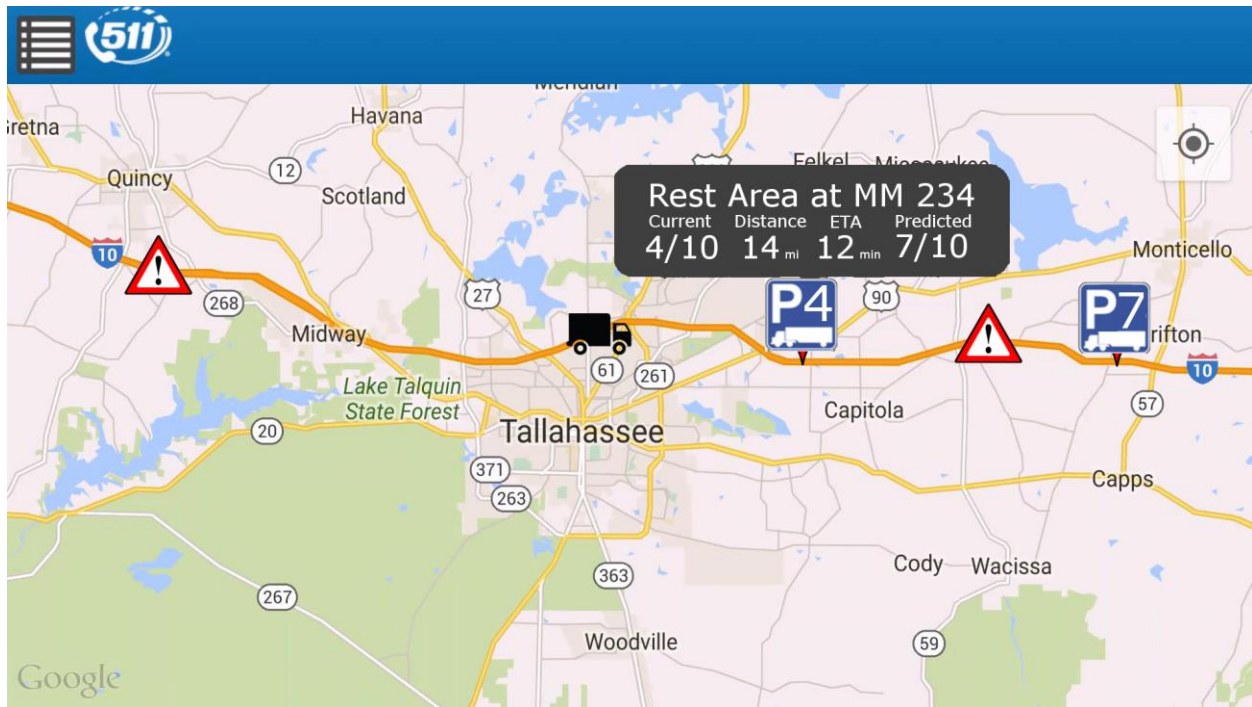
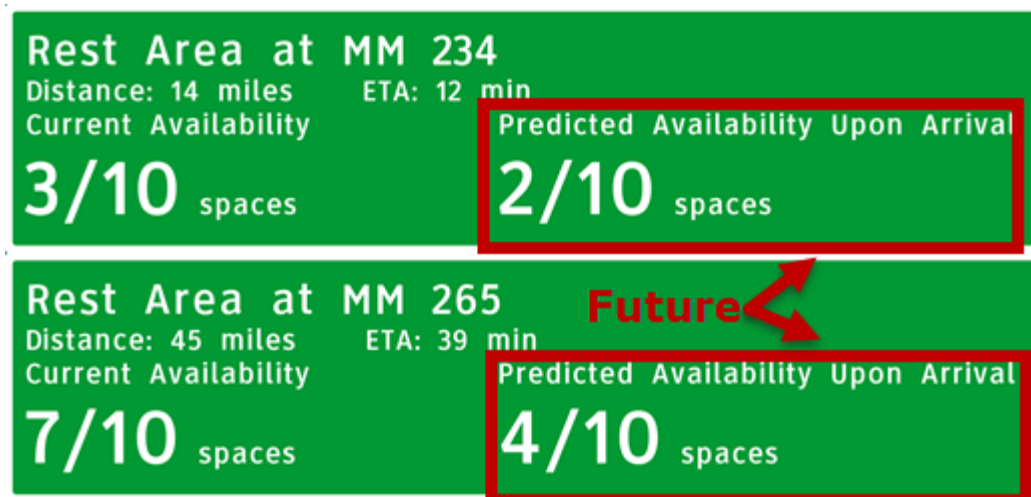**Figure 4.6 – FL511 Mobile App Truck Parking Facility Map View**

Figure 4.7 – FL511 Mobile App Truck Parking Facility Driving Mode View
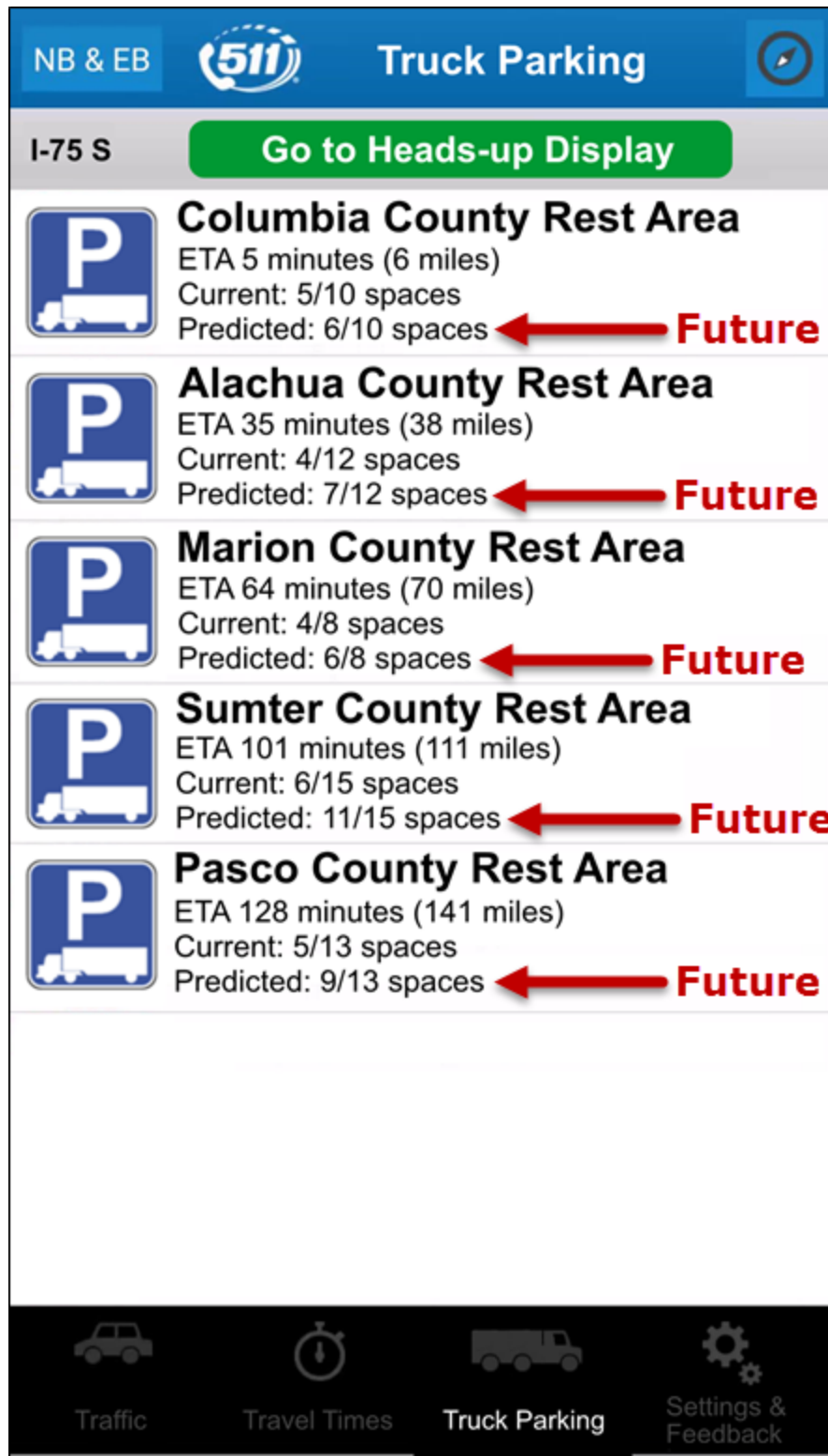
Figure 4.8 – FL511 Mobile App Truck Parking Facility List View

4.10 FL511 Third-Party Data Feed

The FL511 Third-Party Data Feed will include truck parking availability information.

5 SunGuide Software System Requirements

- SunGuide software shall allow users to configure truck parking facilities into the system.
    - SunGuide software shall allow users to configure the following information for the truck parking facilities: name, location, roadway, one or more roadway directions, total number of parking spaces, minimum number of parking spaces before reporting the facility is full, associated DMSs, associated cameras, associated presence or passage detection, low availability alarm threshold, and low availability recovery threshold.
        - SunGuide software shall allow the user to associate entrance volume detection links to a facility.
        - SunGuide software shall allow the user to associate exit volume detection links to a facility.
        - SunGuide software shall allow the user to associate TSS links with occupancy detection to a facility.
        - SunGuide software shall allow the user to associate DMSs with a sign use of the truck parking subsystem to a maximum of one truck parking subsystem facility.
        - SunGuide software shall allow the user to associate cameras to a truck parking subsystem facility.
- SunGuide software shall obtain truck parking availability information from associated truck parking facilities at a configurable interval.
    - SunGuide software shall use presence detection, if available, to calculate current parking availability.
    - SunGuide software shall use entrance and exit volume detection to calculate current parking availability if available and presence is not available.
    - SunGuide software shall use the operator-corrected number of parking spaces available as an offset to adjust the current number of parking spaces available for a facility.
        - The offset value from the operator-corrected number of parking spaces will be used until modified by subsequent operator-corrected number of parking spaces is set.
        - The offset value from the operator-corrected number of parking spaces will be stored in persistent storage.
        - The offset value from the operator-corrected number of parking spaces will be automatically adjusted when needed to prevent the system from reporting a number of available parking spaces less than zero or greater than the spots available at the facility.
- SunGuide software shall maintain the operational status of truck parking facilities.
    - NOTE: This includes user changing op status, facility going into error status when data or devices are not all available, and slow polling of any truck parking subsystem devices. Detailed requirements can be part of the software.

- SunGuide software shall store truck parking availability information for truck parking facilities in persistent storage when the truck parking facility is in an active operational status.
- SunGuide software shall store the following information when the number of available parking spaces is corrected by an operator: Operator's User ID, date and time of the change, the old parking availability value, the new corrected parking availability value, and the ID of an alert for that facility if one is active while the change was made.
- FUTURE: SunGuide software shall calculate predicted truck parking availability information for truck parking facilities when the truck parking facility is in an active operational status.
    - FUTURE: SunGuide software shall calculate predicted truck parking availability at a configurable number of minute interval with a default value of 5 minutes.
    - FUTURE: SunGuide software shall calculate predicted truck parking availability through a configurable number of minutes into the future with a default value of 120 minutes.
        - FUTURE: SunGuide software shall allow the future truck parking availability for a maximum of 24 hours in the future.
    - FUTURE: SunGuide software shall use historical data included in the parking availability prediction.
        - FUTURE: SunGuide software shall use time of day in the parking availability prediction.
        - FUTURE: SunGuide software shall use day of week in the parking availability prediction.
        - FUTURE: SunGuide software shall use day of year in the parking availability prediction.
- SunGuide software shall post the number of currently available parking spaces on the associated DMSs when the truck parking facility is in an active operational status.
    - SunGuide software shall blank the associated DMSs when the truck parking facility is not in an active operational state.
    - SunGuide software shall blank the associated DMSs when parking availability information is not available for a truck parking facility.
    - SunGuide software shall post zero for the currently available parking spaces on the DMSs when the currently available parking spaces at truck parking facilities is less than the configured minimum number of parking spaces.
- SunGuide software shall publish truck parking availability information through center-to-center when the truck parking facility is in an active operational status.
    - SunGuide software shall publish truck parking facility configuration information through center-to-center publisher.
        - Truck parking facility configuration information shall include name, location, roadway, one or more roadway directions, total number of parking spaces, associated DMSs, and associated cameras.
    - SunGuide software shall publish the operational status of each facility through center-to-center publisher.
    - SunGuide software shall publish the current number of available truck parking spaces for each facility through center-to-center publisher.

- ▪ SunGuide software shall publish zero for the currently available parking spaces through center-to-center when the currently available parking spaces at the truck parking facility is less than the configured minimum number of parking spaces.
    - o FUTURE: SunGuide software shall publish a table of the predicted number of available truck parking spaces for each facility for each interval calculated through a configurable time in the future, with a default value of 120 minutes through center-to-center publisher.
- FUTURE: SunGuide software shall publish truck parking availability information to connected vehicles when the truck parking facility is in an active operational status.
    - o FUTURE: SunGuide software shall publish truck parking facility configuration information to connected vehicles.
        - ▪ Truck parking facility configuration information shall include name, location, roadway, one or more roadway directions, total number of parking spaces.
    - o FUTURE: SunGuide software shall publish the current number of available truck parking spaces for each facility to connected vehicles.
    - o FUTURE: SunGuide software shall publish a table of the predicted number of available truck parking spaces for each facility for each interval calculated through a configurable time in the future, with a default value of 120 minutes to connected vehicles.
- SunGuide software shall alert operators when truck parking facilities enter into a low availability alarm state.
    - o SunGuide software shall transition truck parking facilities to a low availability alarm state when the availability goes below the low availability alarm threshold.
    - o SunGuide software shall transition truck parking facilities to a low availability warning state when the availability goes between the low availability alarm threshold and the low availability recovering threshold.
    - o SunGuide software shall transition truck parking facilities to a sufficient availability state when the availability goes above the low availability recovery threshold.
    - o SunGuide software shall present a truck parking low availability alert to the operator when the facility transitions from a sufficient availability state to a low availability alarm state.
    - o SunGuide software shall automatically dismiss a truck parking low availability alert when the facility transitions from a low availability alarm state to a sufficient availability state.
    - o SunGuide software shall present the operator with a truck parking availability facility status dialog when the operator clicks on the low availability alert.
    - o SunGuide software shall dismiss a truck parking low availability alert when the operator invokes the dismiss alert button from the status dialog for that facility.

6 FL511 System Requirements

- The FL511 system shall receive truck parking availability information from center-to-center.

- The FL511 system shall provide information to motorists through the web site, mobile apps, and third-party data feed.
- The FL511 mobile app shall display the current value of available truck parking.
- FUTURE: The FL511 mobile app shall display the predicted value of available truck parking.
- The FL511 mobile app shall display the truck parking facilities with their truck parking information on a map.
- The FL511 mobile app shall display the truck parking facilities with their truck parking information on a list.
- The FL511 mobile app shall select a subset of the truck parking facilities to display.
  - The FL511 mobile app shall use the user's location and heading to determine the truck parking facilities for which parking availability information will be displayed.
  - The FL511 mobile app shall allow the user to extend the distance range to include additional truck parking facilities to display.
  - The FL511 mobile app shall allow the user to change the time range to include additional facilities.