# California ITS Architecture and System Plan

FINAL

## Appendix B3: Vision for California Statewide and Interregional ITS Services

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APPENDIX B3: VISION FOR CALIFORNIA STATEWIDE AND INTERREGIONAL ITS SERVICES

# 1. PROJECT OVERVIEW

New federal regulations require ITS projects funded with highway trust funds, to conform to the National ITS Architecture and standards, be guided by a regional architecture of geographic boundaries defined by stakeholder needs, and use a system engineering analysis that considers the total project life cycle. The California ITS Architecture and System Plan will accomplish two goals in this context:

- Compile an ITS architecture focusing on state-level and interregional services in California that will supplement the regional ITS Architectures and deployment plans to ensure that these statewide and interregional services are deployed in an integrated and cost-effective manner, thereby developing the "regional architecture" described in the above summary of the Final Rule for those projects developed at this level.
- Develop a 10-year System Plan that describes the blueprint for deployment of specific projects that fall within this category of statewide or interregional services. Based on the Final Rule summarized above, each of these projects will require that a systems engineering approach be taken when they are developed.

The process considers ITS plans and architectures including regional ITS architectures and strategic deployment plans, the statewide *Initiatives* project, and the Caltrans draft *Transportation Management Systems Master Plan* and is developing a new Architecture and System Plan that focuses on the state-level and interregional systems in the state. A full bibliography of resources used to develop this project is provided in **Appendix 1**. Where material is used or derived from these resources, annotations refer to the numerical list of resources in the bibliography.

The general approach proposed for this project is one of public participation and a coalition building process that is fully integrated into the ITS Architecture and System Plan development. The approach is built around extensive interaction with and input by regional ITS stakeholders throughout the process and the end result will be an Architecture and System Plan that reflects the current needs and goals of the transportation network from a state-level and interregional standpoint.

# 2. GOALS, OBJECTIVES, AND PERFORMANCE MEASURES

## 2.1 Methodology to Develop Goals and Objectives

California agencies have made a substantial investment in planning for ITS deployment and integration. As a result of the *Transportation Management Systems Master Plan* and *Initiatives* efforts, several strategic goals and objectives, as well as statewide needs and gaps, were identified. These plans and documents were developed based on statewide input from a variety of agencies and perspectives. The *Initiatives* document was developed by a multi-agency consortium of state, regional, county, local, transit, and public as well as private participants throughout the state. They participated in workshops, interviews and deliverable reviews which provided a broad cross-section of needs and priorities from which to base the Initiatives. A concerted effort also was made to reach out to those 'non-traditional' stakeholders (i.e., those stakeholder groups that might not typically be included as part of an ITS project) who would have a vested interest and be able to provide some fresh perspective to the endeavor. These included the California Chamber of Commerce, Port representatives, California Division of Tourism, League of California Cities, American Association of Retired Persons, among others. As a result, the Initiatives are not a

prescriptive set of agency-specific solutions, rather they are a descriptive vision of key objectives for ITS improvements, coordination and needs.

The *Transportation Management Systems Master Plan* puts more focus on Caltrans' and the State's role in system operations, although it was developed in coordination with California Highway Patrol and regional partner agencies, including Metropolitan Planning Organizations, County Transportation Commission representatives, and local agencies. The TMS document outlines recommended Department Actions in the Summary of Action Plan, but does not prescribe specific actions for partner agencies; references to needing to coordinate and work with regional and local agencies to achieve objectives and goals are noted where appropriate.

There are numerous definitions used in the transportation industry as well as other industries, for *goals* and *objectives*. The definitions for *goals* and *objectives* used for this project were chosen to be based on and in line with other Caltrans planning documents, such as the Bay Area Freeway Concept of Operations (2001) or the Caltrans California CVO Strategic Business Plan (1999). In general, the recent Caltrans planning documents used for reference in this report introduce a high-level, overall vision and corresponding guiding principles. As explained by Caltrans in those documents, a set of **goals** is then articulated that supports the vision and mission, and is based on the values and ethics defined in the guiding principles. The goals are further defined by **objectives** that guide the development of activities to support each goal. **Performance measures** are specific measures to assess quantitative and qualitative progress toward achieving the goals and objectives.

The intent of the vision, goals, objectives, and performance measures for the California ITS Architecture and System Plan is not to redefine these established goals and objectives, nor is it looking to override any regional, local or agency-specific ITS goals and programs, but rather build upon them in the context of what would be accomplished by a statewide architecture and plan. This means focusing on common needs and services; that is, those that have statewide, or inter-regional impacts.

With that perspective, the project team conducted a comprehensive review of the existing documentation in the *California Transportation Plan 2025*, *Transportation Management Systems Master Plan* and corresponding *Draft Performance Measurement Framework,* and the *Intelligent Transportation Systems Deployment Initiatives: A Shared Vision for California*. Based on this review, there were several established goals, objectives, issues, and strategic directions that have already been identified, and would need to be validated by stakeholders for their applicability to the purpose and intent of the architecture and system plan.

User needs, as defined by stakeholders throughout California, were another key factor to developing the vision, goals, and objectives for the Statewide ITS Architecture and System Plan. Input as to the needs and services at the regional, inter-regional and statewide level were solicited from stakeholders based on previously completed studies and reports representing statewide, regional and local interests. The common needs within these categories provide the basis for defining the goals and objectives as they relate to the Statewide ITS Architecture and System Plan.

## 2.2 Methodology to Develop Performance Measures

Upon agreement on the Vision, Goals, and Objectives for the California Statewide ITS Architecture and System Plan, several sources were reviewed for performance measures and indicators and each was analyzed in terms of how it addressed the specific objectives articulated

in the vision, goals, and objectives. The intent was to build on existing studies to the extent possible. Sources reviewed include:

- Statewide System Performance Measurement Initiative – This effort started more than five years ago, led by Caltrans, Business Transportation and Housing (BT&H) and many regional stakeholders. The efforts focused on identifying first desired outcomes and then indicators that could be used as proxies for measuring the relative success of achieving the outcomes. Examples of using these indicators were included in a "State of the System Report," which was also reviewed.
- Transportation Management Systems (TMS) Master Plan – This effort started in 2002 and the final documents are currently being reviewed and edited before submittal to the State Legislature. The TMS Master Plan lays out a vision for four Transportation Management System processes: ramp metering, arterial signal management, incident management, and traveler information. Many of the TMS Master Plan's goals and objectives have been incorporated into this document.
- Highway Congestion Monitoring Program (HICOMP) efforts – Over the last several years, the State has compiled an annual report that summarizes congestion in urban areas. Recently, some enhancements to these reports were tested, partly based on the TMS Master Plan recommendations. These developments were reviewed before identifying the appropriate indicators for this study.
- National studies – Several national studies that addressed performance measures were reviewed as well, including National Cooperative Highway Research Program (NCHRP) studies as well as Texas Transportation Institute (TTI) reports and studies.

It is Caltrans' intent that all ITS investments tie into the Department's recently articulated vision and goals, which are shown in the box below:

**Caltrans Improves Mobility across California**

The California Department of Transportation strives to be the highest performing transportation agency in the country. In pursuit of our mission, we continue to build a talented and diverse team and to strengthen ties with our partners. To keep California moving, we commit ourselves to these goals:

Goals:

SAFETY - Achieve the best safety record in the nation

RELIABILITY - Reduce traveler delays due to roadwork and incidents

PERFORMANCE - Deliver record levels of transportation system improvements

FLEXIBILITY- Make transit a more practical travel option

PRODUCTIVITY - Improve the efficiency of the transportation system.

Addressing mobility, safety, reliability, and productivity are all related to ITS investments and reflect desired outcomes for the State transportation system. Therefore, many of the System Performance Measurement initiative and TMS Master Plan performance measures can be used as part of a California ITS Architecture and System Plan.

However, the California ITS Architecture and System Plan has also developed additional objectives related to addressing "execution" performance (i.e., how well stakeholders deploy and operate the ITS infrastructure). Examples include:

- Improving information sharing among law enforcement and transportation agencies (TMS);
- Increasing availability and types of traveler services information statewide (Traveler Information); and
- Developing and implementing a standard specification for interoperability of electronic payment systems in California (Electronic Payment).

These and other examples necessitate the development of three sets of performance indicators:

1. The first deals with desired outcomes related directly to the performance of the transportation system.
2. The second relates to the relative success of the State and its stakeholders in executing the California ITS Architecture and System Plan. This second set is more difficult to quantify performance; therefore, the proposed indicators would be evaluated in terms of value delivered versus cost of implementation.
3. The third type of indicator addresses those objectives that are "enabling" objectives – that is those objectives that are not quantifiable on their own but are key components necessary to achieve other objectives.

## 2.3 Statewide Vision

The *California Transportation Plan 2025* defined a vision for the state's transportation system:

> *California has a safe, sustainable transportation system that is environmentally sound, socially equitable, economically viable and developed through collaboration; it provides for the mobility and accessibility of people, goods, services and information through an integrated multimodal network.*

This high-level vision articulates the need for a collaborative approach to addressing state-level and inter-regional needs with a multimodal perspective. Its focus on sustainability, mobility, goods movement and integration was deemed a suitable vision for the Statewide ITS Architecture and System Plan. Furthermore, by working toward the same vision, the California ITS Architecture and System Plan can be developed as a key tool for agencies to coordinate their planning efforts to address common goals and needs.

Through the process of developing specific goals and objectives, and with input from other task efforts of this project (such as the Operational Concept Report) and workshops with a wide range of stakeholders, detailed 10-year vision statements are defined for each ITS service category (e.g., traffic management, traveler information, etc.) later in this report that serve to support this high-level vision.

## 2.4 Goals, Objectives, and Performance Measures

The *TMS Master Plan* identified broad goals that targeted activities and strategies for the short term (2-3 years) and the longer term (4-10 years), rather than focusing on specific categories of services:

- **TMS Short Term Horizon (2-3 years)**
  Prepare for and support aggressive TMS implementation. Address opportunities for improvement, ensure a minimum level of deployment, leverage past investments fully, and prepare for more aggressive deployment.

- **TMS Longer Term Goal (4-10 years)**
  Deploy aggressively and report continuously. Restore lost capacity (increase productivity) by 20 percent. Reduce projected freeway congestion by 20 percent. Improve travel time reliability by 10 percent.

It is important to note that there will be several factors affecting deployment in the longer-term goal timeframe. While there might be technologies or systems that are deemed a high priority in the planning stage, availability and maturity of those technologies and systems could impact deployment.

For the Statewide ITS Architecture and System Plan, goals for each category were developed that encompass statewide and inter-regional impacts and needs. Keeping in mind what will be accomplished as a result of the architecture and system plan development process, the goals are intended to serve as guiding principles for the operational concepts, integration and deployment recommendations to be developed in subsequent tasks. As such, these goals are phrased as end-states; that is, they describe the results or benefits of achieving more specific objectives. These goals are summarized in **Table 1**.

Objectives and performance measures for two of the categories being addressed as part of the Statewide ITS Architecture and System Plan were developed in the *TMS Master Plan*:

- Transportation Management; and
- Traveler Information.

The objectives for these categories were reviewed for how they fit into the context of the Statewide Architecture and System Plan. Based on the nature of this project, the objectives have been developed that are ‘action’ oriented without being overly prescriptive about specific strategies or who (agency, public/private, etc.) would need to take responsibility for specific strategies. The objectives are not intended to override those specific actions that local agencies plan to do, or need to do, to address specific local issues, rather they were developed keeping in mind the ‘common need’, inter-regional or multiple area focus of this project. Objectives were streamlined so as not to limit the types of performance measures and outcomes that could be applied to those specific objectives.

**Table 1** summarizes the goals, objectives, and performance measures (the indicators proposed for monitoring the impacts of implementing the California Statewide ITS Architecture and System Plan) by category. Where applicable, goals and objectives from previous efforts used as a basis for this task are noted with parenthetical references: TMS Master Plan (TMS) and Initiatives

(INI). Objectives that were derived from the user needs from the previous task are identified as "needs-based" with an (NB) reference.

The table distinguishes between several types of objectives:

1. Objectives that can be monitored with system performance measures – the associated rows are shaded in yellow
2. Objectives that can be monitored with other types of performance measures – the associated rows are shaded in green
3. Objectives that can be monitored by means other than performance measures (e.g., surveys) – the associated rows are not shaded. These are objectives with an enabling theme (as described in the following paragraph).

Ultimately, all categories, objectives, and associated actions have an impact on system performance. Some objectives are not quantifiable on their own – these are considered "enabling objectives". For instance, developing a standard for the inter-operability of systems is an important step towards delivering traveler information, but developing that standard does not directly produce better traveler information, rather it enables other objectives to be met. As such, the different types of objectives in the table should not be viewed as a prioritization scheme. Some rows that are not shaded and do not have any proposed performance measures may actually be the most important objectives to pursue.

**Table 1 – Goals, Objectives, and Performance Measures**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Traffic Management** | | | |
| *Note: Multimodal information gathering system monitoring and management to achieve efficiency and productivity objectives. Includes:*<br>▪ Incident management<br>▪ Day-to-day system operations<br>▪ Local, regional and statewide systems<br>A statewide transportation system that is efficiently managed effectively monitored, safely operated and continuously maintained to reduce delay, enhance safety, improve mobility, and increase productivity.<br>Statewide information exchange among agencies to maximize the data collection activities of agencies across the state.<br>Data sharing across agencies, modes, and protocols, including standardized formats and appropriate security measures.<br>Rapid and accurate detection of congestion, incidents, weather and other impacts on the transportation system.<br>Effective response to real-time conditions by agencies and travelers. (NB)<br>Faster response to incidents and hazards impacting traffic. | Increase Throughput on all modes (highway, rail, transit) | Percent utilization during peak demand conditions. This measure is calculated as the actual flow rates divided by the capacity (generally at 2,000 vehicles per hour per lane). | Productivity Goal:<br>**Improve the efficiency of the transportation system** |
| | Decrease Travel Time Delays | Delay calculated as the difference in travel time when driving at the speed limit compared to actual travel times. | Directly related to the Caltrans vision:<br>**Caltrans improves mobility across California** |
| | Increase Accessibility | Evaluate by method other than performance measure: could be evaluated periodically via discussions and/or surveys. | Directly related to the Caltrans vision:<br>**Caltrans improves mobility across California** |
| | Decrease Secondary Accidents | There is currently no tested methodology to estimate number of secondary accidents. However, "total accidents" is an indicator that is proposed and should reflect reductions in secondary accidents as well. | Safety Goal:<br>**Achieve the best safety record in the nation** |
| | Increase Travel Time Reliability | Variability of travel time over a period of time computed as the standard deviation of travel time divided by average travel time. | Reliability Goal:<br>**Reduce traveler delays due to roadwork and incidents** |
| | Increase Visual (Closed Caption Television, CCTV) and detection coverage of urban freeways | Percent of final planned coverage installed.<br>Percent of final planned coverage operational. | Related to all five Caltrans goals |
| | Increase Reliability of field equipment | Percent of installed coverage operational calculated as the percent of time these installed devices are operating correctly. | Related to all five Caltrans goals |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Traffic Management (continued)** | | | |
| Minimization of delay and restoration of the transportation system to its optimum capacity.<br><br>Cooperative sharing of information, resources, staff and facilities. | Improve Incident Response | Average time to clear incidents computed as the time from incident detection until traffic returns to normal conditions. | Reliability Goal:<br><br>**Reduce traveler delays due to roadwork and incidents** |
| | Improve Information Sharing among law enforcement and transportation agencies and real-time information | Evaluate by method other than performance measure: could be evaluated periodically via discussions and/or surveys. | Productivity Goal:<br><br>**Improve the efficiency of the transportation system** |
| **Traveler Information** | | | |
| Provide the highest level of traveler information to the greatest number of travelers at the lowest possible cost. (INI)<br><br>Access to real-time, multi-agency, multimodal information that is specific to travelers' needs.<br><br>Better planning or alteration of trips while en-route based on real-time conditions.<br><br>Comprehensive multimodal and real-time information which is accessible to private partners.<br><br>Partnerships and business practices which encourage private sector involvement in travel information collection, fusion and distribution. (INI) | Provide simple access to detection data by partners and value added resellers (to reduce agency cost of sharing data) | Evaluate by method other than performance measure: could be evaluated periodically via discussions and/or surveys. | Productivity Goal:<br><br>**Improve the efficiency of the transportation system** |
| | Increase geographical and modal coverage | Geographical coverage for facilities owned and operated by Caltrans is addressed as part of Transportation Management. Modal coverage could be monitored as the percent of transit operators linked to Advanced Traveler Information Systems (ATIS).<br><br>Facilities owned by other agencies should also be monitored for increased geographical and modal coverage. | Productivity Goal:<br><br>**Improve the efficiency of the transportation system**<br><br>Reliability Goal:<br><br>**Reduce traveler delays due to roadwork and incidents**<br><br>Flexibility goal:<br><br>**Make transit a more practical travel option** |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Traveler Information (continued)** | | | |
| Real-time travel information via phone, web, en-route devices and private distribution channels to aid commuters, tourists, commercial vehicles and fleet managers. (NB) | Increase the public's use of traveler information | The State ATIS web site, once developed, can be monitored for use. Typical measures in the internet industry include: average daily unique users and average daily pages hit. This can be viewed as a wider marketing strategy.<br>5-1-1 systems should be monitored for number of calls. | Productivity Goal:<br>**Improve the efficiency of the transportation system**<br>Reliability Goal:<br>**Reduce traveler delays due to roadwork and incidents** |
| | Increase number of agencies making information available for ATIS | Addressed by the geographic and modal objective performance measures. | Productivity Goal:<br>**Improve the efficiency of the transportation system** |
| | Increase availability and types of traveler services information statewide (including tourism and commercial vehicles) | The types must first be defined depending on local/regional attraction points or desired destinations. Then the success of this objective can be measured as the percent of the defined types available to the public and stakeholders. This can also be monitored via periodic, targeted surveys. | Productivity Goal:<br>**Improve the efficiency of the transportation system**<br>Reliability Goal:<br>**Reduce traveler delays due to roadwork and incidents** |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Electronic Payment** | | | |
| *Note: Pending legislation AB64 puts specific parameters on interoperability of smart card systems/contracts issued after 2004. If this legislation passes, it would affect stated goals/objectives for EP systems.*<br><br>Integrated payment systems across the state which streamline electronic payment technology for transit, rail, ferry, parking and toll systems.<br><br>Coordinated fare and pricing policies among transportation modes in California using standardized electronic payment systems.<br><br>Private partners providing flexible payment options for travelers through pre-payment, post-payment and stored value. | Develop and implement a standard specification for interoperability of electronic payment systems in California | This is a yes/no (Y/N) objective. | This is an enabling objective. |
| | Implement a platform that promotes interoperability of multiple vendors and system for multiple travel mode payment purposes | This is a Y/N objective. | This is an enabling objective. |
| | Reduce travel times on toll facilities | Average and total delay on toll facilities. | Directly related to the Caltrans vision:<br><br>**Caltrans improves mobility across California** |
| | Increase throughput on toll facilities statewide | Average throughput during peak demand conditions (throughput during non-peak demand is not relevant to the objective). Measurement: vehicles per hour per toll lane. | Productivity Goal:<br><br>**Improve the efficiency of the transportation system** |
| | Increase passenger throughput on transit systems and other modes | Passenger throughput improvements resulting from electronic payment can be computed as total passengers per hour during peak periods per gate. This is more difficult to assess for bus service, but for operators like the Bay Area Rapid Transit District (BART), it can be computed using electronic payment databases. | Productivity Goal:<br><br>**Improve the efficiency of the transportation system** |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Goods Movement** | | | |
| Implement, operate, and evaluate systems that foster the efficient, safe and legal movement of trade goods into, out of, and through California. *(modified INI)*<br><br>Electronic credentialing systems and travel information specifically for commercial vehicles. (NB)<br><br>Enhanced detection and tracking systems for freight and hazardous materials. (NB)<br><br>Improved traffic management and security measures | Improve commercial vehicle schedule/delivery times | Evaluate by method other than performance measure: could be monitored via targeted surveys. | Related to the overall Caltrans mission:<br><br>**Caltrans improves mobility across California** |
| | Decrease commercial vehicle delays at weigh stations | Average delay per vehicle by weigh station. Data sources for computing this delay are sparse. Computing this measure may require a field survey. | Directly related to the Caltrans vision:<br><br>**Caltrans improves mobility across California** |
| | Decrease vehicle delays at ports of entry | Evaluate by method other than performance measure: could be monitored via targeted surveys. | Directly related to the Caltrans vision:<br><br>**Caltrans improves mobility across California** |
| | Implement standardized security screening systems at all inter-state and international California ports of entry | Specify progress towards objectives (to date, what security systems have been implemented, and where). | Safety goal:<br><br>**Achieve the best safety record in the nation** |
| | Implement standards to support information exchange among freight vehicles, fleet managers, transportation management centers, and enforcement in intermodal terminals and along major freight routes | Specify progress towards objectives (to date, what standards have been implemented) | This is an enabling objective. |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Goods Movement (continued)** | | | |
| | Improve security systems and policies near major intermodal freight centers | This is a Y/N objective. | This is an enabling objective.<br>Safety goal:<br>**Achieve the best safety record in the nation** |
| **Public Transportation** | | | |
| *Note: Pending legislation AB64 puts specific parameters on interoperability of smart card systems/contracts issued after 2004. If this legislation passes, it would affect stated goals/objectives for interoperability of public transportation fare payment systems.*<br>Access to 'universal', real-time information via phone, web, at transit stops and in-vehicles about modes, routes, fares, schedules, arrival times and transfer connections. (modified INI, NB)<br>Traffic management and public transportation management centers share real-time conditions and location information with integrated data exchange capabilities. (NB) | Enhance accessibility to public transportation information | Evaluate by method other than performance measure: could be monitored via targeted surveys. | Flexibility goal:<br>**Make transit a more practical travel option** |
| | Improve transit trip planning through coordination with local agencies | Percent of regions and transit operators have trip planning capabilities. | Flexibility goal:<br>**Make transit a more practical travel option** |
| | Improved transit service information | Evaluate by method other than performance measure: could be monitored via targeted surveys. | Flexibility goal:<br>**Make transit a more practical travel option** |
| | Improved performance of urban and rural transit systems (INI) | Ridership of urban and rural transit systems. Can be monitored using the National Transit database. | Flexibility goal:<br>**Make transit a more practical travel option** |
| | Standard data formats and platforms for exchanging information among public transportation, traffic management and incident management | This is a Y/N objective. | This is an enabling objective. |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Public Transportation (continued)** | | | |
| There is statewide and inter-regional connectivity and coordination among public transportation systems through interoperable fare payment systems, location and tracking systems, reservations services, and easily accessible mode transfer options.(NB)<br><br>Increased security on the vehicles as well as at transfer facilities and stops. (NB) | Implement a platform or system that promotes interoperability of fare payment systems on urban and rural transit systems statewide | This is a Y/N objective. | This is an enabling objective. |
| | Improve trip planning coordination statewide (NB) | Partially addressed by the "improve transit trip planning" objective | Flexibility Goal:<br><br>**Make transit a more practical travel option** |
| | Increase amount and availability of real-time transit services and schedule information (NB) | Evaluate by method other than performance measure: could be monitored via targeted surveys. | Flexibility Goal:<br><br>**Make transit a more practical travel option** |
| | Improve transit security (NB) | Number of annual crimes committed (Property or violent crimes by victim type or location. Number of arrests by location). This can be disaggregated further by crimes on the vehicles, in the stations and at parking lots (if any). | Safety Goal:<br><br>**Achieve the best safety record in the nation** |
| **Vehicle Safety and Control** | | | |
| Public agencies partnered with the private sector for continued research, development, implementation and operations of in-vehicle systems. | Increase use of on-board safety systems. (INI and NB) | Effective intersection collision avoidance project options (developed by IVI IC Program Partnership). | Safety Goal:<br><br>**Achieve the best safety record in the nation** |

**Table 1 – Goals, Objectives, and Performance Measures (continued)**

| Goals (expected outcomes) | Objectives | Performance Measures | Related Caltrans Goals |
|---|---|---|---|
| **Data Archiving** | | | |
| Access to a statewide transportation information archive that uses standard data formats, includes data from multiple agencies and modes, and promotes cross-jurisdictional information sharing to enhance statewide planning efforts. (NB) | Statewide transportation information archive (NB) | This is a Y/N objective. | Productivity Goal:<br>**Improve the efficiency of the transportation system** |
| | Implement standards for archived data | This is a Y/N objective. | This is an enabling objective. |

# 3. VISION STATEMENTS

## 3.1 Methodology for Developing Vision Statements

Building upon the Goals, Objectives and Performance Measures outlined in Section 2, a set of 10-year vision statements was developed to address the range of transportation modes, and encompass the nine service categories. The nine service categories are:

- Traffic Management;
- Traveler Information;
- Public Transportation;
- Electronic Payment;
- Goods Movement;
- Vehicle Safety and Control;
- Data Archiving;
- Emergency Management; and
- Maintenance and Construction Management.

The vision statement for each service category is based on the goals and objectives in the previous sections and input from a wide range of stakeholders within each category.

Stakeholder workshops were held in December 2003 with the purpose of developing the vision statement for each service category in terms of outcome-based milestones to be achieved in the ten-year timeframe of the California ITS Architecture and System Plan. Public and private sector stakeholders were in attendance at each workshop. The outputs from these workshops were consensus-based milestones within each service category that combined, represent an achievable 10-Year Vision. The vision statements are thus intended to serve as consistent guidance for ITS deployment throughout the state, **not** as mandatory milestones which must be achieved within the 10-year timeframe.

## 3.2 Ten-year Vision Statements

A vision statement has been defined for each service category of the California Statewide ITS Architecture and System Plan to represent the achievements and direction that stakeholders believe can realistically be accomplished within the next 10 years. The milestones within each vision statement are mapped to the goals and objectives in **Appendix 2**. It should also be noted that several milestones overlap between two or more vision statements.

The vision scenarios were then developed for representative market groups (described in Section 3.3), incorporating each of the milestones at least once among the market groups. Since the objectives were all mapped to particular milestones, all the objectives outlined in Section 2 are represented by the vision scenarios. These steps are illustrated in **Figure 1**.


**Figure 1 – Methodology for Developing Vision Scenarios**

**Traffic Management Vision Statement**

To have, in ten years:

- Coordinated traffic management operational strategies (including traffic management, incident management, Amber Alert, others) among state, regional, and local agencies resulting in improved interregional mobility;
- Uniform traffic management software systems in each Caltrans District (where traffic management systems are used/ needed) that are consistent and increase efficiency of system maintenance;
- Availability of the same traffic management data in a variety of accessible formats (for example, visual, audio, large-print);
- A comprehensive, real-time data collection infrastructure for multiple agencies, multiple levels, and multiple purposes;
- Systems that comply with National ITS Standards; and
- Improved mobility on state routes serving Ports.

**Traveler Information Vision Statement**

To have, in ten years:

- Traveler information systems on a region-by-region basis, as desired by each region, with provision for links between regional systems;
- Public and private opportunities for dissemination for traveler information;
- CVO-tailored real-time traveler information for truckers statewide;
- Availability of the same traveler information in a variety of accessible formats (for example, visual, audio, large-print);
- A comprehensive, real-time data collection infrastructure for multiple agencies, multiple levels, and multiple purposes;
- Systems that comply with National ITS Standards;

- An inter-regional multi-modal trip planner that serves as a gateway or interface to other trip planners, and that incorporates real-time transit information; and
- En-route real-time public transportation information available on a statewide basis on key corridors.

**Public Transportation Vision Statement**

To have, in ten years:

- Single e-payment accounts for users for both electronic toll collection and transit fare payment at regional and inter-regional levels with account reconciliation that is seamless to users;
- Universal e-payment devices for users for [each of] electronic toll collection and fare payment, which make(s) the system(s) transparent to the users;
- Ability to expand the e-payment account/media to cover other transactions such as goods movement payments, electronic parking payments, etc.;
- Inter-regional coordination of delays on major transit services to avoid stranding passengers making common connections between regions (this concept is also known as *connection protection*);
- An inter-regional multi-modal trip planner that serves as a gateway or interface to other trip planners, and that incorporates real-time transit information;
- En-route real-time public transportation information available on a statewide basis on key corridors;
- Availability of en-route real-time public transportation traveler information in a variety of accessible formats (for example, visual, audio, large-print); and
- Communications systems accessible by drivers and passengers that notify appropriate agencies (the transit agency itself, or police, fire or ambulance) in emergency situations.

**Electronic Payment Vision Statement**

To have, in ten years:

- Single e-payment accounts for users for both electronic toll collection and transit fare payment at regional and inter-regional levels with account reconciliation that is seamless to users;
- Universal e-payment devices for users for [each of] electronic toll collection and fare payment, which make(s) the system(s) transparent to the users; and
- Ability to expand the e-payment account/media to cover other transactions such as goods movement payments, electronic parking payments, etc.

**Goods Movement Vision Statement**

To have, in ten years:

- One-stop state, interstate, and federal credentialing for all commercial vehicles traveling in California with opportunities for local agencies to be involved on a voluntary basis;

- Integrated public agency goods and carrier data collection/tracking software for real-time data exchange and coordination of agency efforts;
- CVO-tailored real-time traveler information to truckers throughout the state; and
- Improved mobility on state routes serving Ports.

**Vehicle Safety and Control Vision Statement**

To have, in ten years:

- Effective intersection collision avoidance project options (developed by IVI IC Program Partnership); and
- Caltrans leadership at the state level (including resources and recommendations) to ensure that vehicle safety and control initiatives throughout the state are capable of interfacing with federal VII (Vehicle Infrastructure Integration) or other vehicle-infrastructure related initiatives and programs.

**Data Archiving Vision Statement**

To have, in ten years:

- A statewide archived data service for state-level data that is available for use by regions as a resource as desired by each region.

**Emergency Management Vision Statement**

To have, in ten years:

- Coordinated HAZMAT transportation routes and procedures statewide and with adjoining states, with voluntary involvement by local and regional agencies; and
- Coordinated statewide response procedures for disasters and evacuations that are developed in coordination with adjoining states' and national procedures and guidelines, with voluntary involvement by local and regional agencies.

**Maintenance and Construction Management Vision Statement**

To have, in ten years:

- A real-time work zone monitoring system for use in Caltrans work zones that is coordinated with District traffic management systems;
- Automated avalanche warning systems at key locations as needed on Caltrans roadways; and
- Roadway condition monitoring that is implemented as needed at a district level for detection of icy bridges and other pavement conditions, that is coordinated with District traffic management and traveler information systems.

## 3.3 Vision Scenarios

The vision scenarios are snapshots of a typical day or task in the life of a California resident. They illustrate in story-like fashion the various ways in which ITS applications can enable or facilitate professional and personal tasks in the context of the specific 10-year vision statements

defined for the various service categories as listed in the previous section. The three representative market groups portrayed in the vision scenarios are as follows:

- Private Automobile Travel;
- Passenger Movement (Transit); and
- Goods Movement.

The three vision scenarios are presented in the following sections.

### *3.3.1 Vision Scenario: Private Automobile Travel*

Janice Moore owns five restaurants throughout northern California. Her days typically contain a mix of meetings with restaurant staff, vendors, food suppliers and contractors, among others. Her restaurants are known for their special event planning and family-friendly atmosphere, not to mention last-minute home delivery. While Janice delegates a sufficient amount of work, she still strives to oversee general operations at all of her restaurants, to ensure consistency of food and atmosphere, while personally demanding the highest quality of customer service from all her staff. Thus, Janice needs to visit all five of her restaurants regularly. To remain competitive, she also recognizes the need to keep up to date with emerging technologies, and incorporate them into day-to-day operations (and her own routine) whenever possible.

This afternoon, Janice is going over monthly financial reports with her restaurant supervisor in Palo Alto. Her staff in her Napa Valley restaurant then contact her with an emergency situation requiring her personal attention. A formal dinner and wine seminar event is scheduled for this weekend at the Napa Valley location, and has been sold-out to restaurant capacity for a few weeks now. The primary food supplier has experienced delivery difficulties, and will be unable to deliver the food this afternoon. In order to be ready on time for the weekend event and prepare the promised menu, the kitchen staff must begin preparations this evening.

Janice had scheduled her Napa Valley restaurant visit on Thursday, so she could finish visiting the three Bay Area restaurants early in the week, then drive to Napa and stay for the weekend to oversee all the event preparations. Today is only Monday. “Well”, she decides, “I’ll just have to rearrange my schedule and go to Napa now, help make new arrangements and sign some new agreements”. She informs her Palo Alto staff that she is postponing their meeting, and gets ready to tie up loose ends so she can spend the rest of the day at her Napa restaurant.

Fortunately there are several routes between Palo Alto and Napa Valley. Janice wants to get traffic information but needs to continue gathering her files and lists before she leaves. In her office, she calls out “Traffic Information” and the office computer switches itself on when it recognizes her voice. “Palo Alto to Napa Valley” she continues, knowing that the traffic information site has stored all of her frequent origins and destinations. A real-time map pops up on her computer screen. A flashing line indicates that the quickest route at this time is across the Dumbarton Bridge, then north on I-880. That there are no red dots on the map signifies that there are no major incidents between Palo Alto and Napa Valley right now. A flashing “1:40” indicates the expected travel time. “Great”, she reacts happily. The website also announces the information in audio: “As of 1:15 PM, the quickest route is Dumbarton to 880. No incidents at this time. Approximate travel time 1 hour 40 minutes”.

Although she does not need both formats, she is happy that the information is always presented in **accessible visual and audible formats**, not only for her own ease of use, but for the several members of her supervisory staff that are disabled and regularly make use of these different formats as they plan similar trips between her different restaurants.

Because of the partnerships between local, regional, and state agencies, Janice's projected travel time of 1 hour, 40 minutes includes travel time on local roadways, added to projected times on the state-operated freeways. Many (although not all) local transportation agencies maintain some type of network allowing them to collect, process and archive anonymous trip data throughout the agency network. For example, some cities use Automated Vehicle Location data already collected in real-time by their transit agency fleets, to indicate speeds on local roadways. From these speeds, local travel times can be roughly extrapolated. A few cities have chosen to use anonymous data from in-vehicle toll transponders (which are practically standard equipment on most vehicles in California these days), so roadside transponder readers can now be utilized by local agencies for data collection. Because all of the systems must **comply with National ITS Standards**, the data can be collected and processed by different agencies but eventually shared and used among different agencies. The data can be used for real-time distribution (such as to travelers like Janice, looking for travel times), or the archived, historical data can be used by universities for research, by developers and planners for traffic studies, and by transportation agencies themselves for operations and maintenance. **State-level data is archived through a statewide service, Some regions have set up their own regional archived data services and others have chosen to utilize the state-level system to provide archived data service in their regions.** Through the deployment of these various systems and services, California has achieved its goal of having a **comprehensive, real-time data collection infrastructure for multiple agencies, multiple levels, and multiple purposes.**

Today's trip is within the Bay Area; however, if she ever had to get information for a trip to her Sacramento restaurant location (her fifth restaurant), it would be as easy the request she just made. Even though Sacramento and Palo Alto are considered to be in different regions, the travel information partnerships and interfaces **between regions allow one region to link easily to another**. Had Janice said "Palo Alto to Sacramento", the information would have been retrieved seamlessly and presented to her in the same formats.

She is almost done packing her final papers and leaving final instructions. "Select Route. Send alerts to Vehicle 2", she says, signifying that the website should send her instant real-time alerts of any delays or incidents (along that particular route selected for her) through her in-vehicle communications system. She specifies "Vehicle 2" since her husband's vehicle has been pre-specified as "Vehicle 1" when they were setting up the website options. Had she wished to scroll through alternative routes, she could have voiced the command "Alternative Route". For those without in-vehicle communications systems in their vehicles (although those are rare these days), the command can be "Select Route. Send alert to Cell Phone 2", or a similar command. No matter which service provider Janice selects for her in-vehicle system or her cell phone (and no matter which service provider her husband selects), the pre-programmed options always work because all traveler information systems and data must **comply with National ITS Standards** and so work together.

The website being accessed by Janice has been created with cooperation from both the private and public sectors. Several public agencies have formed a consortium to operate the

site. Private sector vendors sell information to the consortium (for example, traffic information on some segments of I-880, or travel time information on local roadways which are collected by a private company, then packaged and sold to the public sector at special rates). A different public agency consortium has also partnered with numerous private service providers, such as internet companies and cellular phone providers. This is just one example of the many possible business models Thus, there are numerous **public and private opportunities for dissemination for traveler information**.

After only a few minutes, Janice is ready. "Call me on the road if anything urgent comes up", she instructs the Palo Alto staff, but simply out of habit since all her restaurant staff know that already! As she exits the parking lot in downtown Palo Alto, the transponder mounted on her windshield beeps and identifies her as a business owner and regular monthly parker. Details of her stay (the five hours her car was parked in the lot this morning) are recorded in her e-payment account log. She is not charged additional fees however, as she and her staff are regular monthly parkers and are charged flat fees, with an additional discount for business owners and staff. At any time, she can check or reconcile her activities with her e-payment account log. The log is available for viewing at any time via the internet. Furthermore, customers can choose to have their e-payment account seamlessly linked to their bank accounts; in other words, at chosen intervals (for example, at the end of each month), payments can be debited directly from the customer's bank account (on approval of the final monthly total). Thus, not only is her transponder useful for paying tolls, it can **cover other transactions such as electronic parking payments**.

Janice's restaurant chain is known for its fast and friendly home delivery. Each of her restaurants has three delivery vehicles. Each of these vehicles also has a toll transponder mounted to its windshield, and each is connected to the restaurant chain e-payment account. In other words, **any charges incurred by these vehicles (either for tolls, parking, gas or other necessary purchases) is logged** in a vehicle-specific e-payment account, which is also linked to a business-wide e-payment account. Janice's e-payment account for her own vehicle is also linked to this business-wide account, as is possible for the e-payment account of any employee. This greatly simplifies and expedites record-keeping and financial accounting for Janice and her staff.

The business-wide e-payment account logs can be aggregated by date, by restaurant location, by delivery area, and by employee or employee group. Janice appreciates how these e-payment accounts have simplified operations, and how she can choose to make the different accounts as integrated or as separate as needed. She and her staff decided to automatically link the business-wide e-payment account to the company bank account. Each month she and her staff review transactions and fee totals before the bank account is debited. Janice likes this automatic debit option and uses it whenever possible since it is generally secure, and vastly simplifies her paperwork.

On the customer side, the proliferation of e-payment accounts has positively impacted revenues for take-out at Janice's restaurants as well. Two of her restaurants have partnered with their respective neighboring parking lot systems, and her other three restaurants now have tastefully designed and well-lit drive-through lanes alongside the buildings. When a take-out customer uses a drive-through, the total bill can be automatically charged to that customer's e-payment account using his/her transponder. Alternatively, when a take-out customer leaves one of the parking lot systems, that customer's bill can also be charged to his/her e-payment account as they exit the parking lot. Again, Janice and her staff

appreciate all this simplification and streamlining. Furthermore, because less cash changes hands, her restaurants are less of a target for theft or crime. Security and safety of staff and customers are always at the forefront of Janice's mind.

After a few minutes, Janice is near the Dumbarton Bridge. "I should stop quickly and get gas", she thinks to herself, "It will only take a minute". The gas station is equipped with a transponder reader. After Janice is done filling the tank, the charge for the **gas is billed to the same e-payment account** discussed before, upon Janice's exit of the gas station.

The individual e-payment accounts can also be linked to smart cards, and not only transponders. For example, some of Janice's employees live close to work and do not have to cross any bridges regularly, and so they opt to carry smart cards which can be used for all the transit systems in California. However, when those employees need to drive, their parking charges can be logged on their e-payment accounts, by simply waving their smart cards in front of a contactless card reader upon exiting the restaurant parking area. In this way, different devices are universally accepted now for a growing number of transactions (transit, parking, tolls, gas, and other transactions).

Janice is still on Palo Alto-owned and operated roadways. Even though she is on the local roadway network, the roadside Dynamic Message Signs (DMS) signs notify her of a recent incident on the other side of the state-operated Dumbarton Bridge. This integration is thanks to **coordinated traffic management operational strategies (including traffic management, incident management, Amber Alert, others) among state, regional, and local agencies resulting in improved interregional mobility.** The signs further detail the nature of the incident, flashing the text "HAZMAT incident." Janice wonders if she should be worried, but thanks to **coordinated hazardous materials (HAZMAT) transportation routes and procedures statewide and with adjoining states, along with coordinated statewide response procedures for disasters and evacuations**, most emergencies such as this can be dealt with in an immediate and organized fashion.

She knows that she should divert her trip to another route. At that moment, her in-vehicle communication system comes on, notifying her of a "traffic alert". This was the alert she pre-programmed before her trip. "As of 1:35 PM, one incident along selected route. Alternative route is San Mateo Bridge, I-880. Approximate travel time is 1 hour 55 minutes" is broadcast through the car speakers. If Janice chose, she could also see this information visually through her in-dash monitor; however, she doesn't like to use that option while she is driving.

"Great, it's reassuring to know that everyone is on top of things," she thinks to herself, adding, "Now let's hope I can say the same for me and my restaurant staff after today"!

As she soon heads north on I-880, she is notified in advance of the maintenance activity and work zones along the freeway. Years ago, such roadway work would have caused bottlenecks. These days, since work zones use **real-time work zone monitoring systems coordinated with district-level traffic management,** such delays are minimized or eliminated. Drivers are informed of the work zone activity in advance (for example, using DMS), so they can proceed along their routes without uncertainties when they observe the roadside activity. Details about the work zone activity are also broadcast through the various traveler information media (such as phone or web).

Janice thrives on the exciting world of restaurant ownership, including unforeseen challenges such as this afternoon's supplier cancellation in Napa. "At least I don't have to waste time stuck in traffic" she muses, as she prepares to solve her more pressing problems at hand.

### *3.3.2 Vision Scenario: Passenger Movement (Transit)*

Gregory Chen is a graphic artist living in Pasadena. He enjoys living in the Los Angeles area where the project opportunities in his industry are both numerous and challenging. Just last month he was commissioned to work on a web advertising campaign for a sports equipment company. This month he started a rather different undertaking, as a lead animator for an upcoming televised special. Most of his contracts involve working in downtown Los Angeles, but several are in numerous other locations in the sprawling metropolitan area, such as Pasadena and the South Bay.

Although Gregory was born with a defect in his lower back that confines him to a wheelchair, he does not experience undue difficulty getting around the Los Angeles area. He does not drive and relies almost exclusively on public transportation, with only the occasional ride from friends and family. Because his work is often fast-paced with a lot of client contact, he expects and depends upon the public transportation system to be reliable and efficient so that he can get to his (often different) destinations on time.

This morning Gregory is preparing for a lunch meeting downtown with his current client. While heading towards the Gold Line rail station near his house, his PDA beeps. He finds that a "Transit Alert" has been sent to his PDA. It seems that the route he had pre-programmed for today (on the MTA Gold Line from Pasadena's Lake Station to Union Station downtown) is experiencing a major delay due to a disabled train. Using **either his local transit agency website or websites of any of the surrounding regional agencies (they are linked so he can easily go from one site to the other, depending on his particular travel plans)**, he frequently pre-programs his planned routes the night before or in the morning before he leaves the house. This way he can be alerted immediately of any schedule or route changes and plan accordingly. The text message on his PDA presents several options:

TRANSIT ALERT for GREGORY CHEN. FEB 15 2014.
As of 8:55 AM, 20-minute delay expected on the Metro Gold Line westbound due to a disabled train at Highland Park station.
ALTERNATIVE ROUTES:
Route 485, bus stop at Lake and Washington, next bus arriving at 9:00 AM, estimated travel time to destination: 56 minutes including transfer.
Route 361, bus stop at Fair Oaks and Washington, next bus arriving at 9:01 AM, estimated travel time to destination: 41 minutes including transfer.

Gregory appreciates receiving the information immediately, and decides to head to Fair Oaks and Washington which is only a couple of intersections away. He does not want to keep his new client waiting.

As he expected, the bus on Route 361 arrives on schedule. Boarding never takes him more than several seconds. Kneeling buses these days are extremely well-designed and have their steps practically at curb level before the front door opens. In addition, Gregory does not even have to remove his smart card from his wallet. The contactless card can be read by

the card reader even at a distance of several inches. With all the traveling that Gregory does daily on public transit, he likes the fact that his smart card can be issued and reloaded by his particular local agency, yet the smart card **works on many participating public transit buses, trains, and shared ride vehicles** operated by different local or regional agencies. Whenever he makes a bus transfer to a different transit agency, such as the one coming up in a few minutes, the ease and efficiency of the system becomes extremely apparent. Furthermore, the smart card is a pre-paid card, which can be reloaded at major vendors and does not necessarily have to be loaded at a transit store or station. Thus, when running errands, Gregory can simply reload his smart card at the checkout counter. Some people opt to link their smart card directly to their bank account. Gregory prefers the pre-paid option, and appreciates having the choice for pre-paid or debit.

During his short ride on the Route 361 bus, Gregory notices that the bus seems to be stuck in traffic for some time, but the drive is then expedited by all the green traffic signals that the bus receives along Fair Oaks Avenue. Most buses are equipped with transit priority capabilities, allowing them to "call" or "hold" green lights when they are nearing intersections if the buses are behind schedule or if the bus load is above a certain number of passengers. There are different ways for transit systems to implement signal priority. In this case, after the Route 361 bus passes the traffic bottleneck, the signal controllers at each intersection along Grant Street know that the bus is running a little late since the controllers constantly "communicate" with the buses through radio signals or through a central dispatch system. Since the intersection signal then "knows" that the bus is running late, the signal controller will hold the green signal allowing the bus to get through that intersection. Other signal priority systems can give buses priority based on the number of passengers on the bus. Passengers can be counted using automatic passenger counters, or by recording the number of smart cards swiped, or the driver can track this information. Thus, if a bus is experiencing delays and has more than a certain number of passengers (for example, above 60 passengers), the signal priority system can then be invoked to **maximize the throughput of (in other words, the number of people moved through) the intersection**. When considered over the entire route, the bus can maintain or regain its headway since the travel time is decreased immensely and little time is lost waiting at a red traffic signals.

Gregory estimates that his transfer bus stop should be coming up in a few minutes. "I wonder if my second bus is on time" he wonders, then remembers, "Well, I'm sure I would have received a Transit Alert if there was a long delay on the other route." Gregory's stop then comes up, so he disembarks and goes to his next bus stop across the intersection. He knows that **neighboring transit agencies usually coordinate schedules at major transfer points** such as this one. This way, transfer times are minimized across the entire transit system, and if the first bus happens to be a few minutes delayed, the second bus (to which the passenger is transferring) will usually wait until the first bus arrives, so the transfer can still be made smoothly.

Again, the boarding process is simple and smooth. Because this route is operated by a different transit agency, the transfer is not free; however, a discounted transfer fare applies. Calculations such as these are carried out automatically when passengers make their transfers, and the appropriate fares are charged to their smart cards. **The account reconciliation among the agencies is seamless to the users**, adding to the appeal of such a convenient card.

The time is soon 9:36 AM, and Gregory is nearing his final destination stop. The predicted travel time was pretty accurate. "Great, I'm glad I'll be on time for this 10:00 meeting with the client. I can't wait to show her my storyboards", proud of all his computer graphics work within his laptop.

### *3.3.3 Vision Scenario: Goods Movement*

Denise Ferdinand works for a truck carrier company in southern California. This morning she has been assigned a medium-sized load with books and housewares to be delivered to a client's distribution facility. Because this client is an online retail service with no physical locations in southern California, the products will be going directly into other delivery trucks so that orders can be delivered directly to the customers this afternoon. Thus, as with all clients, efficient and timely delivery of these goods is essential.

Denise arrives at the Port of Long Beach at 7:00 AM as scheduled. Because I-710 is the main route serving the Port, Denise rarely encounters congestion due to the special lanes assigned to heavy vehicles at certain times close to the port. These lanes reflect Caltrans' provision of **improved mobility on state routes serving Ports**.

The books and housewares to be included in Denise's truck load were screened by customs officials upon their arrival in the port, and **security clearance was indicated on the container itself by affixing a computerized label or computer chip describing the nature, country of origin, monetary value, and clearance status of the goods inside**. This label can be easily read at various checkpoints throughout the goods' journey. In turn, the necessary security clearance credentials are assigned to Denise and stored in her transponder, so that as she exits the port, her credentials are instantly verified when they are read by the roadside transponder readers and transmitted to the security officers on duty at the Port.

Denise has been working in the trucking industry for several years, and technology has really changed her day-to-day routine. The inventory and security labels mentioned earlier have simplified Denise's paperwork. Since all the details about where the goods have moved, and with whom, are tracked by computer, Denise does not have to worry about entering details in a manual log. Her work times and mileage are automatically logged by the company's in-vehicle Global Positioning System (GPS), freeing Denise from having to maintain ongoing timesheets each day.

Using the voice command "Traffic", Denise signals to her on-board computer to gather pre-trip travel information along her intended route. The on-board computer monitor immediately shows **CVO-tailored real-time traffic information**, in the form of a color map of her intended route, with green graphics signifying that her route is still relatively free of incidents. "There's one red dot near the I-5 exit," she thinks to herself "but I'll just check the map again closer to that exit, to see if the incident has cleared". The real-time traffic information is constantly streamed to Denise's on-board computer from an information service provider chosen by the carrier company. This information service provider packages only the information needed by the carrier, allowing the company to order only the information it needs at the basic subscription price. By 7:30, Denise pulls out of the loading station and out of the Port, ready for the two hour drive north.

Denise's truck is equipped with a weigh station transponder which allows her to bypass the two roadside weigh stations on I-710. A few yards before reaching one of the weigh stations, Denise's truck is weighed with an in-pavement scale, while an overhead transponder reader transmits credential data such as registration, size, truck equipment, load, safety, and smoke emissions data from Denise's transponder to the weigh station computer. Denise does not have to slow down for either the weighing or the transponder reading. As she nears the weigh station turnoff, a green signal indicates that her truck weight and credentials have been approved, and so she can continue along the mainline. Had Denise seen a red signal, she would have had to turn into the weigh station so that the California Highway Patrol officers could have conducted the necessary weigh station checks and procedures.

The carrier company was able to obtain **state, interstate and federal credentials for Denise's truck through one centralized location** and with one transaction. Because this transaction is centralized and also accessible through the internet, the carrier company saves time and money for each vehicle in the fleet. The central "credential shop" also provides **local agencies** with the capability of requiring certain credentials for commercial vehicles passing through their streets. Thus, the agencies also save time and money, since the usual requisite paperwork involved is now unnecessary. Transactions and payments are handled electronically, streamlining operations for both the carriers and the transportation agencies.

Throughout Denise's trip, data is constantly being collected and tracked by transportation agencies and also by Denise's carrier company. In-pavement systems or weigh-in-motion systems (similar to the scale that weighed Denise's truck before the roadside weigh station) are used by state and local transportation agencies to collect traffic data regarding heavy vehicles. When Denise's vehicle passes over one of the sensors, non-identifying information is collected regarding the truck's axle spacing and vehicle classification, weight, and speed data. This data is transmitted in real-time to a central repository, where it can be accessed in real-time by state and local agencies. Simultaneously, at the main dispatch center of Denise's carrier company, data is also being transmitted from Denise's on-board Global Positioning System receivers, allowing the carrier to track the location of that specific load from the Port all the way to its final destination in Santa Clarita. These two data collection efforts can interface with each other, allowing agencies access to load data and routes, and allowing carriers access to incident information or heavy vehicle statistics on heavily-used routes. **This integration of goods and carrier data collection and tracking software by both the public agencies and carriers** has been beneficial for highway monitoring, improving carrier operations, and decreasing accident rates.

All of the above behind-the-scenes tasks can be carried out without Denise even knowing. Her responsibility is to pick up and drop off the goods, on schedule and safely. As she drives along, although she is already halfway to her destination (thanks to being able to bypass those weigh stations on the way), she decides to check for traffic conditions en-route. Using the simple voice command "Traffic", she signals to her on-board computer to again receive **CVO-tailored real-time traffic information**, just as she did before her trip started. Because she is driving now, she wants to hear the information in audio format. She states "Incidents" and "I-710), and the on-board computer broadcasts an automated message, saying "8:20 AM: No incidents along I-710. Traffic moving smoothly." "Great!", Denise thinks to herself, "That incident near I-5 exit must have been cleared away. I'll stay on I-710 and it should be a smooth ride from here". Denise remembered that the traffic information streamed to her is tailored to commercial vehicles, so she

decides to program an alert in case any more incidents occur along her route. "Traffic," she says again, followed by "Notify of incidents along I-710 or I-5". The computer responds with a message, "Alert programmed. You will be notified of incidents along I-710 or I-5 until notification is turned off".

Although Denise is a careful and diligent driver, she has additional confidence in her safety and the safety of drivers around her, from her on-board safety monitoring systems. On these long drives, especially with an unchanging landscape, it is easy for one to become drowsy. The **collision avoidance systems** in Denise's vehicle will automatically trigger a loud alarm if the truck comes dangerously close to roadside objects or other vehicles. Also, on long inter-state hauls when Denise has to drive through mountainous terrain with large and valuable loads, she gains more security knowing about the several automated **avalanche warning systems at key locations on Caltrans-operated roadways**. Furthermore, because of her heavy loads which would could cause extreme damage and injury upon impact, the programs which **constantly monitor roadway conditions (for example, ice and other dangerous pavement conditions)** are of utmost importance to Denise. These **programs are coordinated with District traffic management systems and traveler information systems.** Denise feels assured that she will be notified through her pre-programmed traffic alerts if any such adverse driving conditions occur along her route.

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