tahoe basin
ITS strategic plan

Prepared by

transpogroup
WHAT TRANSPORTATION CAN BE.

Prepared for

TAHOE REGIONAL PLANNING AGENCY

2014

13293.00 | November 2014

Table of Contents

Executive Summary

Over the last decade, the Tahoe Basin region has seen a steady growth in Intelligent Transportation Systems (ITS) deployments since the introduction of an ITS Strategic Plan in 2003. Since the adoption of this plan, the Tahoe Regional Planning Agency has identified a need to update this document in an effort to promote further deployment of the latest ITS technologies, keep current with ITS advancements, and increase coordination with Tahoe partner agencies. The primary objective of the Strategic Plan is to help the Tahoe Basin define the latest transportation-related needs in the region and measure these needs against the opportunities presented by ITS advancements and their capacity to support the regional movement of people and goods.

Overview

Technology is changing the way we drive, with myriad emerging technologies equipped on vehicles and installed on the roadside. This technology helps drivers avoid collisions, make better route choice decisions, and reduce emissions. Technological functions and features of the vehicle that are now becoming standard include rear-mounted radar, adaptive cruise control, piloted parking, and hands free car systems. The USDOT and private manufactures are now looking towards technology between vehicles that can support an automated and connected vehicle environment. In the near future vehicles may be capable of driving themselves, taking driver error and inefficiencies out of the roadway network.

In regards to ITS applications, the last few years have seen significant advancements and deployments in ITS with progressive advancements in data collection, data sharing, mobile solutions, communication mediums, and traffic monitoring capabilities. Rapid growths in ITS deployments are commonly attributed to their ability in providing a high benefit-to-cost. With the rapid growth in handheld device users, mobile applications and cloud solutions are developing into a normal way of life for many travelers. While much of this growth is spurred from developments in the private sector, responsibility also lies with governmental agencies to harness these opportunities and use them to improve the lives of the citizens they represent.

What is ITS?

Intelligent Transportation Systems

is the application of innovative technology to provide more efficient, safe, and convenient travel. It focuses on enhancing the existing transportation system by providing improved traveler information, traffic management systems, transit operations, and goods movement and has been defined as:

> The application of advanced sensor, computer, electronics, and communication technologies and management strategies in an integrated manner to increase the safety and efficiency of the surface transportation system.

Traditional examples of ITS include changeable message signs (CMS), closed circuit television (CCTV) cameras, traffic signal synchronization and preemption, and Highway Advisory Radio (HAR), Road Weather Information Systems (RWIS), automatic vehicle location devices, information kiosks, and electronic payment services for transit and tolls. More recently mobile applications used in conjunction with handheld devices have proven to be a simple and efficient method to provide information and obtain data from travelers. The recent focus in ITS research and development also includes advancements in connected and autonomous vehicles.

Regardless of the ITS technology, to be most effective, the systems need to be integrated, sharing information that can be used within and outside the Tahoe Basin to improve transportation mobility and safety.

What is the Tahoe ITS Strategic Plan?

The Tahoe Basin ITS Strategic Plan provides a road map to help identify opportunities to implement technology to meet the transportation needs in the region. It is a tool that encourages inter-agency cooperation to help improve transportation safety and mobility as well as the environment through the use of technological advancements. This plan helps prioritize recommended projects to maximize the use of funding sources and provide the most benefit to travelers in the region.

PLAN KEY MOTIVES

- It represents a coordinated effort between partnering agencies that have responsibility for planning, implementing and integrating projects throughout the Tahoe Basin
- It supports ITS projects that will benefit the tourism market by increasing distribution of roadway information, increasing safety along Tahoe's major roads, and increasing ridership of public transit
- It contains information that will be helpful in implementing useful ITS Projects
- It contains ITS Projects for deployment that provide certain benefits that help meet regional and local air quality requirements/mandates
- Conformance with the Regional ITS Architecture contained in this Strategic Plan ensures that ITS Projects in the Tahoe Basin are eligible for Federal funding
- It contains ITS Projects for which Regional and Local agencies will need to determine funding priorities

Strategic Plan Participants

The Tahoe Basin incorporates parts of two states (California and Nevada) and five counties (Carson City, Douglas, El Dorado, Placer and Washoe). The Tahoe Basin ITS Strategic Plan has been a joint effort of transportation, law enforcement, and emergency response agencies, as well as the recreation, entertainment, lodging and other businesses throughout the Basin.

The Tahoe Basin ITS Steering Committee provided oversight and guidance. The Tahoe Metropolitan Planning Organization/Tahoe Regional Planning Agency (TMPO/TRPA) served as the lead agency. A consultant team supported the Steering Committee and TMPO/TRPA. The team was lead by Transpo Group, with support from LSC Transportation Consultants, Inc.

Consultant team

A consultant team was contracted by the TMPO/TRPA to assist in the development of the Tahoe Basin Regional ITS Strategic Plan update.

Regional Characteristics

KEY CHARACTERISTICS

Influencing the development of the ITS Strategic Plan of Lake Tahoe Basin included the following:

Tourism

Tourism is the primary driving force behind the Tahoe Basin economy. The majority of visitors travel from the San Francisco Bay Area, utilizing I-80 for access to north Tahoe and US 50 for south Tahoe. The ITS Strategic Plan places a focus on those travelers from outside the Basin as well as residents of the Basin.

Environmental Concerns

The Tahoe Basin is currently the focus of a major environmental effort to improve the quality and clarity of water in the lake and to improve the quality of the air. The recommendations developed as part of this ITS Strategic Plan have been made with careful consideration of how they will affect the environment and economy of the Basin.

Adverse Weather

The great diversity of the weather in and around the Tahoe Basin creates significant challenges for the transportation system. Many of the recommendations in the Tahoe Basin ITS Strategic Plan address the challenges presented by the weather conditions in the Basin.

Specific ITS strategies were developed to address the needs and challenges presented by these three unique regional characteristics. In the recent years, advancements in web applications have revolutionized the means in which transportation information is communicated, providing new opportunities to reach a broader audience. Coupled with some of the existing ITS investments and traditional ITS strategies, Chapter 4 provides an in-depth discussion of how these specific needs and challenges are met through the deployment of ITS.

THE STRATEGIC PLAN ROAD MAP

A PROGRESSION FROM VISION TO PROJECT PRIORITIES

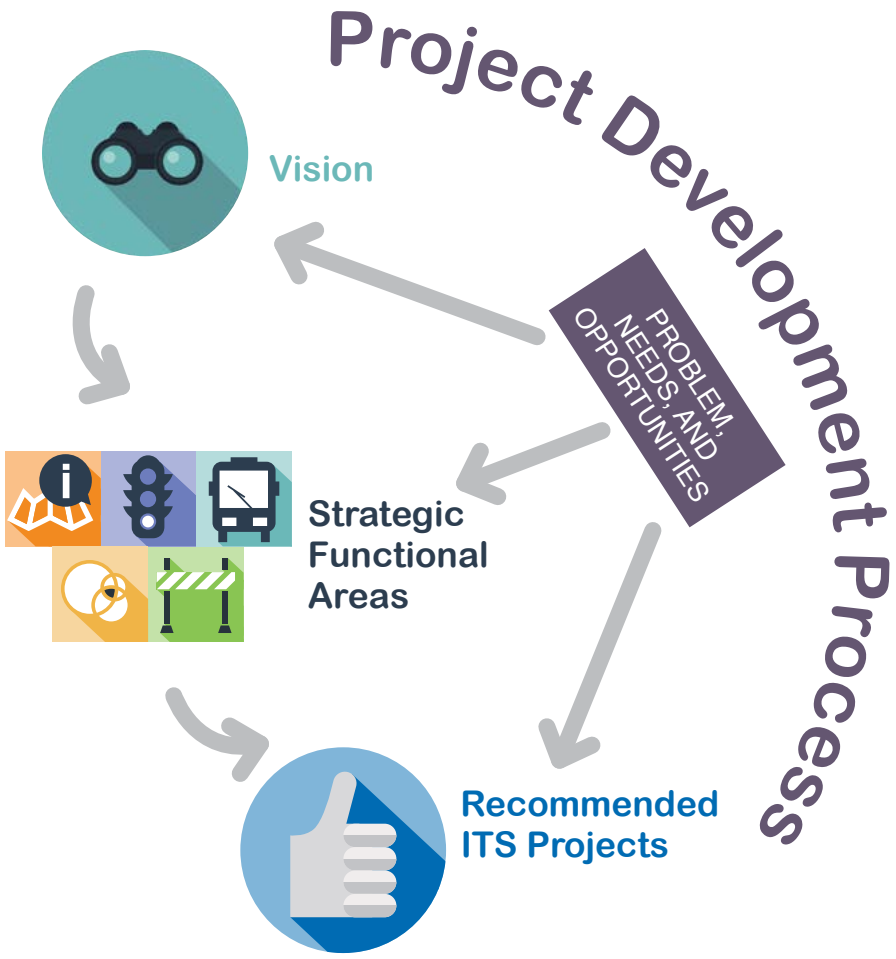
The ITS strategy for the Tahoe Basin can be thought of in terms of a progression from an overall vision to priorities.

ITS STRATEGIC VISION is simply a guide for where we want to go and, to an extent, how we want to get there.

THE STRATEGIC FUNCTIONAL AREA has been defined to support and provide additional detail to the vision. The strategic functional area consists of general principles that apply as we seek to achieve the vision. The vision and related strategic areas for the Tahoe Basin are defined in the body of the report.

RECOMMENDED ITS PROJECTS have been defined that are appropriate to the Tahoe Basin, both for the short- and long-term. ITS concepts can be thought of as types of ITS recommended projects that are not specific to a location or agency.

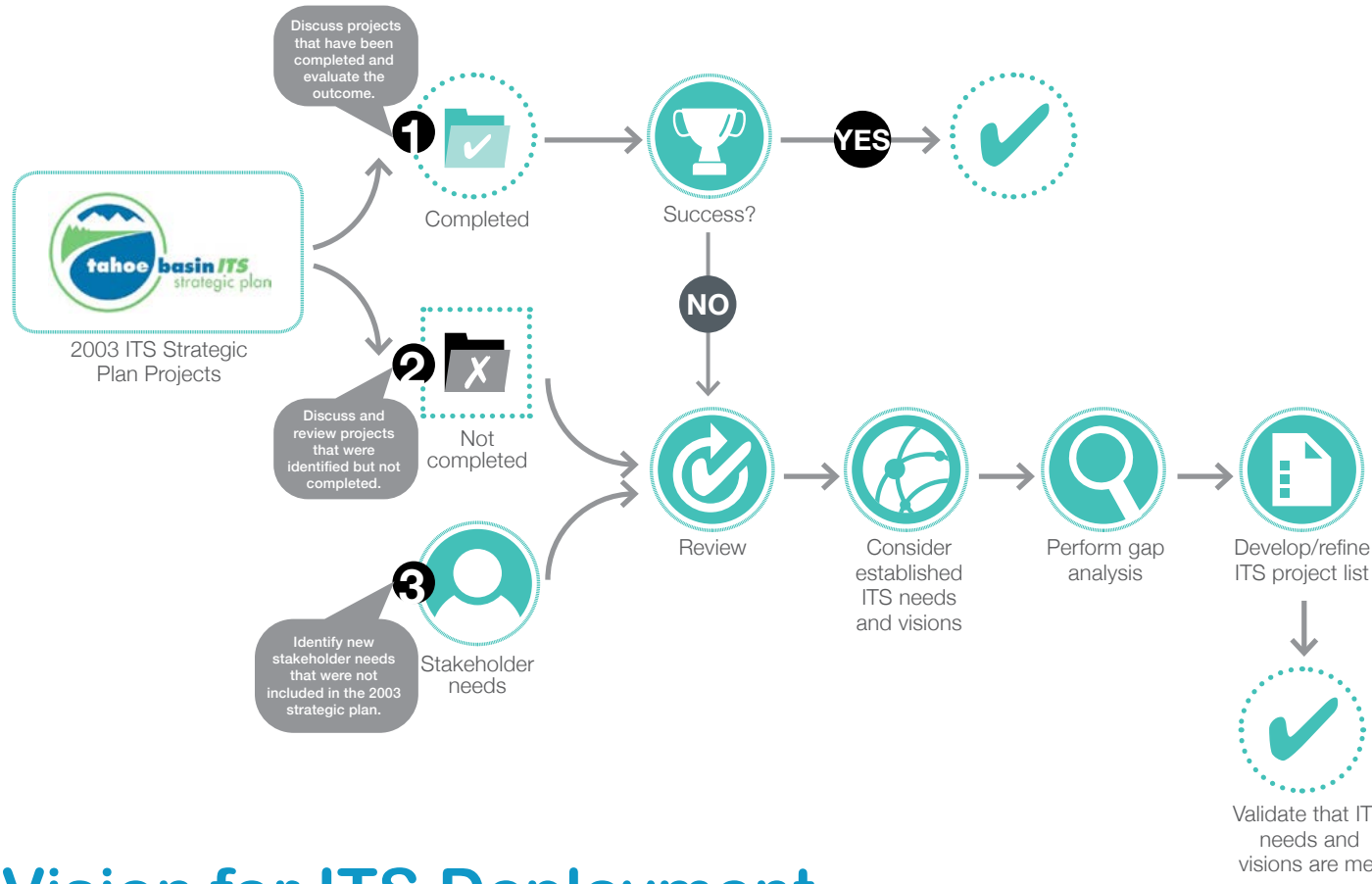
Implementation priorities then define which projects are likely to be deployed earlier than others. These priorities have been indicated in general short-, and long-term time frames, providing flexibility for Caltrans, NDOT, TMPO/TRPA, and other entities to make adjustments in priorities in response to funding availability and overall needs of the transportation system.



As part of the evaluation process, the project team used a systematic approach throughout the project to measure the progression of projects against previous ITS planning efforts and align the strategies against the foundational vision. This process in represented in the following flow chart:

Lake Tahoe ITS Plan Update

Evaluation Process



Vision for ITS Deployment

This ITS strategic plan continues to build on the vision for ITS in the Tahoe Basin that is encompassed by the following statement:

ITS WILL BE INTEGRATED INTO THE TAHOE BASIN TRANSPORTATION SYSTEM INFRASTRUCTURE AND OPERATIONS ON A STRATEGIC BASIS:

- To provide accurate and timely information to interregional and local travelers making travel to and within the Basin a more enjoyable experience,
- To provide public education about and awareness of travel options and conditions,
- To address congestion and safety problems,
- To enhance emergency preparedness and response,
- To encourage use of transit and other modes as alternatives to the automobile whenever possible,
- To improve the efficiency and effectiveness of operational and maintenance functions of all transportation modes,
- To support transportation planning and system management functions, and
- To support and encourage inter-agency operability and effectiveness.

The vision and goals for regional ITS deployment are discussed in detail in Chapter 2.

Strategic Functional Areas & Recommended ITS Projects

A full range of ITS technologies and strategies were considered within the Strategic Plan and many were found to offer potential benefits for the Tahoe Basin. To help identify priorities and focus deployment efforts, the recommended technologies and strategies were organized into five strategic functional areas.

Roadway Traveler Information

Traffic Management & Safety

Transit Accessibility and Service

Maintenance Activities

System Integration & Coordination

Roadway Traveler Information

The most frequently mentioned transportation-related need in the Tahoe Basin was for improved, real-time information about roadway conditions including current traffic levels, congestion, incidents, weather conditions, maintenance and construction activities, and tire/chain requirements. The goal of this functional area is to provide travelers with timely, accurate and easily accessible information about travel delays and conditions, especially those traveling from different regions. The two key aspects for improving roadway information in the Tahoe Basin are the collection of timely and accurate information and better dissemination of the available data.

BY IDENTIFYING WHERE PROBLEMS EXIST AND NOTIFYING TRAVELERS IN ADVANCE, ITS strategies in this functional area can:

REDUCE congestion and traveler delays.

REDUCE crashes, injuries and property damage.

REDUCE traveler frustration.

IMPROVE the visitors' experiences within the Tahoe Basin.

INCREASE the efficiency of the transportation system.

MINIMIZE the impact of the transportation system on the environment.

Recommended ITS Projects

High priority recommended projects include:

- Travel Time Dissemination System (RI-01) – Caltrans and NDOT
- Information Kiosks at Activity Centers (RI-03) – TTD/TART, Caltrans, and NDOT
- Cellular Coverage Analysis (RI-07) – Tahoe Prosperity Center

Traffic Management and Safety

The Tahoe Basin has the characteristics of a rural area where congestion results primarily from heavy peaking in visitor volumes. The winter months also experience higher traffic volumes in the late afternoon when travelers begin to depart from the activity centers. This strategic functional area combines technologies to monitor traffic flow, dynamically control traffic signals to reflect the traffic patterns, and manage the use of lanes for which the direction of travel can be reversed.

These ITS strategies are designed to:

REDUCE congestion, delays and emissions.

IMPROVE safety for all travelers.

REDUCE the resource requirements for traffic control.

REDUCE the need for roadway widening.

Recommended ITS Projects

High priority recommended projects include:

- Parking Lot Detection System (TM-05) – State Parks and TTD/TART
- California and Nevada Signal Communication Upgrades (TM-09, TM-10) – Caltrans and NDOT
- Accessible Pedestrian Signal (APS) Upgrades (TM-19) – Caltrans and NDOT

Transit Accessibility and Service

Consistent with region's Mobility 2035 vision, multimodal transportation is a key element to the region's overall vitality. In recent years, the communities in the Tahoe Basin have made it a high priority to offer an alternative to traveling by automobile. Enhancements to active modes and public transport are a key element to fulfilling this priority goal. Environmental improvements, particularly with respect to air and water quality, has also been a high priority and one for which there is a national initiative underway. A set of ITS strategies has been identified that increase the ease with which transit services in the Tahoe Basin can be provided and used, and thereby improve mobility and reduce the need for use of private vehicles.

The ITS strategies in this functional area are designed to:

INCREASE the efficiency with which transit services are operated.

INCREASE traveler awareness of transit services and current status.

INCREASE transit ridership.

REDUCE vehicular travel thereby reducing congestion and emissions.

INCREASE the safety and security of using transit.

Recommended ITS Projects

High priority recommended projects include:

- Transit Vehicle Fare Collection System Upgrade (TR-08) – TTD/TART
- Transit Station and Vehicle Surveillance (TR-10) – TTD/TART
- NextBus Implementation (TR-11) – TTD/TART

Maintenance Activities

Maintenance of the region's roadways is one of the most significant transportation functions in the Tahoe Basin. Improving the efficiency and effectiveness with which the two state departments of transportation, and county and city agencies are able to clear snow and maintain the region's roadways is a recurring need and high priority. A bundle of ITS projects has been identified that will improve the precision with which maintenance crews and vehicles are dispatched and increase the effectiveness of the maintenance they provide.

These ITS applications are designed to:

IMPROVE the efficiency and effectiveness of maintenance activities.

REDUCE maintenance costs.

REDUCE traffic delay due to maintenance.

IMPROVE maintenance worker and traveler safety.

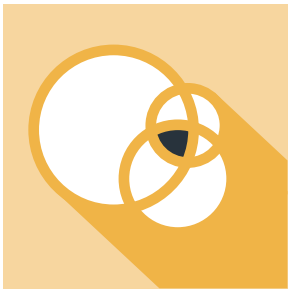
REDUCE incidents due to roadway conditions or maintenance activities.

REDUCE environmental impacts from more efficient use of anti- icing and de-icing chemicals.

Recommended ITS Projects

'High priority recommended projects include:

- Intelligent Mobile Observation (MT-01) – Caltrans and NDOT
- Basin-wide Snow Removal Policy (MT-03) – Local Cities, Caltrans, and NDOT
- Maintenance Vehicle Sensor and Locator Expansion (MT-06) – NDOT



System Integration & Coordination

Many organizations provide transportation system management in the Tahoe Basin: two state departments of transportation, four counties, two transit operators, and a number of municipalities. Coordinating management actions across these organizations is critical. This functional area includes a set of technologies and strategies to improve the communication and coordination within and between transportation, law enforcement and emergency response agencies in the Tahoe Basin.

By improving communication and coordination between agencies, the strategies in this functional area are designed to:

INCREASE the speed, consistency, accuracy and comprehensiveness with which transportation system information is shared.

REDUCE congestion and delays.

IMPROVE safety through the enhanced identification of and response to incidents.

IMPROVE coordination between services and modes.

Recommended ITS Projects

High priority recommended projects include:

- Communication Infrastructure Standard (IC-01) – Caltrans and NDOT
- Data Warehouse and Third Party Integration Plan (IC-02) – Caltrans, NDOT, and Public/Private Partnership
- Chain-up Information Strategic Plan (IC-06) – Caltrans and NDOT

NEXT STEPS

While the strategies and operational concepts defined in an ITS strategic plan are useful, the impetus for developing the plan is to effect new ITS deployments to address the many safety, mobility and environmental benefits. Through the course of this planning process and future ITS growth, it is important that energy and momentum from stakeholders be maintained to champion the initiatives that are identified.

Project Deployment

As part of these next steps, individual agencies or entities will need to step forward to lead or "champion" individual ITS projects based on their level of interest, expertise, and need. Lead agencies have been defined in the Plan, and these lead agencies will need to take the initiative to move ITS Projects forward by identifying funding, developing a design, and taking it through procurement.

To facilitate the efficient and effective implementation of ITS projects, several factors must be considered during both the design and deployment of these projects. These factors may be summarized as follows:

Interoperability

To take full advantage of their potential, most individual ITS applications will need to accommodate linkages to other systems and coordination between different agencies. The regional architecture and ITS standards provide a framework for this interoperability.

Project Conformance

Federal funding of ITS Projects will be contingent on projects conforming to the Regional ITS Architecture and, by extension, the National ITS Architecture. It is also required that a systems engineering approach be used in the further development of individual projects.

Standards

Another element of the federal requirements is that applicable ITS standards be used for all federally-funded ITS projects. More importantly, use of these standards can help support the design and specification process, and ensure interoperability between systems. The Regional ITS Architecture and related database tool can be used to identify the current standards activity associated with every architecture flow within the Tahoe Basin's planned architecture.

Inter-Agency Agreements

Most of the ITS deployments in this Plan call for cooperative deployment and operations efforts between multiple jurisdictions. This will require a greater degree of coordination between participating agencies.

Funding

Opportunities for funding and implementation for ITS Projects are not as obvious as for traditional types of transportation improvements. In some cases, ITS applications may be best implemented as “add-ons” to conventional improvements. In other cases, targeted funding needs to be sought for stand-alone ITS applications.

Procurement

The traditional procurement and contract procedures used by agencies vary and may not always be well suited to the unique characteristics of ITS projects. Selection of appropriate procurement procedures for designing, developing/manufacturing and installing the elements of ITS projects will help ensure that long delays don’t occur during implementation.

Operations and Maintenance

Successful ITS applications depend to a great extent on the approach taken to provide day-to-day operation of the systems. Project sponsors must have a plan for and devote resources to operations.

ITS Program Management

Successful implementation of ITS also requires top level leadership that focuses on the overall program.

This program leadership should involve both an ITS Coordinating Committee to provide oversight of ITS activities in the region, and an ITS Coordinator responsible for specific activities related to the region's ITS program. The Tahoe Regional Planning Agency (TRPA) will ideally lead this effort by providing staff and funding for the ITS Coordinator position, while recognizing that the Tahoe Transportation District (TTD) should also seek a similar position to mainstream ITS into their planning process. The TRPA and TTD are locally based and can act as an interface between regional public agencies, private companies, and third-party entities. The vision for this TTD role is similar to TTD's Mobility Manager which was recently enacted through the Coordinated Human Services Transportation Plan. The Mobility Manager has proven to be a successful means to implement social service mobility projects. Implementation is one area that is struggling in the ITS project process. The following list identifies the main responsibilities of the ITS Coordinator with support and oversight from the ITS Coordination Committee.

TRACKING project deployment and conformance

UPDATING the Strategic Plan

MAINTAINING the regional ITS architecture

MAINTAINING intra- and inter-regional coordination

PROVIDING technical support and assistance

IDENTIFYING funding opportunities

EVALUATING the ITS program and individual projects

ENSURING federal compliance

MAINSTREAMING and implementing ITS

chapter 1
Project Background

Project Overview

The Tahoe Basin ITS Strategic Plan is a regional effort aimed at providing direction for the application of advanced transportation technology in the five- county, two-state Tahoe Basin region with a heavy focus towards supporting tourism and interregional travel. The ITS Strategic Plan defines the technological applications that make the most sense for the Tahoe Basin over the next twenty years and provides an action plan for implementing the identified strategies.

The ITS Strategic Plan represents an important element of a comprehensive transportation plan for the region. Intelligent transportation systems are capable of providing additional efficiencies to transportation facilities and services that are constrained by physical and environmental limitations. The ITS Strategic Plan serves as a blueprint for how technology may be used to enhance the transportation system in both the short and long term.

The ITS Strategic Plan was developed under the leadership of the Tahoe Metropolitan Planning Organization/Tahoe Regional Planning Agency (TMPO/TRPA) and by a steering committee consisting of stakeholder agencies form the region. The steering committee was assisted by a consulting team led by Transpo Group. The overall goal of the project was to identify and prioritize proposed ITS applications in the region based on existing and projected future travel and transportation needs and deficiencies.

The ITS Strategic Plan is organized into six sections as outlined in Exhibit 1.1. The report is designed to identify the recommendations that have emerged from stakeholder consultations and technical assessments. An emphasis was placed on the ITS projects that have been implemented in the region, the region's latest needs, and recommended projects that address these needs.

Exhibit 1.1

Overview of ITS Strategic Plan Document

SECTION	DESCRIPTION
Executive Summary	**Provides an overall summary of the Tahoe Basin ITS Strategic Plan.**
1 Project Background	Describes the project scope, defines ITS and its potential benefits, and describes what the Tahoe Basin ITS Strategic Plan and update is and identifies who was involved in developing it.
2 Recommended Projects and Priorities	Identifies and prioritizes ITS Projects for the Tahoe Basin based on a vision and set of strategies that respond to regional needs and deficiencies.
3 ITS Program Management	Identifies requirements and recommendations for on-going management and implementation of an ITS program for the Tahoe Basin.
4 System Characteristics	Summarizes the existing and projected travel and the characteristics and conditions of the transportation infrastructure and service around the Tahoe Basin.
5 Regional ITS Architecture	Defines the open architecture based on communications technologies and the national architecture that supports exchange of data between transportation management systems.
6 Deployment Considerations	Provides guidance on the steps and issues associated with project deployment.

Source: Transpo Group

What is ITS?

Intelligent Transportation Systems.

ITS is the application of advanced sensor, computer, electronics, and communication technologies and management strategies in an integrated manner to increase the safety and efficiency of the surface transportation system.

Why is ITS important for the Tahoe Basin?

This definition encompasses a broad array of techniques and approaches that can be applied to Tahoe Basin's roadway and transit systems to operate more safely and efficiently. Some of the main objectives of ITS for the Basin are to:

OBTAIN the maximum use and efficiency of the transportation infrastructure while reducing vehicle emissions.

MAKE travel safer and more convenient.

IMPROVE connectivity and inter-agency management of the transportation network.

APPLY technology to better disseminate traveler information to transportation network users at a local and interregional level.

Improvements & benefits:

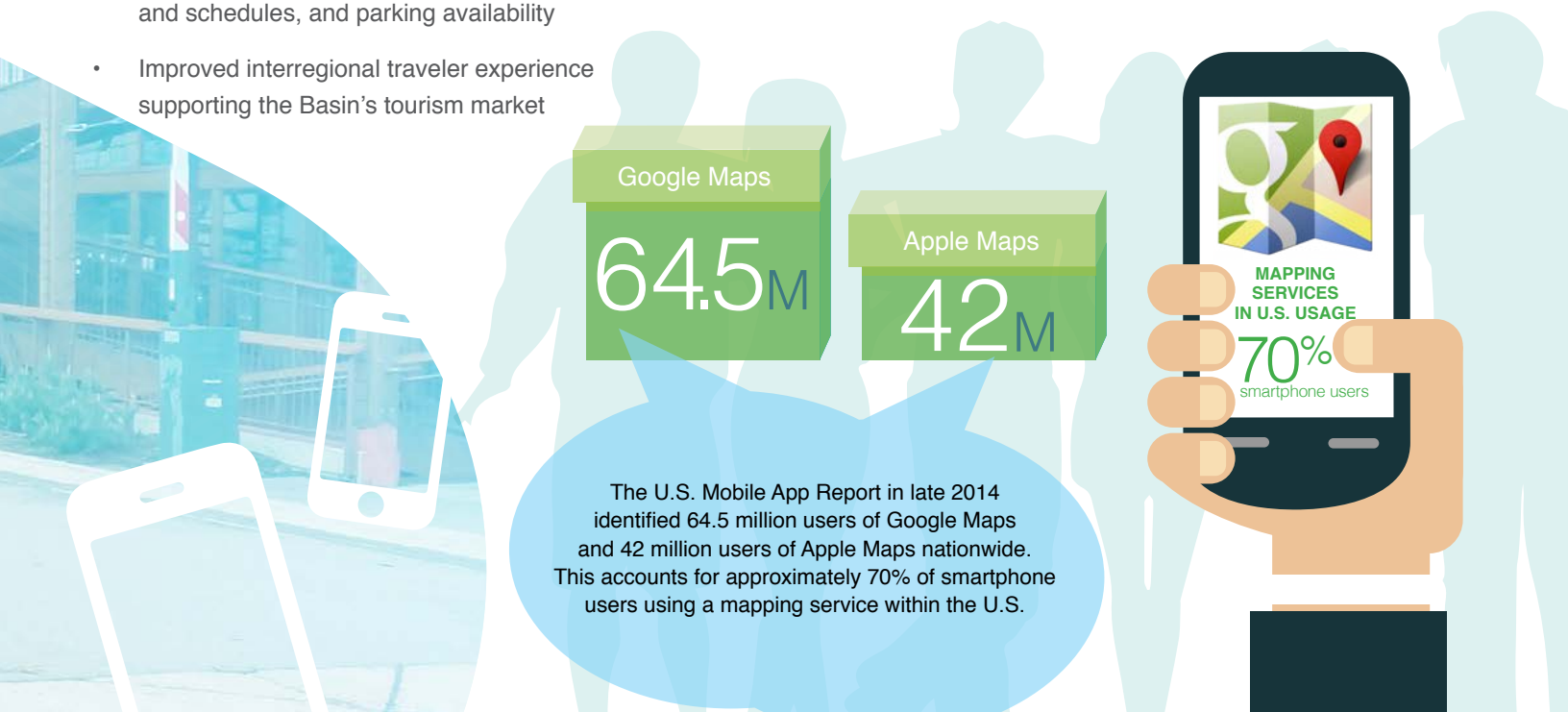
ITS improvements can provide a wide range of benefits to Tahoe Basin's transportation at a higher benefit-to-cost than traditional transportation strategies such as adding traffic lanes, building new roads or increasing bus fleets. The strategic plan identifies traveler information services as one of the quickest changing markets with the introduction of mobile handheld devices. In the recent years, a wide variety of traveler information applications such as traffic flow maps, traveler advisories, parking guidance systems and dynamic routing tools have become available to mobile device users.

ITS BENEFITS FOR THE TAHOE BASIN

- Reduced delays and vehicle emissions at traffic signals through improved signal coordination or adaptive signal control systems
- Reduced delays, emissions and secondary accidents through faster incident identification, clean-up, and traveler advisories
- Improved on-time performance for transit and reduced travel times through vehicle tracking, schedule adherence monitoring and traffic signal priority
- Improved motorist and transit rider safety and security through video monitoring, emergency call devices and faster response
- Reduced traveler frustration and increased convenience through accurate, real-time information on traffic conditions, alternate routes, transit routes and schedules, and parking availability
- Improved interregional traveler experience supporting the Basin's tourism market

EXISTING ITS TECHNOLOGIES AND APPLICATIONS WITHIN THE TAHOE BASIN

- Interconnected traffic signal control systems
- Highway advisory radio (HAR) systems
- Closed circuit television (CCTV) cameras
- Electronic sensors in roadways
- Changeable or variable message signs (CMS and VMS)
- Road Weather Information Systems (RWIS)
- Data sharing
- Third-party mobile applications
- California and Nevada 511 Systems
- Vehicle tracking technology



Tahoe ITS Strategic Plan Update Process

The ITS planning update process in the Tahoe Basin has been much like any other transportation planning activity but with the focus on technological solutions.

One of the primary areas of emphasis of ITS planning in the Basin has been the extensive involvement and participation of the stakeholders of the region. This has been especially important to ensure inter-agency integration, address potential institutional issues early, and to provide the necessary education and awareness of advanced technology transportation solutions.

Process guidelines tasks

The Tahoe Basin ITS Strategic Plan Project followed federal ITS planning process guidelines and included six tasks:

Activity areas

These tasks were used to facilitate the activities among four broad activity areas:

Agency Coordination and Stakeholder Outreach.

The Tahoe Basin ITS Strategic Plan Steering Committee developed the ITS Strategic Plan in a coordinated and cooperative manner. During the course of the Strategic Plan development, the Steering Committee met to develop goals and objectives, review needs and problems, and discuss recommended ITS projects.

The Steering Committee identified key stakeholders that would provide the greatest amount of input for the update process. Phone conversations and in-person interviews took place to assess their transportation related problems, needs, and potential solutions. Stakeholders were provided an opportunity to review draft versions of the plan as well as identify and discuss information specific to their concerns.

Development of New ITS Projects

The central element of the ITS Strategic Plan is the definition of projects that will be deployed to deliver the enhanced efficiencies available through ITS. Project definitions were discussed and created through direct interaction with the Steering Committee. A preliminary ITS project list was submitted to the Steering Committee based on the problems and needs assessment performed during the outreach process. The Steering Committee further refined these projects with internal review sessions leading to the final development of the recommended projects provided in this Plan.

Technical Assessments

In addition to the outreach, needs definition, and project development activities which comprised the majority of the effort in developing the ITS Strategic Plan, several technical assessments were performed by the consulting team. These assessments included the update of the regional system architecture which defines how the various ITS systems could be integrated, as well as various technical reviews and documentation.

Project Participation

The Tahoe Basin ITS Strategic Plan was a joint effort by a combination of governmental agencies and private interest groups in the region. Exhibit 1.2 lists the stakeholders involved in the strategic plan development. Contact information of all stakeholders is included in Appendix A.

Exhibit 1.2 Source: Transpo Group

Tahoe Basin ITS Strategic Plan Steering Committee

- Tahoe Metropolitan Planning Organization
- Tahoe Regional Planning Agency
- U.S. Department of Transportation Federal Highway Administration
- Nevada DOT
- Caltrans
- SACOG Sacramento Area Council of Governments
- TART Tahoe Area Regional Transit
- Tahoe Transportation District

Consultant team

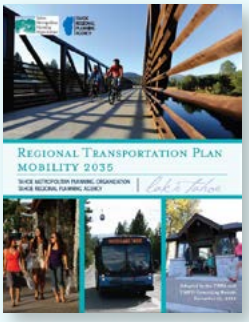
A consultant team was contracted by the TMPO/ TRPA to assist in the development of the Tahoe Basin Regional ITS Strategic Plan update.

transpogroup WHAT TRANSPORTATION CAN BE.

LSC Transportation Consultants, Inc

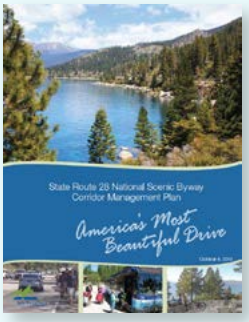
Relationship to other Tahoe Basin Plans

This vision for ITS in the Tahoe Basin must not stand alone in the Strategic Plan. It needs to be reflected in a variety of plans and programs that are developed and updated on a regular basis; that is, it needs to be mainstreamed into the Tahoe Basin's traditional transportation planning process. It should also be noted that the Tahoe Basin ITS Strategic Plan was influenced by many of these other planning activities including the Tahoe Basin Regional Transportation Plan, Bay to Tahoe Basin Travel Impact Study, and SR 28 Corridor Management Plan.



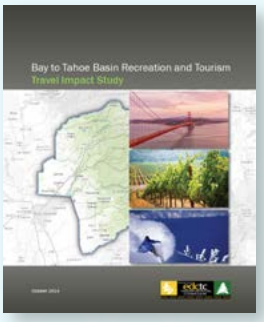
The Tahoe Basin Regional Transportation Plan

Mobility 2035 is "Lake Tahoe's blueprint for a regional transportation system that enhances the quality of life in the Tahoe Region, promotes sustainability, and offers improved mobility options for people and goods. ITS applications considered include improved signal timing, traffic monitoring, in-person traffic management in response to changing local conditions, rehabilitation and maintenance of roads, and provision of real-time information on driving conditions and transit service.



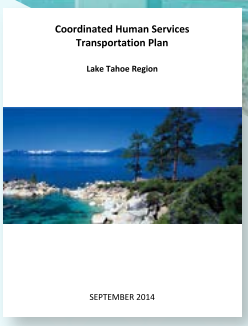
The SR 28 Corridor Management Plan

This plan is the first of six corridor management plans for the planning of Lake Tahoe's highway corridors. The plan recognizes how innovations in technology can increase the ability to manage and maintain the Corridor in a beneficial way. ITS applications considered include parking management and parking guidance systems that utilize mobile applications and roadside dynamic message boards.



The Bay to Tahoe Basin Travel Impact Study

This study evaluated the impacts of regional tourism travel on the highway system to and from the Basin, evaluated the existing and future tourism market, and provided an evaluation of existing and potential funding sources. The study utilized Bluetooth reader technology to obtain origin and destination data. Section 5 of the study provides specific recommendations for improving the traveler experience, all of which were considered when drafting the ITS Strategic Plan.



Coordinated Human Services Transportation Plan

This plan provides a comprehensive approach to increasing access and mobility for transit-dependant travelers. It focuses on providing a coordinated transportation system where by social factors such as employment, health care, education, social services, and recreation are considered.

One of the ITS-cased strategies identified includes enhancements to web-based traveler information systems, leveraging the mainstream use of mobile devices.

chapter 2

Recommended Projects & Priorities

Tahoe Basin's ITS Strategic Plan is built upon an established vision that recognizes the region's needs and seeks opportunity from the latest ITS technologies. The Strategic Plan is a result of a collaboration of stakeholders who understand not only the recent developments in the Basin, but also the latest technology that can support it.

ITS STRATEGIC VISION is a guide for where the Tahoe Basin wants to go with respect to the deployment of ITS and the collaboration required between state and local jurisdictions.

THE STRATEGIC FUNCTIONAL AREAS are the defined focus areas for the strategic direction of ITS deployment and directly represent the needs and opportunities for the Tahoe Basin.

THE RECOMMENDED ITS PROJECTS are projects identified for each of the strategic functional areas as a means of going from a proposed to an implementation perspective. The projects represent specific ITS strategies or applications, but are limited in detail with regard to specific technologies and locations.

Vision for the Tahoe Basin

ITS WILL BE INTEGRATED INTO THE TAHOE BASIN TRANSPORTATION SYSTEM INFRASTRUCTURE AND OPERATIONS ON A STRATEGIC BASIS TO:

SUPPORT & ENCOURAGE...

...inter-agency operability and effectiveness

PROVIDE...

...accurate and timely information to all travelers

...public education about and awareness of travel options and conditions

ADDRESS...

... congestion, safety, and environmental concerns

ENHANCE...

...emergency preparedness and response

IMPROVE...

... the efficiency and effectiveness of operational and maintenance functions of all transportation modes

PROMOTE...

...use of transit and other modes as alternatives to the automobile whenever possible

CONDUCT...

...transportation planning and system management functions

In order for the ITS Vision of the Tahoe Basin to succeed, stakeholders shall use this ITS Strategic Plan as a guide to plan and implement ITS projects across all jurisdictions of the region. The stakeholders that took part in the consultation process each recognize their role and need for collaboration. The consultation process also brought a renewed momentum for the deployment of the latest ITS technology to meet the needs and objectives of the Tahoe Basin.

Strategic Functional Areas

A set of strategic functional areas are defined within the Tahoe Basin ITS Strategic Plan. The term "functional area" is intended to reflect a general area of emphasis for deployment of ITS technologies that address specific transportation-related needs and opportunities. These strategic functional areas were developed through a process that assessed the applicability of various ITS "service packages".

The term "service package" is derived from the National ITS Architecture and is intended to represent an ITS improvement strategy or set of strategies that can be deployed as a unit to address a transportation, safety, or air quality objective or problem. The assessment process involved evaluating each service package on whether it addressed the needs of the Tahoe Basin and if implementation of the service package is feasible.

- Roadway Traveler Information
- Traffic Management & Safety
- Transit Accessibility and Service
- Maintenance Activities
- System Integration & Coordination

Roadway Traveler Information

Today's traveler expects real-time information at their fingertips so that they can best plan and alter their trip if needed. Information such as current traffic conditions, incidents, weather, maintenance and construction activities, and tire/chain requirements can aid the traveler in making their travel decisions.

By identifying where problems exist and notifying travelers in advance, the ITS strategies in this functional area can produce benefits by reducing congestion and traveler delays; reducing crashes, injuries and property damage; reducing traveler frustration; improving the visitors' experiences within the Tahoe Basin, increasing the efficiency of the transportation system; and minimizing the impact of the transportation system on the environment.

A heavy emphasis was placed towards interregional travel into the Basin. The sharing of information to these travelers will positively impact Tahoe Basin's tourism market by making the travel to the Basin more appealing.

USER SERVICE OBJECTIVES

1 Inform travelers about travel delays from recurrent congestion, special events, incidents, weather problems, and other emergencies.

2 Increase the knowledge of visitors about travel conditions and activities during the off-peak times, days of the week or seasons.

3 Improve the ability of transportation agencies to warn travelers of potentially difficult roadway conditions.

The Roadway Traveler Information functional area can enhance dissemination of traveler information by improving existing and deploying new data gathering technologies. This can be accomplished by utilizing recent advancements in roadside technologies such as Bluetooth technology and third-party data provides such as Inrix and Google. Dissemination can be improved through the expanded enhancement and installation of agency-operated systems including electronic roadside message signs for travel times, parking lot capacity information, and variable speed signs for adverse weather conditions.

Other considerations have been made for a single Basin-wide Highway Advisory Radio (HAR) frequency and the expansion of mobile and Internet-based information systems such as 511 and mobile device applications. **More importantly, the widening of cellphone coverage will accomplish both data gathering and data dissemination goals by obtaining data from existing ITS systems such as the transit AVL system and providing access to third-party mobile device applications.**

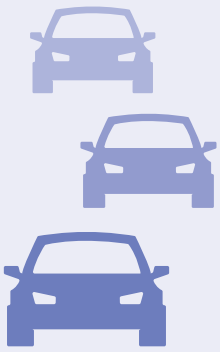
Effective Roadway Traveler Information strategies will require collaboration between participating transportation agencies so data sharing can occur. This also is true for public/private partnership where third parties can access this information for traveler information applications. Private sector businesses, such as those providing recreational activities, food, and lodging, produce the largest draw of visitors. These businesses can enhance information dissemination by working with the public sector agencies to develop ways to pass along information to the travelers such as though mobile applications and interactive kiosks. There may also be opportunities for public/private partnerships in which there is private funding of dissemination methods such as DMS installations for parking guidance purposes.

Traffic Management and Safety

Congestion patterns in the Tahoe Basin are somewhat unique in that they are related primarily to visitor travel patterns. Congestion during peak periods can be worsened significantly by crashes or bad weather conditions.

USER SERVICE OBJECTIVES

1. Enhance traffic flow on the major roads providing access to and circling the lake, improve safety, and reduce the impact of visitor volumes during peak travel times.
2. Enhance traffic monitoring capabilities to collect and verify information on roadway conditions and vehicle flows.
3. Improve the ability of transportation agencies to identify the nature and location of difficult driving conditions.
4. Reduce number and severity of crashes related to congestion, roadway incidents or other conditions affecting the roadway.
5. Provide safe opportunities for walking and the use of bicycles.
6. Facilitate traffic flow to improve ingress to and egress from, and minimize the traffic impact of activity centers and special events.



There are a number of ITS applications that could be effective in reducing delay and improving safety. Improved signal coordination and timing along US 50 as well as alternative vehicle and bike detection technologies can improve traffic flows and reduce delays. Additionally, improved remote communications to the signals within the Basin can support future adaptive signal control and remote monitoring.

Vehicle detection along major routes and parking detection at major destinations also play a key role in providing travelers with better information about traffic/travel times, roadway conditions, and parking availability. Utilizing third party traffic data reduces the need for new vehicle detection installations. Displaying parking information (e.g. roadside DMS, parking app) increases utilization of private lots associated with the resorts and public lots associated with the transit system, such as the East Shore Express.

ITS strategies may also be deployed to directly improve safety on the region's roadways. Creating a standard for systems that combine speed detection and electronic signs can be used to warn drivers about excessive speeds on curves and grades while maintaining a consistent feel throughout the Basin. A standard can also be adopted for warning devices such as rectangular rapid flashing beacons at pedestrian crossings which warn drivers when the crossing is in use. The same theory goes for systems where bike lanes share the road with vehicles such as at a tunnel.

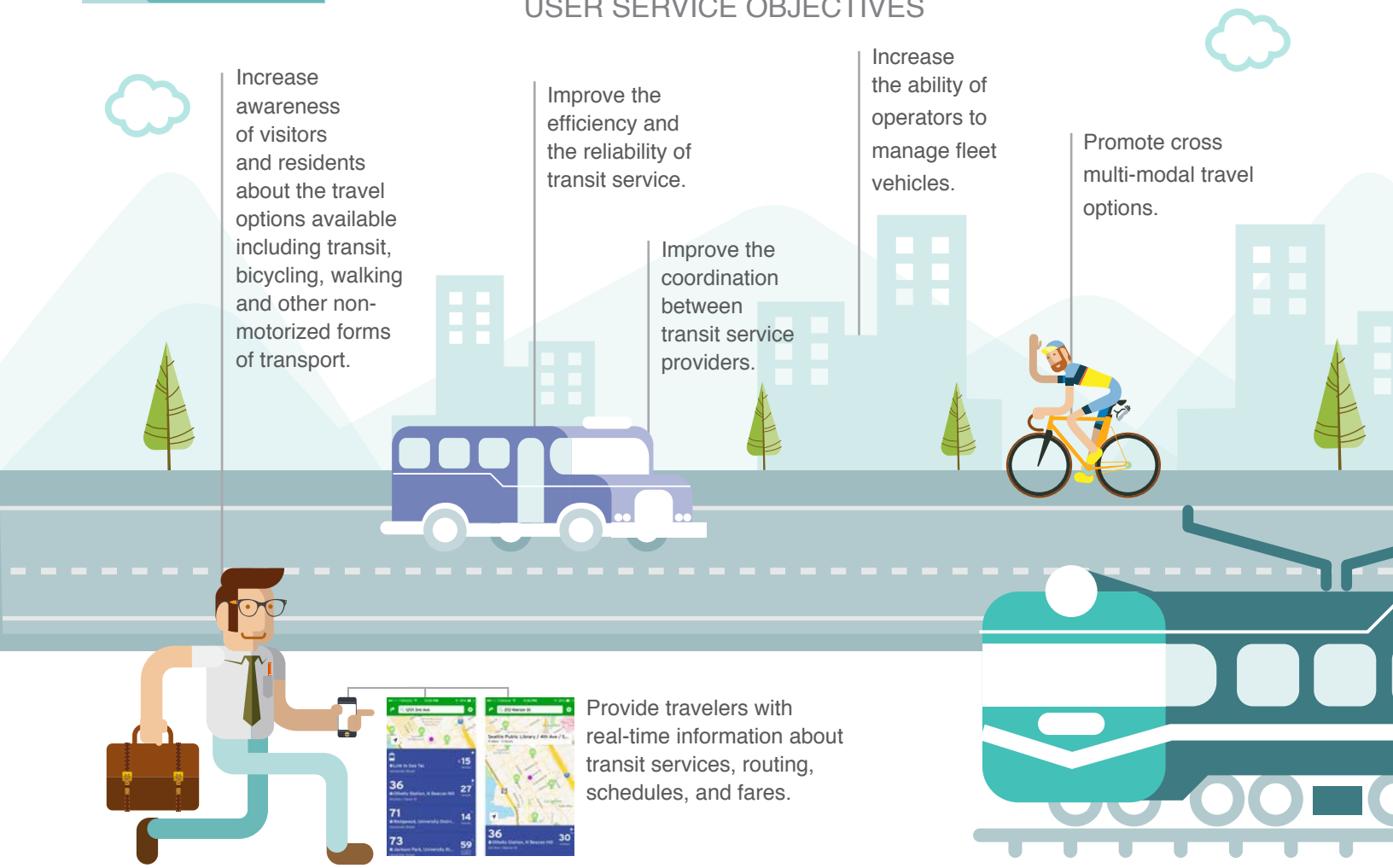
To further increase safety and responder response times, consideration has been made for a unified first responder network. This would place all responders from the different cities, counties, and states onto the same communication network to better utilize resources and respond to incidents in quicker more efficient manner. For future planning purposes, consideration will need to be made for FirstNet adaption. The US Government emergency response program is currently being deployed in urban cities, but eventually could be incorporated into the Basin.

Transit Accessibility and Service

The stakeholders of the Tahoe Basin have made it a high priority to offer alternatives to traveling by automobile for residents and visitors. Coordination amongst transit agencies and public outreach have led to an increase in transit service and improvements in the accessibility of transit services.

USER SERVICE OBJECTIVES

- Increase awareness of visitors and residents about the travel options available including transit, bicycling, walking and other non-motorized forms of transport.
- Improve the efficiency and the reliability of transit service.
- Improve the coordination between transit service providers.
- Increase the ability of operators to manage fleet vehicles.
- Promote cross multi-modal travel options.



Provide travelers with real-time information about transit services, routing, schedules, and fares.

Many ITS strategies have been applied to public transit in the Basin, however, additional improvements were identified. The existing automated fare collection system could be modified such that one form of media could work on all modes of public transportation within the Tahoe Basin aiding travelers in fare payment across different modes. Expanding the Automated Vehicle Location (AVL) system from the north shore to the south shore transit routes can help the operators track the location of vehicles and improve scheduling over time. Transit signal priority (TSP) has also been considered for the South Tahoe signals. TSP could potentially act as a means to synchronize signalized intersections, however, a large coordination effort between the transit agency and Caltrans would be required.

ITS improvements on the transit vehicle include dynamic message signs, passenger count collection systems (specific to each stop), and surveillance systems. Safety and user experience of the transit system can also be improved with transit station upgrades such as ticket vending machines, safety and surveillance equipment, and real-time information kiosks.

Maintenance Activities

Improving the efficiency, effectiveness and safety with which the state DOTs, county and city agencies are able to clear snow in the winter, repair and repave roadways in the late spring, summer and early fall, and in other ways maintain the region's roadways has been repeatedly raised as a high priority for ITS technologies.

USER SERVICE OBJECTIVES

1. Improve the safety and efficiency of highway maintenance, snow clearance activities, and roadway anti-icing and de-icing.
2. Inform travelers about travel delays from construction, maintenance, and special events.

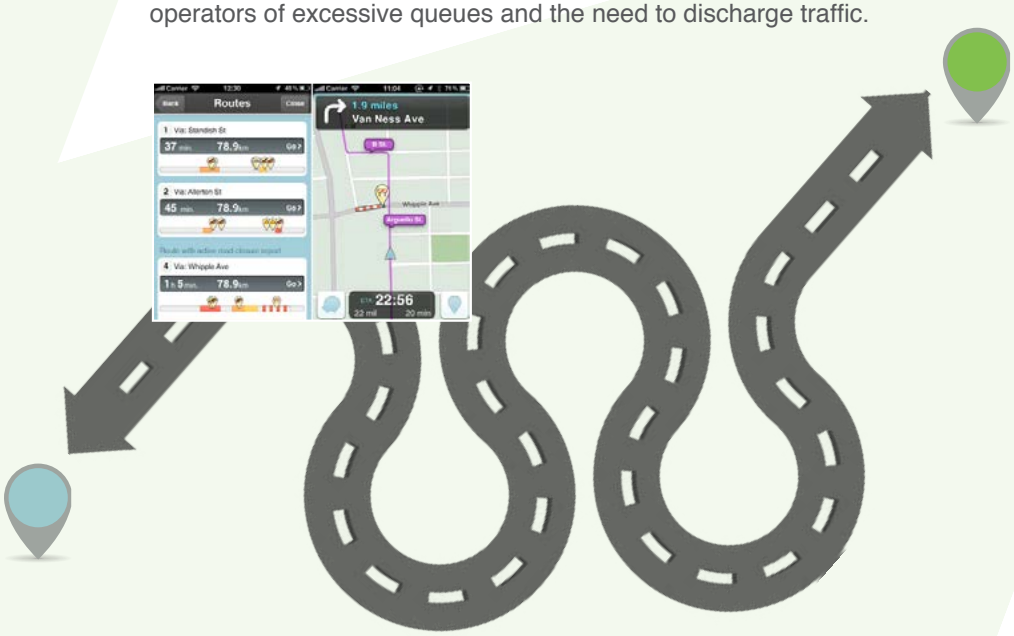
ITS applications can improve the precision with which maintenance crews and vehicles are dispatched, and increase the effectiveness of the maintenance they provide.

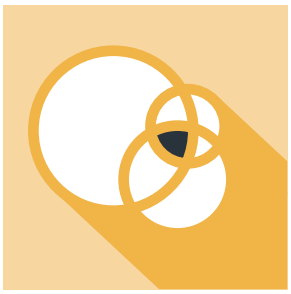
The primary benefits include reduced maintenance costs, reduced traffic delay due to maintenance, reduced incidents due to roadway conditions or maintenance activities, and reduced environmental impacts from more efficient use of de-icing chemicals.

In addition, coordination efforts need to occur to best utilize existing systems, such as roadway chain-up signs and integration with new systems such as mobile device applications.

AVL systems that track maintenance vehicles in real-time can lead to better optimization of crew and vehicle deployment especially during de-icing and snow removal operations in the winter. ITS equipment installed on these vehicles can monitor weather conditions and roadway temperatures, thereby improving the effectiveness of winter maintenance activities by more precisely responding to roadway icing or snow. By applying anti-icing as a preventative measure, roadway closures may be avoided or the amount of de-icing chemicals needed may be reduced.

Safety is a significant concern in almost all kinds of roadway maintenance work. Traffic management around work zones and traveler information about maintenance activities are both essential to protecting the work crews and the traveling public. Dynamic roadway signing and displaying information on mobile device applications such as Waze and Google Maps can alert drivers to the presence of work zones or snowplowing operations ahead. Cellular communication can provide traffic management centers remote control of messages as conditions or traffic management needs change. These systems can also reduce congestion by directing motorists to alternative routes or by notifying operators of excessive queues and the need to discharge traffic.





System Integration & Coordination

Coordination amongst the various transportation systems in the Tahoe Basin is essential to accomplish the vision identified in this strategic plan. With two state departments of transportation, four counties, two transit operators, and a number of municipalities that serve the area; coordination and communication between these agencies will improve the Basin complete transportation network.

USER SERVICE OBJECTIVES

1 Increase the speed, consistency, accuracy and comprehensiveness with which transportation system information is shared between the transportation and emergency response agencies of the Basin.

2 Increase the ability of agencies to communicate directly to coordinate traffic management, transit management, special event management or emergency response.

3 Improve the clarity of roles and responsibilities of Tahoe Basin agencies in responding to emergencies on the Basin's transportation system.

System integration and coordination leverage communication mediums to bring together individual subsystems owned and operated by the regional agencies and ensures that these subsystem function as a complete system.

The functional area would build upon the technologies and strategies to improve the communications between the traveling public, transportation agencies, law enforcement, and emergency response agencies in the Tahoe Basin. The strategies mentioned in previous sections include improvements in radio and cellular telephone capabilities to facilitate traffic management and emergency response.

Communication agreements with third party travel data and information providers will minimize large scale ITS installations (vehicle detection, message signs) by utilizing cell phone data and mobile device applications. In addition, communication upgrades will directly impact policy guidelines that pertain to ITS such as DMS usage, CCTV video sharing, chain-up strategies, Nevada and California 511 integrations, and requirements for future ITS related infrastructure installations.

Recommended ITS Projects

For each strategic functional area, high and low priority ITS projects have been developed. This step represented a transition from a needs or functional perspective to more of an implementation perspective. Resources for the development of the projects included current transportation improvement plans and programs, input from ITS Steering Committee members and other stakeholders, and the consultant team members' knowledge of both existing and emerging technologies.

High Priority Projects

Low Priority Projects

A number of factors were considered when establishing the priority of projects: whether the project required significant regional co-ordination; whether the project would result in a significant or an immediate impact; and finally, whether the project would address a particular ITS need in the Tahoe Basin. The priorities established in the ITS Strategic Plan are intended to help determine where ITS funding should be focused in the coming years. This should be reflected in the projects incorporated into the RTP and future RTIPs.

ITS projects within the Tahoe Basin will be added, removed, or modified over time as new ideas are generated and as technology changes, offering opportunities that had not been anticipated. In some cases, it may be appropriate for multiple projects to be designed and procured together under one solicitation.

In other cases, the projects may need to be split further and provided with greater detail than could be developed in this Strategic Plan. Note that there is no requirement for an ITS Project to be in the Strategic Plan before it can be programmed. However, the ITS Project will require a determination of conformance with the Regional ITS Architecture in order to receive federal funds.

ITS PROJECT GLOSSARY

The recommended ITS projects each contain the following components:

Project Name: The project title is not official and can be changed before project is programmed.

Description: The description provides detailed information regarding deployment location and parameters. These project descriptions are intended to help agencies and other entities as they proceed through the deployment process.

Project Number: The project number is comprised of the abbreviation of the related strategic functional area followed by a number for reference purposes.

Service Packages: The service packages listed were used to develop the project. The service packages are part of the National ITS Architecture which provide guidance and additional information relating to the project type.

Project Dependencies: Most of the ITS projects identified in this Strategic Plan may be deployed independently of the other projects. However, it is important to recognize where dependencies occur and how this may impact the sequencing of project deployment.

Lead Agency: The lead agency has the highest ownership of the project. Funding, planning, design, construction, operation, and maintenance of the project should be considered by this agency.

Related Agencies: Regional agencies or third parties could potentially be participants and partners. In most cases, formal agreements or memoranda of understandings will need to be put in place. These agreements are discussed further in Chapter 6.

ITS Components: The components listed are not defined as individual pieces of equipment or technology, but rather multiple pieces or "systems" that would be implemented together. Defining the components as individual pieces of equipment or technology would introduce a level of complexity and detail that may be confusing to those without an extensive knowledge of ITS.

Timeframe: Due to the uncertainties regarding such items as the development of new technology and the availability of funding for deployment, the estimated timeframe for the implementation has been stated simply as either short- or long-term. The "short-term" refers the period from now to about 10 years into the future. The "long-term" refers to the period 10 to 20 years into the future. It should be recognized that a number of the projects identified in this ITS Strategic Plan are already moving forward.

Performance Measures: The development and reporting of ITS operations performance measures demonstrates and documents the benefits of ITS. For example performance measures can evaluate incident duration, travel-time reliability, pollution reduction, vehicle miles traveled, and customer satisfaction.

Estimated Capital Cost: For those projects that have been well-defined, the capital costs represent the estimated total project cost. For others, where the number of locations or units involved has not been defined, unit costs are reported. In some cases, the capital costs reflect the cost to define project specifics, including necessary procedures and protocols, and may not involve the deployment of equipment.

Estimate O&M Cost: Annual O&M costs generally reflect the estimated costs associated with operating and maintaining physical equipment. For some projects, the O&M costs reflect the estimated cost for additional staff resources needed to operate and manage the various systems. In many cases, deployment of the recommended projects will not require dedicated staffing, but may add to the duties of existing staff and cumulatively may require more staff such as that at the TMC.

Please note that these costs provide a starting point and possible baseline for future ITS deployment costs applicable to the Tahoe Basin Region. Examination of the assumptions, local conditions, and other factors associated with the particular project should occur before finalizing a cost.

Exhibit 2.1 : Tahoe Basin ITS Strategy Development Process

Roadway Traveler Information

Travel Time Dissemination System

Utilize roadside probe detection equipment data (TM-18) to disseminate travel time information via roadside signs, third party mobile applications, internet applications, and/or through the DOT website to aid travelers in pre-trip planning and en-route decision making. Roadside signage can utilize existing dynamic message signs or designated travel time signs which consist of a larger static sign with dynamic travel time displays.

Project Number
RI-01

Project Dependencies
TM-18

Service Packages
ATIS01, ATIS05,ATIS06, ATMS02, ATMS06, ATMS09

ITS Components
Travel time back-office system

Stakeholder
Caltrans/NDOT
Third-party Developer

Timeframe
Short Term

Performance Measures
Travel time reliability
Customer satisfaction

Scale
8 locations

Estimated Capital Cost
$50,000

Estimate O&M Cost
$1,000

Parking Lot Information and Guidance System Integration

Utilize parking lot management systems (TM-05) to display real-time parking availability information via roadside dynamic message signs, internet applications, and mobile devices for pre-trip planning. Message signs and mobile device applications shall also provide way-finding guidance to public parking lots to encourage alternative travel modes (e.g. East Shore Express parking lot).

Project Number
RI-02

Project Dependencies
TM-05

Service Packages
ATIS01, ATIS05,ATIS06, ATIS07, ATMS09, ATMS17

ITS Components
Parking information back-office system

Stakeholder
TTD/TART
Caltrans/NDOT
Resorts

Timeframe
Short Term

Performance Measures
Parking availability
Transit usage
Customer satisfaction

Scale
4 locations

Estimated Capital Cost
$200,000

Estimate O&M Cost
$10,000

Information Kiosks at Activity Centers

Provide traveler information kiosks at activity centers (resorts, transit centers, etc.) which display traveler information (roadway conditions, travel times, arrival time etc.) between local destinations and major access routes. Kiosks should provide multi-modal traveler information and incorporate real-time information from all data sources including state traffic management and transit systems.

Project Number
RI-03

Service Packages
ATIS01, ATIS02,ATIS06, ATIS07, ATIS08, APTS11, ATMS06

Project Dependencies
None

Stakeholder
Resorts
TTD/TART
Caltrans/NDOT

ITS Components
Weather and vandal resistant display equipment
Connection to Caltrans, NDOT, and transit websites

Timeframe
Short Term

Performance Measures
Transit usage
Customer satisfaction

Scale
6 locations

Estimated Capital Cost
$240,000

Estimate O&M Cost
$5,000

Variable Speed Signs for Weather Conditions

Develop and deploy a system that utilizes RWIS information to regulate variable speed signs. Posted speeds shall reflect both roadway and climate conditions, requiring travelers to reduce speed in an effort to improve safety.

Project Number
RI-05

Project Dependencies
None

Service Packages
ATIS01

ITS Components
CCTV and speed sign deployment
Radio communication
RWIS and speed sign system integration

Stakeholder
NDOT

Timeframe
In Progress

Performance Measures
Collision reduction and escape ramp usage
Customer satisfaction

Scale
2 locations

Estimated Capital Cost
$1.2 million

Estimate O&M Cost
$50,000

Roadway Traveler Information

Cellular Coverage Analysis

Perform Basin-wide broadband analysis to identify gaps in cellular coverage. Send out surveys to the community to receive input on results from the analysis.

Project Number
RI-07

Project Dependencies
None

Service Packages
ATIS05

ITS Components
Cellular coverage maps of cellular providers
Survey results from the community

Stakeholder
Tahoe Prosperity Center
Public/Private Partnership

Timeframe
In Progress

Performance Measures
Customer satisfaction
Signal strength

Scale
One analysis

Estimated Capital Cost
$80,000

Estimate O&M Cost
$1,000

Cellular Tower Installation

Utilize results from Cellular Coverage Analysis (RI-07) to strategically place new cellular towers within the Tahoe Basin to improve cellular coverage. This will increase reliability of wireless communication for ITS equipment and personal cellphones.

Project Number
RI-08

Project Dependencies
RI-07

Service Packages
ATIS05

ITS Components
Cellular towers
Mobile devices

Stakeholder
Cellular Providers
US Forest Service

Timeframe
Short Term

Performance Measures
Customer satisfaction
Signal strength

Scale
4 towers

Estimated Capital Cost
$1.6 million

Estimate O&M Cost
$50,000

Traffic Management & Safety

Parking Lot Detection System

Install vehicle detection equipment at parking lot entrance and exit points to count inbound and outbound vehicles. Parking lot data can be used for planning purposes and integration with parking guidance systems (RI-02).

Project Number
TM-05

Project Dependencies
None

Service Packages
ATMS16

ITS Components
Vehicle detection equipment
Communication connection
Back-office software

Stakeholder
State Parks
TTD/TART
Resorts

Timeframe
Short Term

Performance Measures
Parking availability
Customer satisfaction

Scale
4 parking lots

Estimated Capital Cost
$400,000

Estimate O&M Cost
$40,000

North Tahoe Signal Timing Upgrades

Update signal timing and coordination at intersections along North Tahoe (such as at the SR-28/SR-89 and SR-28/SR-267 intersections) and implement seasonal signal timing to better reflect varying traffic patterns especially within Tahoe City. Seasonal signal timing will require coordination with winter traffic control plans in North Tahoe.

Project Number
TM-06

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Signal timing plans

Stakeholder
Caltrans

Timeframe
Short Term

Performance Measures
Idle time reduction
Customer satisfaction

Scale
6 intersections

Estimated Capital Cost
$80,000 per intersection

Estimate O&M Cost
N/A

Traffic Management & Safety

South Tahoe Signal Timing Updates

Update signal timing at specific intersections along US-50 and Pioneer Trail and implement seasonal signal timing to better reflect varying traffic patterns. Signal timing will require turning movement and demand analysis. Intersection traffic data shall be used when available however new studies will most likely be required.

Project Number
TM-07

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Signal timing plans

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Idle time reduction
Customer satisfaction

Scale
10 intersections

Estimated Capital Cost
$150,000

Estimate O&M Cost
N/A

California Signal Communication Upgrades

Utilize DSL lines for increased communication functionality to support remote monitoring and signal coordination.

Project Number
TM-09

Project Dependencies
None

Service Packages
ATMS037

ITS Components
Traffic signal cabinet communication upgrades
ATMS software modifications

Stakeholder
Caltrans

Timeframe
In-Progress,
Short Term

Performance Measures
Idle time reduction
Customer satisfaction

Scale
16 intersections

Estimated Capital Cost
$20,000

Estimate O&M Cost
$5,000

Nevada Signal Communication Upgrades

Utilize existing radio communication tower infrastructure to support remote monitoring of traffic signals. This project will incorporate new communication hardware in traffic signal cabinets to enable radio communication.

Project Number
TM-10

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Traffic signal cabinet communication upgrades
ATMS integration
Radio equipment installation

Stakeholder
NDOT

Timeframe
In-Progress,
Short Term

Performance Measures
Idle time reduction
Customer satisfaction

Scale
6 intersections

Estimated Capital Cost
$40,000

Estimate O&M Cost
$5,000

Unified First Responder Network

Create and deploy a unified first responder network that functions over the same platform. This will reduce response times and ensure that all first responders receive identical information and eliminate redundancies between departments.

Project Number
TM-13

Project Dependencies
None

Service Packages
EM01, EM05, EM06, EM08

ITS Components
Radio and communication upgrades

Stakeholder
Emergency Responders

Timeframe
In-Progress,
Short Term

Performance Measures
Collision reduction and escape
Emergency response time
Customer satisfaction

Scale
Basin-wide deployment

Estimated Capital Cost
$200,000

Estimate O&M Cost
$10,000

Traffic Management & Safety

Nevada ATMS Implementation

Implement an ATMS system to remotely monitor Washoe and Douglas County traffic signals from a central control center.

Project Number
TM-15

Project Dependencies
TM-10

Service Packages
AD1, AD2, ATMS03

ITS Components
Traffic signal cabinet communication upgrades
ATMS integration

Stakeholder
NDOT
Nevada Counties

Timeframe
Short Term

Performance Measures
Congestion management
Customer satisfaction

Scale
Single deployment

Estimated Capital Cost
$500,000

Estimate O&M Cost
$50,000

Radio Tower Installation

Utilize proposed cell tower installations for backhaul communication between ITS field equipment and traffic management centers. This project would enhance the coverage and reliability of the radio and cellular communication systems through the installation of additional antennas and relay stations. This project would require participation from private service providors.

Project Number
TM-17

Project Dependencies
None

Service Packages
ATIS06, ATMS06, ATMS07, ATMS09

ITS Components
Radio equipment
Traffic management center integration

Stakeholder
NDOT

Timeframe
Short Term

Performance Measures
Remote operations
Customer satisfaction

Scale
2 locations

Estimated Capital Cost
$150,000

Estimate O&M Cost
$15,000

Travel Time Deployment for Planning Purposes

Install roadside probe detection equipment such as Bluetooth and WiFi along key California and Nevada corridors (US-50, I-80, SR-89, SR-28, SR-267, SR-207, SR-431) to capture travel times and origin/destination data. Planning applications could include traffic signal optimization, travel demand management, and trip planning.

Project Number
TM-18

Project Dependencies
None

Service Packages
ATIS06, ATMS02, ATMS06, ATMS09

ITS Components
Travel time field equipment
Travel time back-office system

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Travel time reliability
Customer satisfaction

Scale
8 locations

Estimated Capital Cost
$8,000 per site

Estimate O&M Cost
$1,000

Accessible Pedestrian Signal (APS) Upgrades

Update signal timing and coordination at intersections along North Tahoe (such as at the SR-28/SR-89 and SR-28/SR-267 intersections) and implement seasonal signal timing to better reflect varying traffic patterns especially within Tahoe City. Seasonal signal timing will require coordination with winter traffic control plans in North Tahoe.

Project Number
TM-19

Project Dependencies
None

Service Packages
ATIS06, ATMS02, ATMS06, ATMS09

ITS Components
Pedestrian push buttons, signal heads, and controller
Pedestrian ramp upgrades

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Customer satisfaction

Scale
25 intersections

Estimated Capital Cost
$750,000 per intersection

Estimate O&M Cost
$25,000

Transit Accessibility and Service

Future Real-Time Ferry Arrival and Capacity Information

When the cross-lake ferry is commissioned, a system shall be implemented to provide real-time ferry arrival information based on a GPS unit installed on the ferry. Ferry capacity information shall be provided capacity by the fare collection system. Information shall be posted to dock kiosks, website, and third party applications.

Project Number
TR-01

Project Dependencies
TR-11

Service Packages
APTS01, APTS02, APTS07, APTS08, APTS10, APTS11

ITS Components
GPS unit
Fare collection system with remote communication
Integration with NextBus software

Stakeholder
TTD/TART

Timeframe
Short Term

Performance Measures
Arrival time and capacity accuracy
Transit ridership
Customer satisfaction

Scale
Single ferry installation

Estimated Capital Cost
$15,000

Estimate O&M Cost
$1,500

Basin-wide Fare Payment Transferability

Expand existing payment media to include other payment systems such as parking, ferry and entry fee payments. This would enable travelers to use the same fare media to access multiple public and private services. Expand and integrate payment media with local resort payment media (i.e. private transit service, resort purchases).

Project Number
TR-06

Project Dependencies
TR-08

Service Packages
APTS04 , APTS07, APTS11

ITS Components
Transferable payment media

Stakeholder
TTD/TART, Resorts

Timeframe
Short Term

Performance Measures
Transit ridership
Customer satisfaction

Scale
6 locations

Estimated Capital Cost
$100,000

Estimate O&M Cost
$1,500

Transit Facility Real-Time Information Enhancements

Install overhead DMS at transit stops and kiosks at transit centers to display real-time transit arrival information. Real-time travel information will be provided through the CAD/AVL system (NextBus).

Project Number
TR-07

Project Dependencies
TR-11

Service Packages
APTS08

ITS Components
Ruggedized electronic signage with real-time information
Integration with NextBus system

Stakeholder
TTD/TART

Timeframe
Short Term

Performance Measures
Transit ridership
Customer satisfaction

Scale
3 transit centers
40 buses

Estimated Capital Cost
$645,000

Estimate O&M Cost
$2,000

Transit Vehicle Fare Collection System Upgrade

Upgrade transit vehicle fare collection system so that all buses operating in the Tahoe Basin are equipped with automated fare collection system. This allows for cashless payment methods such as prepaid bus passes. System shall also accommodate future integration with basin-wide fare payment media (TR-06).

Project Number
TR-08

Project Dependencies
None

Service Packages
APTS04

ITS Components
Fare collection system

Stakeholder
TTD/TART

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
50 buses

Estimated Capital Cost
$1.25 million

Estimate O&M Cost
$2,000

Transit Accessibility and Service

Transit Station and Vehicle Surveillance

Install CCTV cameras on-board transit and at transit stations to improve surveillance and increase safety. New CCTV security systems shall be compatible with the existing CCTV security system at the Tahoe City Transit Center.

Project Number
TR-10

Project Dependencies
None

Service Packages
APTS05

ITS Components
Video surveillance equipment

Stakeholder
TTD/TART

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
3 transit centers
50 buses

Estimated Capital Cost
$700,000

Estimate O&M Cost
$10,000 per center
$1,000 per vehicle

NextBus Implementation

Extend TART's NextBus system to the South Shore for implementation on TTD's South Shore transit vehicles. Integration of the NextBus system into a Basin-wide transportation smartphone application (RI-09). It will be the discretion of the transit agency to make transit data open source for use by third parties.

Project Number
TR-11

Project Dependencies
None

Service Packages
APTS01, APTS08

ITS Components
Transit vehicle GPS equipment
NextBus system expansion

Stakeholder
TTD/TART
Public/Private
Partnership

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
50 buses

Estimated Capital Cost
$150,000

Estimate O&M Cost
$25,000

Maintenance Activities

Intelligent Mobile Observation

Remotely monitor and support work zone activities through the use of dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers, and informing other groups of activity (e.g., ISP, TM, other). Portable CMS and CCTVs shall be equipped with antennas for wireless communication allowing remote control capability back at the respective traffic management center.

Project Number
MT-01

Project Dependencies
None

Service Packages
MC07, MC08, MC09

ITS Components
Wireless communication antennas

Stakeholder
Caltrans/NDOT
Local Counties

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
4 set-ups

Estimated Capital Cost
$100,000

Estimate O&M Cost
$10,000

Automated De-Icer System

Install in-pavement system to monitor pavement temperatures at key bridge and tunnel locations. When threshold temperatures are reached,these systems activate embedded nozzles which will spray liquid de-icer on the roadway to promote safe driving conditions.

Project Number
MT-02

Project Dependencies
None

Service Packages
MC05, MC12

ITS Components
De-icer system

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
3 locations

Estimated Capital Cost
$210,000

Estimate O&M Cost
$6,000

Maintenance Activities

Basin-wide Snow Removal Policy

Create and implement a new Basin-wide snow removal policy along key winter travel routes. This may involve collecting weather information from RWIS and automatically dispatching snow plows to locations with reported heavy snowfall.

Project Number
MT-03

Project Dependencies
None

Service Packages
MC06, MC10

ITS Components
Basin-wide snow removal policy

Stakeholder
Caltrans/NDOT
Local Cities

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
1 policy

Estimated Capital Cost
$15,000

Estimate O&M Cost
$5,000

Maintenance Vehicle Sensor and Locator Expansion

Expand the regional Connected Vehicle pilot deployment by equipping additional maintenance vehicles with road condition sensors and AVL technology for remote monitoring.

Project Number
MT-06

Project Dependencies
None

Service Packages
MC07

Stakeholder
NDOT

Timeframe
In-Progress,
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
40 vehicles

Estimated Capital Cost
$200,000

Estimate O&M Cost
$20,000

System Integration & Coordination

Communication Infrastructure Standard

Develop "Dig Once" Basin-wide Standard requiring public and private construction roadwork to include the installation of conduit, thus reducing the need to excavate roadway sections for conduit placement in the future. TRPA shall ensure all projects enact this standard.

Project Number
IC-01

Project Dependencies
None

Service Packages
MC07

ITS Components
Communication infrastructure standard

Stakeholder
Caltrans/NDOT
TRPA/TRPO

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
1 standard

Estimated Capital Cost
$15,000

Estimate O&M Cost
$1,000

Data Warehouse and Third Party Integration Plan

Develop an integration plan that promotes the use of Caltrans and NDOT data warehouses by private third-parties. Data includes traveler information such as weather alerts, chain-up information, and roadway conditions. Third parties may include 511, Tahoe Basin smartphone applications (RI-09), and resort applications.

Project Number
IC-02

Project Dependencies
None

Service Packages
AD1, AD2, AD3, ATIS05, ATMS06, ATMS09

ITS Components
Data warehouse sharing and integration
Third-party applications

Stakeholder
Caltrans/NDOT
Public/Private
Partnership

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
1 plan

Estimated Capital Cost
$60,000

Estimate O&M Cost
$15,000

System Integration & Coordination

California and Nevada 511 Data Sharing

Develop capability for data sharing between Caltrans and NDOT 511 systems to better support a uniform 511 system within the Tahoe Basin. This will reduce redundant information between sources.

Project Number
IC-04

Project Dependencies
None

Service Packages
AD1, AD2

ITS Components
511 system integration and upgrades

Stakeholder
Caltrans/NDOT
Public/Private Partnership

Timeframe
In-Progress,
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
2 system modifications

Estimated Capital Cost
$70,000

Estimate O&M Cost
$50,000

Chain-up Information Strategic Plan

Develop a strategic plan that evaluates the effectiveness of existing chain-up information sources and recommends potential improvement areas for providing this information prior to departure and while in-route. Information could be disseminated over 511 automated alerts, additional roadside chain-up signs, permanent and portable CMS, kiosks located at resort activity centers, and through third-party applications.

Project Number
IC-06

Project Dependencies
None

Service Packages
ATIS01, ATIS05

ITS Components
Chain-up information strategic plan

Stakeholder
Caltrans/NDOT
Resorts

Timeframe
In-Progress,
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction

Scale
1 plan

Estimated Capital Cost
$20,000

Estimate O&M Cost
$5,000

Roadway Traveler Information

Basin-Wide HAR System (Nevada/ California Interface)

Integrate Basin-wide HAR system. This requires coordination between Nevada and California TMCs to provide a single distribution frequency for travel information pertaining to travelers in the Basin.

Project Number
RI-04

Project Dependencies
None

Service Packages
AD1, AD2,
ATIS01, ATIS06,
ATMS06

ITS Components
Radio upgrades
Back-office system synchronization

Stakeholder
Caltrans/NDOT

Timeframe
Long Term

Performance Measures
HAR channel usage
Customer satisfaction

Scale
1 HAR network

Estimated Capital Cost
$40,000

Estimate O&M Cost
$5,000

511 System Expansion-B

Expand 511 System to include information from fire alert cameras and seismic meters (currently operated by University of Nevada - Reno) as well as campfire regulation information from the US Forest Service.

Project Number
RI-06

Project Dependencies
None

Service Packages
EM05, EM06, EM07, EM10

ITS Components
Back-office system integration and data sharing
511 interface upgrades

Stakeholder
Caltrans/NDOT
Public/Private
Partnership

Timeframe
Short Term

Performance Measures
Travel time reliability
Customer satisfaction

Scale
2 system expansions

Estimated Capital Cost
$80,000

Estimate O&M Cost
$30,000

Tahoe Basin Smartphone Applications

Smartphones have become the most accessible device for pre-trip planning. This project will develop a smartphone application to enhance traveler information dissemination. Envisioned applications include transit, parking, and traffic network data. Applications will be advertised on Tahoe Transportation District's website. To realize the full benefit of this project, enhanced cellular coverage is required to provide better accessibility to the application's data.

Project Number
RI-09

Project Dependencies
RI-01, RI-02, RI-08, TR-11

Service Packages
ATIS01, ATIS05,
ATIS06, ATMS06,
ATMS09

ITS Components
Smartphone application

Stakeholder
TRPA/TMPO
TTD/TART
Caltrans/NDOT
Public/Private
Partnership

Timeframe
Short Term

Performance Measures
Travel-time reliability
Customer satisfaction
Mode choice

Scale
1 application

Estimated Capital Cost
$350,000

Estimate O&M Cost
$35,000

Traffic Management & Safety

Bike Detection for Lane Share Warning

Install bike detection units at locations of narrow roadway or where sight line interferences exist (such as at tunnel entrances). Warning systems can include roadside signage and flashing beacons to alert drivers. NDOT has scheduled a bicycle and icy road warning installation at Cave Rock for 2016/2017.

Project Number
TM-01

Project Dependencies
None

Service Packages
APTS07, ATMS03

ITS Components
Bike detection equipment
Dynamic signage

Stakeholder
Caltrans/NDOT

Timeframe
Long Term

Performance Measures
Bicycle collision reduction
Customer satisfaction

Scale
2 locations

Estimated Capital Cost
$30,000

Estimate O&M Cost
$1,000

Traffic Management & Safety

Pedestrian Activated Beacon Standards

Adopt standards for pedestrian hybrid beacons (PHB) and rectangular rapid flashing beacons (RRFB) for pedestrian crossings. PHBs are most effective where pedestrian volumes are high and don't require vehicle detection or a constant green signal. RRFBs are intended for shorter crossings near residential areas where pedestrian crossings are less frequent. Each standard shall consider beacon and pushbutton equipment, power service options, and aesthetics.

Project Number
TM-02

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Flashing beacon standard plan

Stakeholder
Local Counties
TRPA/TMPO

Timeframe
Short Term

Performance Measures
Pedestrian collision reduction
Customer satisfaction

Scale
2 standards
2 crossings

Estimated Capital Cost
$200,000

Estimate O&M Cost
$4,000

Speed Warning Sign Standard

Adopt a speed warning sign standard. Speed warning signs will be equipped with speed detection equipment to notify drivers who are exceeding the speed limit by a LED flashing warning sign.

Project Number
TM-03

Project Dependencies
None

Service Packages
ATMS19

ITS Components
Speed warning sign standard plan

Stakeholder
Local Counties
TRPA/TMPO

Timeframe
Short Term

Performance Measures
Speed and collision reduction

Scale
4 locations

Estimated Capital Cost
$100,000

Estimate O&M Cost
$4,000

Traffic Signal Detection Upgrades

Replacement of video detection with alternative detection systems that have proven to reliably detect vehicles in inclement weather such as in heavy snow where standard camera detection is low. Radar or thermal detection may improve accuracy in these instances.

Project Number
TM-04

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Vehicle detection equipment

Stakeholder
Caltrans/NDOT

Timeframe
LongTerm

Performance Measures
Detection accuracy
Signal operation

Scale
16 intersections

Estimated Capital Cost
$400,000

Estimate O&M Cost
$35,000

South Tahoe Signal Coordination

Building upon the region's signal communication upgrades (TM-09) and implementation of Nevada's ATMS system (TM-15), interconnect the Caltrans separate signal groups along US-50 to support corridor wide signal operation. Include coordination across state line by utilizing both ATMS systems. Project shall consider design decisions that would support adaptive signal control in the future.

Project Number
TM-08

Project Dependencies
TM-09, TM-15

Service Packages
ATMS03

ITS Components
Radio and communication
Signal interconnect and backhaul communication
ATMS integration
Advanced detection (for adaptive signal control

Stakeholder
Caltrans/NDOT

Timeframe
Long Term

Performance Measures
Idle time reduction
Customer satisfaction

Scale
12 intersections

Estimated Capital Cost
$250,000

Estimate O&M Cost
$20,000

Traffic Management & Safety

New Traffic Signals at Unsignalized Resort Entrances

Install traffic signal control at the Alpine Meadows resort entrance to improve circulation of traffic to and from the resort and along the mainline. Consideration should also be made at the Sierra-at-Tahoe entrance; however this location is outside the regional scope.

Project Number
TM-11

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Traffic signal cabinet communication upgrades
ATMS integration

Stakeholder
Caltrans

Timeframe
In-Progress,
Long Term

Performance Measures
Congestion management
Collision reduction
Customer satisfaction

Scale
1 intersection

Estimated Capital Cost
$600,000

Estimate O&M Cost
$4,000

Bicycle Detection at Signalized Intersections

Evaluate existing video detection accuracy for bicycle detection at signalized intersections. Upgrade video detection equipment as deemed necessary. Accurate video detection equipment that detects bicycles can be used to extend green time on certain movements to clear intersections to promote safety for alternative modes of travel and recreation.

Project Number
TM-12

Project Dependencies
None

Service Packages
ATMS03

ITS Components
Bicycle detection equipment
Signal phasing modifications

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Bicycle collision reduction
Customer satisfaction

Scale
10 intersections

Estimated Capital Cost
$120,000

Estimate O&M Cost
$10,000

FirstNet Considerations

FirstNet, a broadband data network dedicated to emergency responders, was signed into law in 2012. Planning agencies in the Tahoe region should consider the needs of this network for future deployment.

Project Number
TM-14

Project Dependencies
TM-13

Service Packages
EM01, EM05, EM06, EM08

ITS Components
Radio and communication upgrades

Stakeholder
Emergency Responders

Timeframe
Long Term

Performance Measures
Emergency response time
Customer satisfaction

Scale
Basin-wide

Estimated Capital Cost
Uncertain due to Long-Term Timescale

Estimate O&M Cost
Uncertain due to Long-Term Timescale

Use of Third-Party Vehicle Travel Data

Establish contracts with third-party vendors for obtaining travel data to provide roadway users with increased traveler information and eliminate the need for new roadside vehicle detection equipment.

Project Number
TM-16

Project Dependencies
None

Service Packages
AD1, AD2, ATMS02

ITS Components
Data interface
Integration into ATMS systems

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Travel time reliability
Customer satisfaction

Scale
150 miles

Estimated Capital Cost
$120,000

Estimate O&M Cost
$100,000

Traffic Management & Safety

Automated Red Light Camera Enforcement

Install roadside red light enforcement equipment at select signalized intersections with high collision history. Roadside equipment includes camera, flash, control cabinet, and integration with signal phasing and backhaul communication.

Project Number
TM-20

Project Dependencies
None

Service Packages
ATIS06, ATMS02, ATMS06, ATMS09

ITS Components
Roadside enforcement equipment
Back-office ticketing system

Stakeholder
Local Counties

Timeframe
Short Term

Performance Measures
Red light adherence
Violation tickets

Scale
2 locations

Estimated Capital Cost
$160,000

Estimate O&M Cost
$10,000

Transit Accessibility and Service

Public Private Trip Planner

Develop and deploy a Basin-wide cross-modal trip planning system. The system will coordinate private bus arrival information with existing public NextBus system and ferry tracking system. To provide a comprehensive selection of transit options, this project would require integration of private bus schedules into a transit smartphone application (RI-08).

Project Number
TR-02

Project Dependencies
TR-11

Service Packages
APTS01, APTS07, APTS08, APTS11

ITS Components
NextBus integration
Transit application development

Stakeholder
TART/TTD
Public/Private
Partnership

Timeframe
Short Term

Performance Measures
Transit usage
Customer satisfaction

Scale
1 system

Estimated Capital Cost
$200,000

Estimate O&M Cost
$70,000

Transit Signal Priority Along South Shore

Deploy transit signal priority system along South Tahoe Shore to increase transit speed and reliability. This system will detect transit vehicles approaching intersections and either extend or truncate green time to reduce transit stops along corridors with signalized intersections.

Project Number
TR-03

Project Dependencies
TM-09, TM-10

Service Packages
ATMS03, APTS09

ITS Components
Intersection and transit vehicle TSP equipment
Back-office software and integration with ATMS

Stakeholder
Caltrans/NDOT
TART/TTD

Timeframe
ShortTerm

Performance Measures
Transit usage
Customer satisfaction

Scale
10 intersections
20 vehicles

Estimated Capital Cost
$475,000

Estimate O&M Cost
$5,000 per intersection
$1,000 per vehicle
$7,500 software

Buses Equipped with Dynamic Message Signs

Install fully automated transit on-board dynamic message signs. These DMS will display next stop information and provide real-time audible alerts for stop arrivals.

Project Number
TR-04

Project Dependencies
TR-11

Service Packages
APTS08

ITS Components
Dynamic signage
Integration with NextBus arrival information

Stakeholder
Caltrans/NDOT
Public/Private
Partnership

Timeframe
Short Term

Performance Measures
Customer satisfaction

Scale
50 vehicles

Estimated Capital Cost
$750,000

Estimate O&M Cost
$45,000

Transit Accessibility and Service

Passenger Count Collection System

Install automatic passenger counters on transit vehicles with centralized system to analyze boarding and alighting data within the transit network. When combined with an Automatic Vehicle Location (AVL) system, ridership data can be paired to vehicle location through on-board GPS system providing the transit agency more robust data.

Project Number
TR-05

Project Dependencies
None

Service Packages
APTS06, APTS10

ITS Components
Passenger count collection system
Back-office software
Integration with NextBus AVL

Stakeholder
TART/TTD

Timeframe
In-Progress,
Long Term

Performance Measures
Resource allocation

Scale
Equip Fleet

Estimated Capital Cost
$100,000

Estimate O&M Cost
$10,000

Ticket Vending Machines

Install automated transit ticket vending machines at transit stations to expedite passenger payment & boarding.

Project Number
TR-09

Project Dependencies
None

Service Packages
APTS04

ITS Components
Ticket vending machines
Integration with payment system

Stakeholder
TART/TTD

Timeframe
Short Term

Performance Measures
Transit usage
Customer satisfaction

Scale
3 locations

Estimated Capital Cost
$210,000

Estimate O&M Cost
$5,000

Maintenance Activities

Real-Time Temporary Camera Feeds at Major Construction Closures

During times of construction closures, install temporary CCTV cameras at construction closures to display real-time traffic conditions. Live streams should be made available on the DOT website, and the regional smartphone application, once available.

Project Number
MT-04

Project Dependencies
None

Service Packages
ATMS01, MC07

ITS Components
Portable CCTV cameras
Wireless communication

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Construction re-route
Customer satisfaction

Scale
4 locations

Estimated Capital Cost
$220,000

Estimate O&M Cost
$8,000

Standards Development for Smart Work Zones

Develop a standard for work zone safety systems that detects vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment to improve safety.

Project Number
MT-05

Project Dependencies
None

Service Packages
MC07, MC08, MC09

ITS Components
Smart work zone standards

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
Construction zone safety
Customer satisfaction

Scale
1 standard

Estimated Capital Cost
$20,000

Estimate O&M Cost
$1,000

System Integration & Coordination

Dynamic Message Sign Usage Policy

Develop and promote a DMS usage policy that details what can and cannot be displayed on public agency owned permanent and temporary dynamic signs. The policy ideally will lead to a public and private collaboration effort to better utilize DMS's for traveler information especially during heavy congestion times such as special events, traffic incidents, and seasonal traffic.

Project Number
IC-03

Project Dependencies
None

Service Packages
ATIS01, ATIS06, ATMS06

ITS Components
Dynamic message sign usage policy

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
DMS usage
Customer satisfaction

Scale
1 policy

Estimated Capital Cost
$15,000

Estimate O&M Cost
$1,000

CCTV Video Feed Policy- Cellular Tower Installation

Develop and promote a CCTV video feed policy that details the capabilities of video feeds within the Basin. Camera feed access could be made available via a foreign entity connection for city and public agencies to avoid image time-out. Camera presets could be established for request by private companies (resorts) during peak congestion periods and displayed at activity center kiosks and through third party applications.

Project Number
IC-05

Project Dependencies
None

Service Packages
ATMS01

ITS Components
CCTV video feed policy

Stakeholder
Caltrans/NDOT

Timeframe
Short Term

Performance Measures
CCTV video fees usage

Scale
1 policy

Estimated Capital Cost
$15,000

Estimate O&M Cost
$1,000

chapter 3

ITS Program Management

Program Leadership

Through the Tahoe Basin ITS Strategic Plan effort, momentum has been gained for the deployment of ITS in the Tahoe Basin region. It is important that this energy and momentum be maintained through program leadership. This program leadership should involve both an ITS Coordinating Committee to provide oversight of ITS activities in the region, and an ITS Coordinator responsible for specific activities related to the region's ITS program.

The ITS Coordinating Committee

will help guide further planning and implementation of Tahoe Basin ITS Projects. This group should meet on a periodic basis to provide input pertaining to the design and implementation of the projects in the Tahoe Basin ITS Strategic Plan. It should be a forum for assessing the status of strategic plan implementation, facilitating coordination among the agencies within the region as well as with the adjacent regions, and for working out inter-agency agreements.

The ITS Coordinating Committee would be ideally those stakeholders that participated in the ITS strategic planning effort (TMPO/TRPA, Caltrans, NDOT, FHWA, and transit agencies). Through their involvement in this process, members of the committee have developed the knowledge base to enable continued successful guidance of the ITS program and provides an appropriate cross section of the transportation community in the region.

The ITS Coordinator

will be responsible for guiding the coordinating committee, identifying potential funding for ITS Projects, monitor progress on project implementation, provide information to those within and outside the agency on ITS applications, and serve as a primary point of contact for interregional coordination on ITS issues. The Tahoe Regional Planning Agency (TRPA) will ideally lead this effort by providing staff and funding for the ITS Coordinator position, while recognizing that the Tahoe Transportation District (TTD) should also seek a similar position to mainstream ITS into their planning process. The TRPA and TTD are locally based and can act as an interface between regional public agencies, private companies, and third-party entities. The vision for this TTD role is similar to TTD's Mobility Manager which was recently enacted through the Coordinated Human Services Transportation Plan. The Mobility Manager has proven to be a successful means to implement social service mobility projects. Implementation is one area that is struggling in the ITS project process.

Track Project Deployment & Conformance

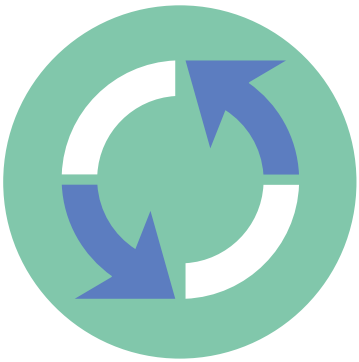
As individual projects proceed with deployment, it is critical that their status be actively tracked. During the design phase, this tracking will involve checking for conformance with the regional architecture and applicable standards, and will help facilitate coordination among projects. As projects evolve and are implemented, this information should be used to update project descriptions and the regional architecture, and be reflected in updates to the Strategic Plan.

The ITS Coordinating Committee

should serve as a forum for sharing information regarding the status of individual projects. This may include information regarding design details, timing, funding sources, and coordination requirements.

The ITS Coordinator

should maintain a log of ITS projects, and use this information to check conformance and update program resources such as project descriptions, the ITS inventory and the regional architecture.



Update Strategic Plan

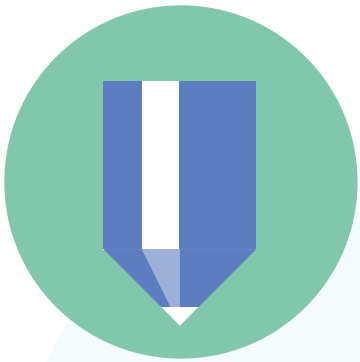
The Tahoe Basin ITS Strategic Plan should be a living document. This is particularly important in light of the rapid pace of change in technology. A process should be established to conduct a periodic review and update of information in the Strategic Plan. It is suggested that this be done on a cycle similar to updates of the Regional Transportation Plan (i.e. three years). Particular attention needs to be given to the inclusion of new/revised ITS Projects and updates of the Regional ITS Architecture.

The ITS Coordinating Committee

should be responsible for overseeing updates to the regional ITS plan. This could include revisions of top level issues such as program goals, or it could focus on specific issues such as project scoping and scheduling and detailed architecture refinements.

The ITS Coordinator

should be responsible for initiating this activity and producing the updated documents.



Maintain Regional ITS Architecture

The regional ITS architecture was developed based on current conditions including the existing transportation infrastructure and the needs and priorities of the region as they exist today. These conditions will inevitably change as ITS elements are deployed and connections are made enhancing integration. In addition, the National ITS Architecture will continue to develop and evolve necessitating changes in the Tahoe Basin Regional ITS Architecture. Therefore, the regional architecture will need to be revised periodically in order to remain useful.

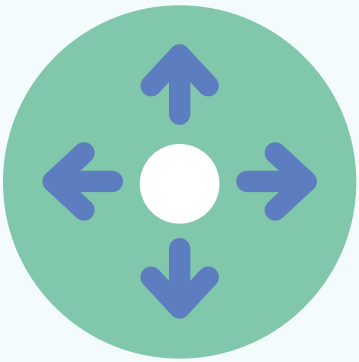
It is recommended that the

ITS Coordinating Committee

facilitate and oversee the maintenance of the Tahoe Basin Regional ITS Architecture. This will include providing the information needed to update the architecture, and reviewing the accuracy of the updated architecture.

The ITS Coordinator

shall have the specific responsibility for maintenance of the regional architecture. This maintenance effort will require that the Coordinator become familiar with the architecture database and the Turbo Architecture program used to create it.



Maintain Intra- & Inter-Regional Coordination

A significant component of the program leadership will consist of coordination among agencies as the ITS plan is implemented. The coordination of ITS activities by various agencies provides the key to maximizing the value of integration of systems. Intra-regional coordination is necessary on a project level basis. This may involve issues of compatible communication technologies, data formats, and physical connectivity, as well as the need for inter-agency agreements.

Beyond the boundaries of the Tahoe Basin, coordination may be necessary at both program and project levels. At the program level, contact with other regions can facilitate congruent implementation approaches. A focal point for inter-regional coordination is the sharing of traveler information. A significant portion of travel in the Tahoe Basin involves a trip end outside the boundaries of the Basin itself. For the traveler, therefore, it is valuable to have access to information not only for the Basin but also for the adjacent regions. Neighboring regions with which agreements regarding data sharing are appropriate include the Tahoe Gateway, Sierra Nevada region, the Sacramento area, and the San Francisco Bay area.

The ITS Coordinating Committee will need to be involved in coordination of system linkages, integration and interoperability issues at both the intra- and inter-regional levels. Because several potential members of the ITS Coordinating Committee are also active in these other regions, the committee should serve as one forum for addressing inter-regional coordination issues.

The ITS Coordinator can help facilitate these activities by working with the program managers from these regions and participating in their committee discussions as appropriate.

Provide Technical Support & Assistance

The level of ITS knowledge and expertise among potential ITS project implementers in the Tahoe Basin can vary greatly. Therefore, it would be valuable to establish the means for sharing the available knowledge and supporting the activities of individual implementers.

The ITS Coordinating Committee should serve as forum for sharing information and an opportunity for members to ask questions of one another.

The ITS Coordinator should maintain a library of ITS- related information that may include:

- Technical resources and guidance material for ITS project design, procurement, maintenance, and operations. Source for these documents include FHWA, FTA, Caltrans, and NDOT.
- Sample RFPs for ITS design, deployment and management projects.
- ITS Project conformance in regards to updates with the National ITS Architecture.
- Funding sources and procurement contracting information.
- Sample inter-agency agreements and memorandums of understanding.

Evaluate ITS Program & Projects

As the ITS program moves forward in the Tahoe Basin and new deployments are implemented, a criteria to evaluate the effectiveness of these implementations will be required. This stems from the desire to ensure that future expenditures on ITS implementations will continue to be worthwhile and cost effective.

The purpose of the evaluation criteria is to identify specific data types that can be used to assess system performance of the ITS deployment. This evaluation would compare against quantitative and qualitative goals for measuring improvements in the transportation network (e.g. accident reduction, travel time).

The ITS Coordinating Committee, with guidance and support from FHWA, should take the lead in defining appropriate evaluation criteria.

The ITS Coordinator would then be responsible for leading evaluation efforts with the support of the individual implementing agencies.

Ensure Federal Compliance

Similar to individual ITS projects, the Tahoe Basin ITS Strategic and the Regional Architecture need to comply with federal requirements in order to qualify ITS projects in the region for federal funding. According to FHWA Final Rule 940 published in the Federal Register on January 8, 2001, the Strategic Plan and Regional Architecture must contain the elements identified in Exhibit 3.1.

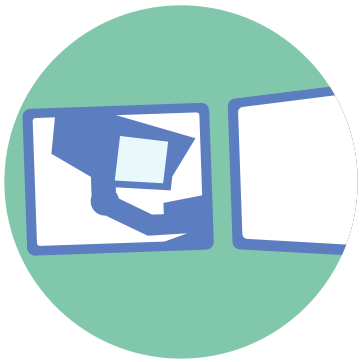
This exhibit also identifies the degree to which this Strategic Plan and related architecture meet these requirements.

The Final Rule also requires that the regional architecture be maintained. It should be the role of the **ITS Coordinator,** with guidance from the **ITS Coordinating Committee**, that compliance with these requirements is maintained as individual projects are developed.

Exhibit 3.1

Federal Compliance

FHWA RULE 940 FEDERAL REQUIREMENT	TAHOE BASIN ITS STRATEGIC PLAN & REGIONAL ARCHITECTURE
1. Description of the Region	Chapter 4
2. Identification of participating agencies and other stakeholders	Chapter 1
3. An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture	Chapter 5
4. Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture	Recognized throughout the ITS Strategic Plan
5. System functional requirements	Chapter 2
6. Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems an architecture flows as defined in the National ITS Architecture)	Regional ITS Architecture (Turbo)
7. Identification of ITS standards supporting regional and national interoperability	Regional ITS Architecture (Turbo)
8. The sequence of projects required for implementation	Chapter 2



Mainstream & Promote ITS

"Mainstreaming" ITS involves incorporating ITS into the established transportation planning and programming process and is a key to initiating the ITS plan. This means considering ITS projects alongside more traditional transportation solutions during the process of updating local and state transportation programs, or integrating ITS elements into larger, more traditional transportation projects that share location or objective. As part of the mainstreaming effort, elements of this ITS Strategic Plan should be incorporated into other transportation planning and programming activities including the Regional Transportation Plan, other planning documents, Project Study Reports (PSRs), Short-Range Transit Plans, Long-Range Transit Plans, Route Circulation Reports, etc.

Benefit of Mainstreaming ITS

1. Increase awareness of ITS strategies by putting them before the broader transportation planning audience.
2. Initiate deployment of ITS technologies as part of larger projects.
3. Make available additional funding opportunities beyond the separate funding mechanisms provided in the past. ITS projects will compete with other transportation improvements as part of traditional funding programs.

This mainstreaming activity should be undertaken by all agencies that prepare transportation improvement programs and planning documents for this Tahoe Basin. In particular, this includes TMPO/TRPA, Caltrans, and NDOT. Furthermore, all ITS stakeholders should undertake efforts to promote ITS as part of outreach efforts to policymakers, agency management, and the general public. These efforts are needed to gain the support to obtain funding and overcome institutional obstacles. While this should be a collective effort involving the ITS Coordinating Committee, the sponsors or "champions" of individual projects should also seek to promote their ITS project and ITS in general.

Action Plan

One of the keys to a successful, ongoing ITS program is having individuals who understand and can promote its objectives. The implementation of the Tahoe Basin ITS Strategic Plan will require several individuals in key agencies who have this vision. They will need to possess or be supported by technical and management expertise that can deal with the specific challenges of ITS technologies and ongoing operations. Communications with technical staff at Caltrans and NDOT, and with technical staff in larger urban areas with ongoing ITS applications will be helpful in developing the expertise in Tahoe Basin agencies. Exhibit 3.2 lists a series of actions that should be taken following the approval of the Strategic Plan and the agencies responsible for initiation of those actions.

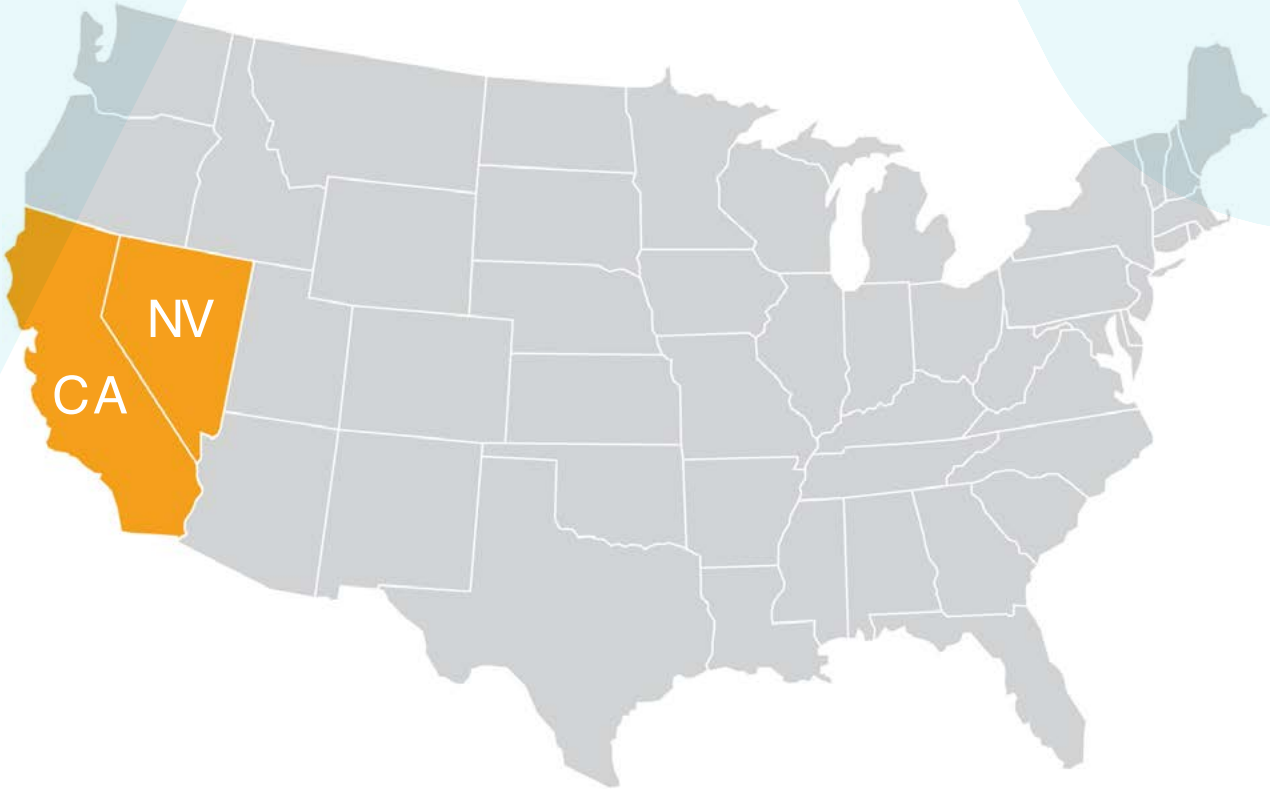
Exhibit 3.2

List of Actions and Agencies Responsible for Those Actions

ACTION	RESPONSIBLE AGENCIES				
	ITS Cord. Comm.	Caltrans/ NDOT	TMPO/ TRPA	Local Agencies	FHWA/ FTA
Designate an ITS Coordinating Committee to insure that ITS funding and implementation is moving forward in a coordinated fashion. This group would meet on a periodic basis.	●				
Identify an ITS Coordinator that would be responsible for identifying potential funding, monitor progress on project implementation and conformance, provide information to others on ITS applications, and serve as a primary point of contact for inter- county coordination.			●		
Maintain a log of ITS Projects in the transportation programs of state, regional and local agencies, and distribute that information at least on a biannual basis.	●		●		
Review and update the ITS Strategic Plan on a periodic basis including the update of project information and the maintenance of the regional ITS architecture.	●		●		
Begin to identify specific funding opportunities for short-term projects.	●				
Collect information on ITS-related contracting to make available to agencies responsible for ITS Project implementation.		●	●		●
Provide updates of information on ITS Project conformance with the National ITS Architecture.					●
Proceed with ITS Project design and implementation, as funding becomes available.		●		●	
Develop evaluation criteria with performance measures to assess the impacts and benefits of ITS projects.	●				
Incorporate ITS Strategic Plan elements into the Regional Transportation Plan (RTP), agency planning documents, Project Study Reports, Short-Range Transit Plans, etc.		●	●	●	
Incorporate ITS considerations into program and project prioritization criteria, where applicable.			●		
Incorporate projects into the Regional Transportation Improvement Program.			●		
Include information about ITS in agency outreach efforts to help promote ITS.		●	●		
Support statewide ITS Projects, legislative changes, or other public/private ITS initiatives, as appropriate, to foster ITS implementation in the Tahoe Basin.	●	●	●	●	

chapter 4

System Characteristics



General Characteristics

The Tahoe Basin incorporates parts of two states (California and Nevada) and five counties (Carson City, Douglas, El Dorado, Placer and Washoe). The Basin itself is defined by the ridgeline of the mountains that surround Lake Tahoe. However, for the purposes of the Tahoe Basin ITS Strategic Plan, the project area has been extended northward to incorporate the Town of Truckee, which is located in Nevada County. It should be noted that the Truckee area is also within the project boundaries of the Tahoe Gateway Counties ITS Strategic Plan developed in 2002 for the California counties bordering the Tahoe Basin. This overlap is intentional and reflects the importance of the connections between the Tahoe Basin and I-80 through the Truckee area. The overlap is also intended to help strengthen the coordination between the two strategic planning efforts.

KEY CHARACTERISTICS

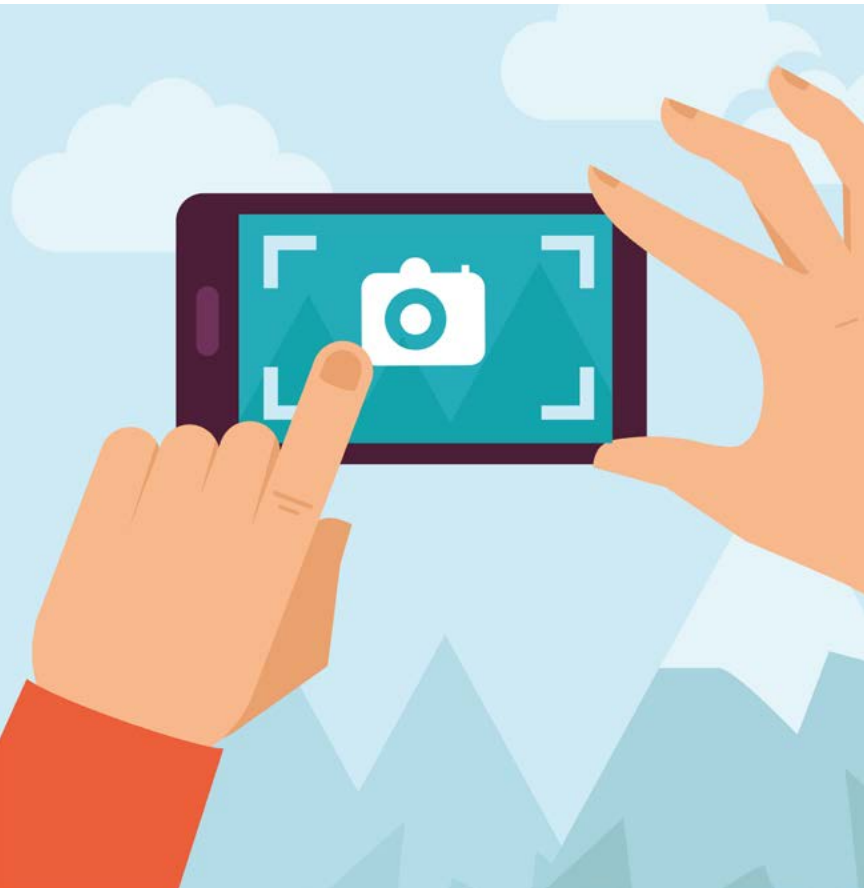
influencing the development of the ITS Strategic Plan of Lake Tahoe Basin included the following:

Tourism

As a major destination for ski resorts, casinos, state parks and numerous other attractions, tourism is the primary driving force behind the Tahoe Basin economy and seasonal traffic patterns. A summary of existing traffic conditions was prepared as a basis for the Tahoe Basin ITS Strategic Plan update. The memorandum identified peak weekend interregional travel through I-80 and US 50 during the winter season and even higher, but more stable interregional travel during the summer season. This Strategic Plan focused towards these interregional travelers as well as local residents.

Environmental Concerns

Air and water quality are highly regarded in the Tahoe Basin region in an effort to preserve the natural surroundings. ITS recommendations presented in the ITS Strategic Plan consider these concerns and any potential impacts to the environment and economy of the Basin.



Adverse Weather

The Tahoe Basin experiences significant seasonal changes in climate and weather, which creates a wide array of challenges for the transportation system including significant snowfall, icy conditions, snowmelts, and dry summer heat which often have a direct effect on the roadway conditions in the Basin. Examples of the effects include rock and mudslides, forest fires, and slippery roadways which often result in closures and roadway conditions that are difficult for motorists to negotiate.

Institutional Setting

The Tahoe Basin is unique in terms of its planning environment, largely due to the fact that the region encompasses parts of two states and five counties. There are numerous federal, state, county, and local agencies with responsibilities within the Basin, each with different ITS systems, goals, and standards. There are also several private groups with significant interest in the region. To facilitate cohesive and coordinated planning in the region, the Tahoe Metropolitan Planning Organization/Tahoe Regional Planning Agency (TMPO/TRPA) was established as the regional land use and environmental resource planning agency. TMPO/TRPA has been given additional responsibility for Basin-wide transportation planning. TMPO/TRPA served as the lead agency in the development of the ITS Strategic Plan, but many other entities also participated through the ITS Steering Committee.

Exhibit 4.1

Study Area Characteristics

Source: 2003's ITS Strategic Plan

Transportation Systems

The Tahoe Region's transportation system consists of multiple components. These components, which function as separate but related systems, include highways and roads, public and private transit, pedestrian and bicycle facilities, waterborne services, and airborne services. Most of Tahoe's travelers are interregional traveling from the San Francisco Bay area which feeds the Tahoe Basin's tourism market.

Exhibit 4.2

Tahoe Transportation Transit Map

Highway and Roads

The roadway network within the Basin consists essentially of a single ring around the lake with spokes at several locations that provide links to areas outside the Basin. There are seven entrance points that provide primary access to the Tahoe Basin, four from California and three from Nevada. From the California side, Interstate 80 (not within the Tahoe Basin boundary) and US 50 provide the primary access for most of the visitors to the Tahoe Basin. From Interstate 80, travelers take either SR 89 or SR 267 to enter the Basin. SR 89 also provides an entrance to the Basin from the south. To enter the Basin from the Nevada side, drivers can either enter from the north (the Reno area) using SR 431, from the east (the Carson City area) using US 50, or from the south (the Minden/Garnerville area) using SR 207. Within the Basin, the principal roadway network consists primarily of six state highways.

Transit Service

The Tahoe Basin is currently served by two publicly operated transit systems, tourist-oriented trolley and express bus services, a number of privately operated shuttle systems and taxi services. The current public transit services in the Tahoe Basin are illustrated in Exhibit 4.2. Tahoe Area Regional Transit (TART) operates four fixed routes serving 30 miles of shoreline area along Tahoe's north shore (Tahoma, CA to Incline, NV), as well as the Town of Truckee via SR-89 and SR-267. The Tahoe Transportation District (TTD) operates transit services along the East and South Shores. In 2013, TTD implemented the East Shore Express which shuttles visitors from Incline Village to Sand Harbor. This was enacted to counter the lack of available parking at the popular park as well to reduce shoulder parking to increase safety. In the South Shore area, BlueGo is the primary transit service operating between the "Y" (the junction of SR 89 and US 50), the casino core on US 50, and connections to Carson City and Carson Valley. Additional transit service in the South Shore areas includes a summer trolley service to Emerald Bay. In addition, Truckee North Tahoe Transportation Management Association (TNT/TMA) operates the Night Rider program which provides free winter and summer shuttle service along the north shore between the major resorts and residential areas. Major transit centers, shown as stars on Exhibit 4.2 are located at Tahoe City (constructed in 2012), Northstar, Truckee, South Tahoe, and the "Y" near Meyers.

Privately-operated shuttles include those operated year-round by the casinos in the South Shore area, and winter-time shuttles offered by the major ski areas usually in collaboration with TTD and TART. A number of other recreation attractions and resorts also provide limited shuttle service for their guests. Northstar for example provides a dial-a-ride service while Squaw Valley and Alpine Meadows provides shuttle service between their two resorts.

Intercity transit services are offered through a number of operators, including North Lake Tahoe Express, South Tahoe Express, Greyhound, Amtrak, and a number of charter bus operators. These operators utilize the Truckee transit center in the north basin (I-80) and the "Y" transit center in the south basin (US 50).

Waterborne Service

The TTD plans to implement a passenger ferry with service between Tahoe City and South Lake Tahoe. The final docking locations are still under review. Prior to the ferry, a now suspended North Tahoe Water Shuttle operated during the summer that made stops in Homewood, Carnelian Bay, and Tahoe City with 10 trips daily. The shuttle held 12 passengers and 8 bicycles. There are also several commercial vessels currently providing waterborne services on Lake Tahoe. These vessels typically operate as excursion vessels, providing short day trips to various parts of the Lake.

Air Service

There are four general aviation facilities operating in the Tahoe Basin project area. The primary aviation facility in the region is the Lake Tahoe Airport located in the City of South Lake Tahoe. There is currently no commercial air service to the Lake Tahoe Airport. However the airport provides an emergency operation center for disaster management and coordination. The two other facilities on the south shore are a heliport site at Heavenly, and a helipad at Barton Memorial Hospital. The Truckee Tahoe Airport is the primary general aviation airport serving the north Lake Tahoe region including Incline Village, Truckee, and the Donner Summit area. There is currently no commercial air service at the Truckee Tahoe Airport.

An emergency helipad is scheduled for construction in 2016 adjacent to North Tahoe Fire Protection District Station 51 in Tahoe City. The helipad will be constructed and maintained by the Truckee Tahoe Airport District (TTAD)

The Reno-Tahoe International Airport in Reno, Nevada is the nearest major airport, providing regularly scheduled air carrier services. Transportation from Reno to the Tahoe Region is provided by air taxi, airport shuttles (e.g. North Tahoe Express), limousine services, and rental cars.

Ped/Bike Facilities

The Lake Tahoe Basin has an extensive bicycle trail system to accommodate residents and visitors. The network is expanding rapidly with trail projects ready to go on the ground. The bikeways can range in design from a separate path to a shared route on a highway. The trail network is heavily used in the summer months creating safety concerns. Although, the system is extensive, it is incomplete around the lake.

Pedestrian facilities are found primarily in the more urbanized areas of the Basin. These facilities include both sidewalks, generally paved, and walkways that may or may not be paved. In many areas, pedestrians share the use of recreational trails with bicyclists. Pedestrian facilities are not continuous, with frequent and lengthy gaps between facilities.

In 2010, the Lake Tahoe Region Bicycle and Pedestrian Plan (soon to be updated and called the Lake Tahoe Active Transportation Program) was developed by the TRPA/TMPO as a guide for planning, construction, and maintaining a regional bicycle and pedestrian network, facilities, and programs. The plan includes updated maps, prioritized project lists, and policy guidelines for involved agencies.

Commercial Vehicle Operations

Because the Tahoe Basin region is neither a major producer nor consumer of manufactured or agricultural goods, truck volumes on the region's highways are relatively low. The exception, of course, is Interstate 80 through the Town of Truckee where average truck volumes exceed 4000 per day. I-80 is major goods movement route and is part of the national network for trucks. Commercial vehicle operation issues along this corridor are addressed as part of the Tahoe Gateway and I-80/US 395 ITS planning efforts.

The other highways in the Basin generally serve only as terminal access routes for the delivery of goods to retail outlets within the Basin. Truck size limits have been established on some highways including SR 267 and the segment of SR 89 along the west side of the lake. An agricultural inspection station is located on US 50 westbound in Meyers. US 50 is a vital trucking corridor for the delivery of consumer goods and supplies to the Tahoe Basin as well as for smaller trucks traveling between California and Nevada. However, due to US 50's steep terrain, areas of narrow right-of-way, and many curves, larger STAA (Surface Transportation Assistance Act) trucks are not accommodated or allowed between Sly Park and the Tahoe Basin.

Emergency Service and Roadway Maintenance

The transportation operating agencies include Caltrans, NDOT, individual counties, and the City of South Lake Tahoe. Law enforcement agencies include the CHP, NHP, county sheriffs, and South Lake Tahoe City police. Ambulance service in the region is provided by the private sector, the local fire departments, and the California Department of Forestry.

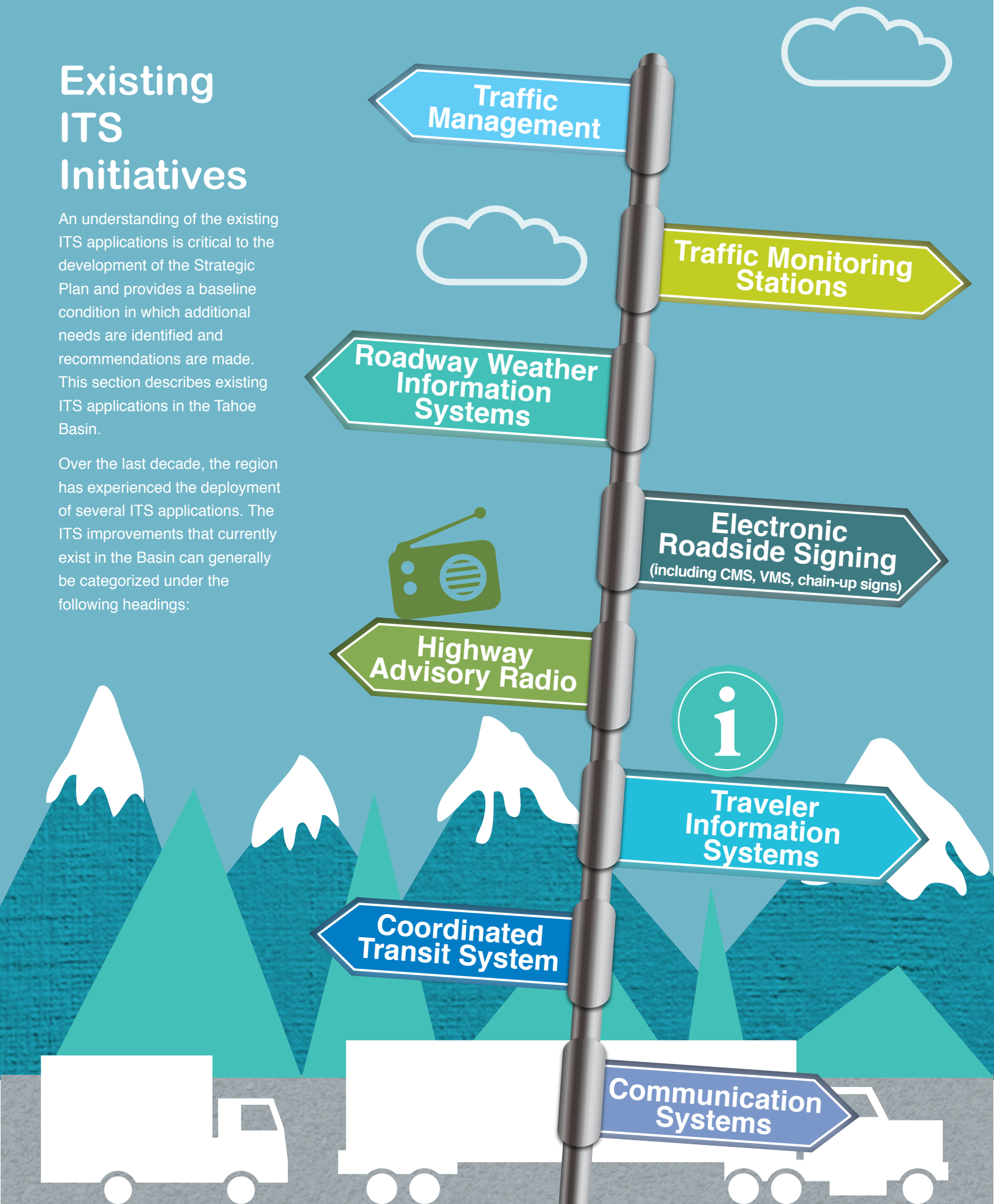
General roadway maintenance is typically managed by Caltrans or NDOT, while local maintenance such as snow removal is managed at a city and county level. Caltrans operates a maintenance facility located in Kingvale (north Tahoe area) providing on-site maintenance staff. NDOT has two unstaffed maintenance facilities at Incline Village and Spooner Summit and relies heavily on Road Weather Information Systems for road condition information. Maintenance crews are then dispatched accordingly.

Incident and emergency detection is achieved through the traditional means of observations by field or patrol staff, and telephone call-ins. To aid in the response to reported incidents, inter-agency protocols and communication channels have been established. For major emergencies and disasters, individual counties have established Emergency Operation Centers. Although typically not used for transportation-related incidents, these centers can serve as a focal point for coordinating transportation and emergency responses during large-scale emergencies.

Existing ITS Initiatives

An understanding of the existing ITS applications is critical to the development of the Strategic Plan and provides a baseline condition in which additional needs are identified and recommendations are made. This section describes existing ITS applications in the Tahoe Basin.

Over the last decade, the region has experienced the deployment of several ITS applications. The ITS improvements that currently exist in the Basin can generally be categorized under the following headings:



Traffic Management Systems

Most of the traffic signals in the Basin are located in the South Lake Tahoe/Stateline area, although there are also isolated traffic signals in Meyers, Tahoe City, Kings Beach, Incline Village, Truckee, and along the north triangle. The signals on state highways are operated by Caltrans within California, and by the respective counties within Nevada. Features found in the existing signal systems include, but are not limited to, actuated control, coordinated operation between adjacent signals, and physical interconnects between signals. The majority of traffic signals throughout the Basin detect vehicles using video detection technology.

Caltrans

Along US 50 in South Tahoe, there are approximately 18 traffic signals between the intersection of US 50 and SR 89 and Stateline (operated and maintained by Caltrans). Caltrans signalized intersections use a combination of video detection and induction loops for vehicle detection. Caltrans signalized intersections along US 50 in South Tahoe are connected with conduit with copper interconnect, however, cabinet and controller upgrades are still required for signal communication.

Dial-up is currently used for backhaul communication to each signal group. In order to improve the reliability of the existing connection between Caltrans' Traffic Management Software System (TMSS) and signal controllers, Caltrans is planning DSL communication upgrades.

Caltrans also operates traffic signals outside each of the major ski resorts (Squaw Valley, Northstar, Heavenly). To accommodate the fluctuations in seasonal traffic volumes during ski season, these intersections operate on unique weekend signal timing plans during peak travel periods.

Douglas County (Nevada)

Douglas County owns and operates four traffic signals along US 50 within the Stateline vicinity. The county contracts our all signal maintenance needs to NDOT. At one of the signalized locations, Douglas County has implemented radar stop bar detection and wireless radio communication for remote access. Currently, this is the only signal that Douglas County can access remotely. In addition to operating traffic signals, Douglas County also operate and maintains a cyclist-activated tunnel flashers along US 50 to alert vehicles of an upcoming shared road condition.

Traffic Management Centers (TMC)

Caltrans

Caltrans manages and operates the Tahoe Basin ITS network primarily at the District 3 RTMC located in Rancho Cordova. The RTMC is co-located with California Highway Patrol's Sacramento communication center.

To supplement the operations of the District 3 RTMC, Caltran's Kingvale maintenance facility was upgraded with a Satellite Operations Center (SOC) to manage winter traffic operations in the Basin. The SOC has the same traffic management capabilities as the RTMC including CCTV control, however, all signal timing operations at resort accesses are monitored and managed by the RTMC.

The following systems are available at both District 3 RTMC and Kingvale SOC:

- **TMCal Login System:** Provides operators with the ability to track operator inputs for traffic monitoring, incident logging, and DMS posting.
- **Parsons (formerly Delcan) Advanced Transportation Management System (ATMS):** Allows Caltrans operators to interface with the field infrastructure, including detector stations, ramp metering systems, CCTV cameras, dynamic message signs (DMS) on a software graphical user interface (GUI). This ATMS is currently being updated to Version 5.
- **Commercial Wholesale Web Portal (CWWP):** Provides a platform for regional data sharing (traffic data, CCTV images and video, and chain control information).
- **Performance Measurement System (PeMS):** Provides system-wide real-time traffic data and historical traffic data http://pems.dot.ca.gov/.

Exhibit 4.3

Traffic Signal Inventory

Source: Transpo Group

NDOT

NDOT District 2 manages and operates their CCTV cameras, DMS, RWIS, and HAR system from the Road Operations Center (ROC) in Sparks, NV. Staffing increases have led to a more operations-focused group increasing communication with other agencies such as Caltrans (winter operations) and emergency responders (Traffic Incident Management Coalition).

The following systems are implemented at the NDOT District 2 ROC:

- **Kimley Horn Central System Software (CSS):** Allows NDOT operators to manage RWIS, traffic flow maps, CMS, anti-icing system, Travel Time Signs (TTS), HAR, and CCTV cameras.
- **FLIR Cameleon ITS:** Allows NDOT to provide live-streaming video on their traveler information website.

Additionally, NDOT plans to implement a Traffic Management Data Dictionary (TMDD) which will promote data sharing. The data exchange will include public-to-public partnership and will also serve as a shared traffic signal timing data warehouse in addition to other ITS information.

Traffic Monitoring Stations

Traffic Counters/ Recorders

Data collection sites currently exist along the north triangle (SR 89, SR 28, and SR 267) and along US 50 in South Tahoe. All sites are owned and operated by Caltrans. Travel time detection currently does not exist, but is being considered through the use of technology such as Bluetooth readers, third-party data providers, and radio frequency identification (RFID).

Closed Circuit Television (CCTV) Cameras

CCTV cameras exist in numerous locations within the Basin. Caltrans has installed 9 CCTV cameras at key intersections around the north triangle and three CCTV cameras along US 50, which communicate using a combination of DSL and cellular networks. NDOT has installed two CCTV cameras in Incline Village (cellular communication), one CCTV near Tramway, and one CCTV just outside the Basin near the Mt. Rose summit.

Bluetooth Reader Technology

Six Bluetooth devices were temporarily installed in the Tahoe Basin for the Bay to Basin Project which provided real-time travel time information between the Basin and Sacramento. Locations included Tahoe City and King's Beach (North Tahoe) and Emerald Bay, Meyers, and Stateline (South Tahoe). Currently four Bluetooth devices are installed in several locales outside the Basin, in surrounding areas. Caltrans is currently looking to expand their detection system and technology use within the Basin to increase data penetration and enhance travel time data accuracy. Along with this system expansion, Caltrans plans to integrate this data into the ATMS to display travel times on DMS.

Third-Party Consideration

Over the recent years, the ITS industry has experienced a significant growth in data collection advancements from third-party data providers. Such providers have permeated the traffic data collection market by introducing new means and methods of data collection with applications that utilize vehicle and mobile device probe data, and social media feeds. Caltrans District 3 is evaluating the benefits of obtaining traffic data through potential partnerships with third-party data providers. Benefits to third-party data sources include improved data collection in remote areas and reduce the need for permanent traffic counters/recorders.

Smart Work Zones

Smart work zones are construction work zones that implement ITS technology as a means of improving operations, safety, and efficiency for roadways impacted by construction activity. Caltrans has recently trialed smart work zones by implementing radar-equipped traffic barrels for construction projects along US 50. Using this technology, it is possible to inform the travelling public about anticipated travel time, estimated delays, and safety warnings through construction zones.

Roadway Weather Information Systems (RWIS)

Roadway Weather Information Systems are comprised of an Environmental Sensor Stations (ESS) that measure atmospheric, pavement, and/or water level conditions and communicate this data back to a central system providing

road operators and maintainers information on the current and forecasted roadway conditions. Recognizing the importance of winter weather and road conditions, and their effect on seasonal resort traffic in the Basin, a regional effort has been made by Caltrans and NDOT with regards to obtaining and sharing RWIS information to improve importation, dissemination and road maintenance. The following systems have been implemented and are part of this regional effort for RWIS data sharing:

- **ScanWeb:** ScanWeb is operated by Caltrans and can be accessed in real-time over the Caltrans intra-net. Caltrans RWIS data also displays weather data in a more accessible format at weathershare.org.
- **Kimley Horn's Central System Software (CSS):** NDOT uses their CSS ATMS system to manage RWIS data and a data visualization model to look at historical RWIS data.

Three RWIS sites are installed in the north shore area and one on US50 at Echo Summit. NDOT, on the other hand, relies on RWIS data for maintenance purposes since crews are located further outside of the Basin. Within Nevada, nine RWIS installations exist around the Tahoe Basin with the majority along US 50. The information gathered from the RWIS installations is transmitted over a radio system to NDOT's District 2 Headquarters in Sparks for processing and dissemination to users.

Additional Weather-Related ITS Technologies

- Caltrans typically performs a road closure (approximately 30 minute durations) during avalanche control. NDOT has avalanche gates on SR 431 (not within the basin), but has no current plan to install any additional gates in the basin.
- NDOT's Wind Warning Project will implement RWIS detectors to feed messaging to variable speed signs based on traffic and wind conditions. A point-to-multipoint communication system will be used in Washoe County (just outside of the Basin) to interface with this equipment.
- NDOT is in partnership with University of Nevada, Reno (UNR) to implement a Connected Vehicle application involving Intelligent Mobile Observation (IMO) where Automatic Vehicle Locators (AVL) and pavement temperature sensors are installed on snow plows and maintenance vehicles. Data collected by the sensors is communicated to a central data management system. NDOT is looking to expand this application and evaluate other technologies for data transmission. Similarly, Caltrans maintenance vehicles are equipped with on-board IR sensors but operate in a standalone environment.
- The Town of Truckee and the City of South Lake Tahoe's Department of Public Works have integrated a GPS onto their snow plows with capability to map the location of cleared routes online.

Electronic Roadside Signing

Permanent Dynamic Message Signs

Permanent Dynamic Message Signs (DMS) are roadside electronic messaging boards that provide traveler information to road users. On the Nevada side, there are three signs within the Basin, with three additional along the approaches to the Basin (SR 431, US 50, and SR 207). All of these programmable message signs can be controlled by an operator at NDOT's District 2 TMC. NDOT shares the use of their permanent DMS infrastructure with surrounding counties, including Douglas County within the Basin, when required.

In addition to NDOT's DMS infrastructure, Caltrans maintains programmable DMS installations at nine locations along US 50 (two), SR 28 (five) and along SR 89 (two). There are also numerous signs installed along the approaches to the Basin from the California side along US 50 and I-80. Caltrans signs communicate over DSL and legacy telephone / dial-up back to the RTMC for remote control. Usage of Caltrans and NDOT DMS is generally limited to messages related to:

- Statewide campaigns
- Construction closures
- Chain control requirements
- Special event information

Travel times and resort-related parking information are currently not displayed on DMS, however, with additional integration of detection systems, it would be possible to include travel time messaging in the future.

Portable Changeable Message Signs (CMS)

In addition to the fixed DMS deployments, both NDOT and Caltrans also operate portable electronic message signs. Portable CMS provide similar functions to the permanent DMS installation but are typically equipped on a mobile trailer for use during temporary and unusual conditions such as construction, special events, and road closures due to mud or rockslides. NDOT District 2 currently owns and operates one mobile trailer equipped with a combination of traffic flow detection, RWIS, and CCTV cameras which is typically installed for long periods of time. Within the Nevada side of the basin, Douglas County also leases portable CMS from Search & Rescue.

At two of the private resorts, including Heavenly and Northstar, portable CMS have been utilized for parking management purposes. The signs are privately operated and maintained by each resort and are typically used to direct travelers to available parking facilities.

Chain-Up Signs

Chain-Up signs are used to inform travelers that they should use chains on their tires due to winter road conditions. In the Tahoe Basin, there are four Nevada locations where Chain-Up signs are implemented. The signs have a flashing beacon, which indicate when snow chains and tires are required.

The beacons are activated locally by the snow plow operators, with authorization from their respective supervisors. The beacons can be activated from a radio installed on the maintenance vehicle with proper line-of-sight.

Manually-operated chain-up sign and beacons exist on Caltrans-operated roadways around the Basin. These manual signs are activated and managed by the Caltrans Maintenance department.

Speed Feedback Radar Signs

A limited number of speed feedback radar signs have been installed along north and west shore at locations with known concerns for speeding in high parking, pedestrian, and/ or bicycle activity environments. The signs alert drivers when they are exceeding the posted speed limit through a flashing dynamic display that indicates the vehicle's speed.

Highway Advisory Radios

Highway Advisory Radios (HAR) are licensed AM radio stations controlled and operated by state agencies to provide motorists information on incidents, roadway conditions, and emergencies. HAR systems are comprised of a transmitter, flashings signs (activated when message is broadcasted), and a communication system that allows for operators control at a centralized location such as a Traffic Management Center (TMC). HARs continue to be used for road controls (such as road closures and chain requirements), incidents, construction information, and Amber and Silver alerts. In California, five HAR transmitters are located on US 50 in Meyers, near the SR 89/SR 28 junction in Tahoe City, on SR 89 near Squaw Valley, and on SR 267 at King's Beach. On the Nevada side, there are two existing HAR transmitters within the Tahoe Basin area at the Spooner Summit Maintenance Yard and Sand Harbor. All NDOT transmitters are arranged on a synchronized network (AM 530). In 2014, NDOT replaced the digital recorder-player modules with the most recent firmware in order to allow communication between CSS and HAR. A goal for the HAR network on both sides of the border is to synchronize the messages at all locations. This will reduce message interference and allow travelers to tune into a single station for the Basin. There currently is no connection between the HAR system and Caltrans and NDOT's 511 websites.

US 50 ITS Improvements

US 50 serves as a major east-west connector to I-5 and SR 99 and is a major feeder (along with I-80) to the Tahoe Basin. Caltrans has identified US 50 as part of the Interregional Transportation Strategic Plan and is classified as a "High Emphasis Route." High Emphasis Routes are intended to have priority for programming and construction to minimum facility standards in order to better assure that a statewide trunk system is in place and able to handle higher volume interregional trip movements between urbanized areas. Proposed ITS improvement projects directly impacting the Basin include signal synchronization and numerous intersection improvements.


Exhibit 4.4
Existing Weather and Traffic Monitoring Locations
Donner Mem. State Park
TRUCKEE
Northstar
INCLINE VILLAGE
KINGS BEACH
Agate Bay
Crystal Bay
Burton Creek State Park
Carnelian Bay
TAHOE CITY
Squaw Valley
Alpine Meadows
Sand Harbor
Lake-Tahoe - Nevada State Park
CARSON CITY
NEVADA
CALIFORNIA
LAKE TAHOE
Glenbrook
Spooner Summit
Homewood
McKinney Bay
Sugar Pine Point State Park
Meeks Bay
Rubicon Bay
Zephyr Cove
Kingsbury Grade
D.L. Bliss State Park
SOUTH LAKE TAHOE
Stateline
MINDEN
Emerald Bay State Park
Heavenly
Centerline
Fallen Leaf Lake
MEYERS
Fredricksburg
Echo Summit
Picketts Jct.
Paynesville
Sierra-at-Tahoe
Woodfords
80
89
267
431
395
43
50
207
88
Closed Circuit TV (CCTV)
Road Weather Information System (RWIS)
Traffic Monitoring System (TMS)
Past Bluetooth Reader (BTR) Installations
Tahoe Basin Boundary
Source: Transpo Group

Pre-Trip Traveler Information Systems

Pre-trip traveler information systems provide travelers roadway information that pertains to their route and mode of travel. These information systems utilize data from other ITS systems (i.e. vehicle detectors, RWIS, and CCTV cameras) and displays this information in a user-friendly format. The most common pre-trip traveler information systems are found online on the respective state DOT's website.

NDOT 511

NDOT recently implemented a new 511 system which includes a combination of a 511 number, 800 number (1-877-NVROADS), and a web site (www.nvroads.com) where travelers can get information about road alerts, controls, incidents, and construction information. The map feature also provides information from RWIS stations, CCTV cameras, incidents, construction, and road conditions (wind restrictions and chain-up requirements).

SACOG 511

With the support of SACOG and use of StarNet's inter-agency communication tool, Sacramento has deployed a 511 system (http://www.sacregion511.org/) complete with transit, traffic, rideshare, and bicycling information. A mobile app can be downloaded and local tweets can be followed. The 511 system extends into the California side of the Basin with the intent of interfacing with Nevada's 511 system.

Caltrans Highway Information Network (CHIN)

Caltrans maintains an 800 number (1-800-GAS-ROAD) and a web site (http://quickmap.dot.ca.gov/) that acts as the statewide roadway information provider for chain-up requirements and road closure information. The Sacramento 511 system can be accessed from this site. Caltrans also maintains a website for all state highway projects in the Tahoe Basin (http://www.tahoeroads.com).

Other Traveler Information Systems

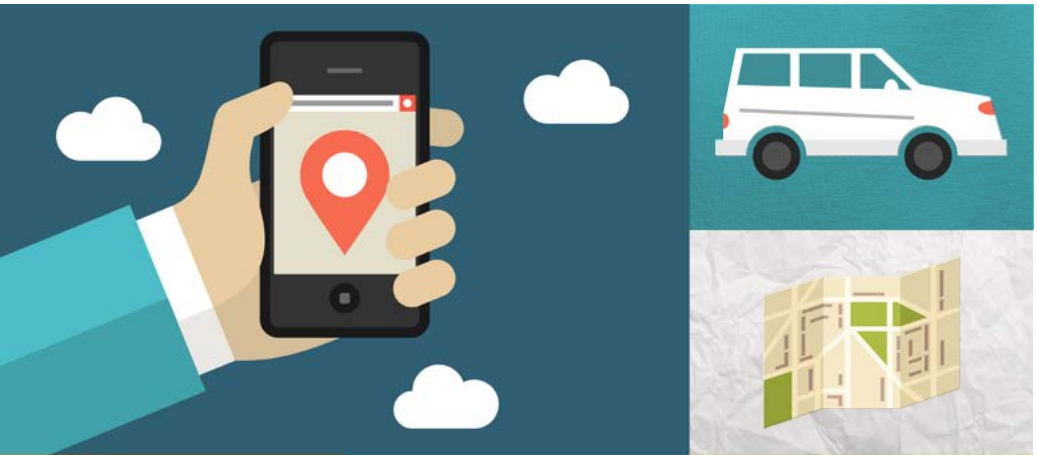
Outside of the Caltrans and NDOT deployments for pre-trip information systems, many privately-operated systems also benefit travelers in the Tahoe Basin. These include Internet sites for transit arrival times (NextBus), third-party traffic information (Google Maps – vehicle, transit, bicycle, and pedestrian route information), transit services (such as the North Tahoe Express airport shuttle) and numerous tourism web sites that provide traveler information related to attractions, hotel/motel reservations and weather conditions.

The region's resorts have recently introduced mobile applications for their customers. Information such as ski routes taken, available ski lifts, and photo sharing are included with the application. While these mobile applications currently do not provide traveler information such as travel times, chain-up requirements, parking, and parking, there is a future desire to do so. Additionally, the Tahoe Fund has recently released the Tahoe Beaches app that provides direction and beach information to travelers.

Coordinated Transit System

General

Through past ITS initiatives, a regional transit coordination project known as the "Coordinated Transit System" (CTS) sought to increase the attractiveness of transit as an alternative means to the private



vehicle. Solutions included a satellite-based automated vehicle locations (AVL) system, an advanced traveler information system (ATIS), and a computer-aided dispatching (CAD) system. Since the proposal stages of the project, a few transit groups tested and enacted a few of these technologies, however, a common identity for a basin-wide service is still in the planning stages.

Tahoe Area Regional Transit System (TART)

The Tahoe Area Regional Transit (TART) was the first to deploy transit technology within the Basin. TART buses are equipped with a Genfare Odyssey Validating Farebox system which accepts magnetic strip cards and cash while recording transactions, boardings, and boarding times. TART also uses GPS technology (NextBus, Trapeze, and Zonar) to provide arrival times to passengers and manage fleet operation. Arrival time is accessible online, over the phone, and displayed on message boards.

In 2012, the new Tahoe City Transit Center provided three indoor 50" monitors and overhead message boards for arrival time display for regional transit users. Other developments include three new large shelters equipped with power and future plans to install on-board bus surveillance.

The Town of Truckee has a small transit fleet that acts as an extension of TART. Bus payment between Truckee's transit system and TART is transferrable. To further increase the interface of each system, Truckee is in the process of implementing the NextBus system.

Tahoe Transportation District (TTD)

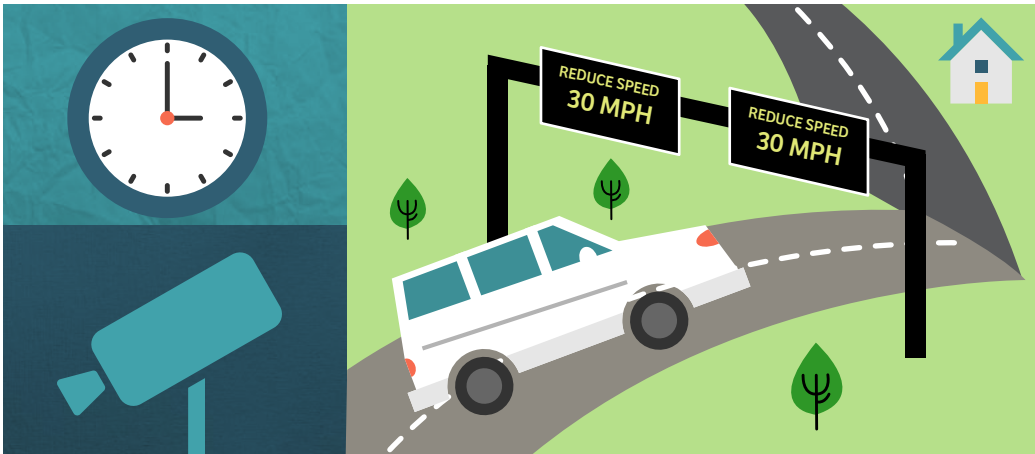
The Tahoe Transportation District is responsible for transit systems Basin-wide. Along the north shore, a summer seasonal East Shore Express route was deployed for service between Incline Village and Sand Harbor. This was introduced as an effort to reduce illegal roadside parking near the popular recreational facilities. TTD is also currently overseeing the development of the cross lake ferry service between north and south shores.

In the south shore, the BlueGo transit vehicles are also outfitted with the Genfare validating system. Currently TTD is in the process of implementing the software and database component of the system (CIPAce). Unlike TART, the BlueGo transit system has a nonoperational AVL deployment that has yet to be replaced due to lack in funding and deficiencies in communication coverage.

Resorts

The resorts are major financial contributors to the north and south shore transit systems. A large majority of transit ridership comes from the resort's employees and patrons. In addition to public transit access, some resorts provide their own transit system within the resort neighborhoods and between parking lots. Resort-operated transit initiatives currently available or under development are as follows:

- **Northstar:** Northstar currently has the largest automated dial-a-ride system in the area that receives shuttle requests and allows operators to allocate pick-ups with shuttle drivers. The Northstar Transit Center at the main resort has eight stations for resort shuttles, dial-a-ride buses, and the TART.
- **Squaw Valley/Alpine Meadows:** Squaw Valley/Alpine meadows is interested in implementing GPS technology for tracking resort shuttles.
- **Heavenly:** Heavenly has partnered with TTD for free shuttle service to their base areas.



Communication Systems

General

Common to many rural applications, communication infrastructure is usually sparse. However, communication within the Basin is slowly evolving. The Tahoe Prosperity Center (TPC) has recognized the need for increased communication coverage and backhaul capability for telecommunications and remote access to field equipment. The TPC is currently conducting a study that documents coverage maps for broadband coverage throughout the Basin. The study will then ground test these documents by issuing public surveys and identify coverage gaps and underserved areas. In addition, NDOT and Caltrans both have working relationships with cellular communication providers in the area to increase cellular coverage. In addition to cellular communication, fiber and DSL lines exist either within the Basin or just outside the Basin. Table 1 following this section identifies existing communication means for the different ITS elements in the Basin.

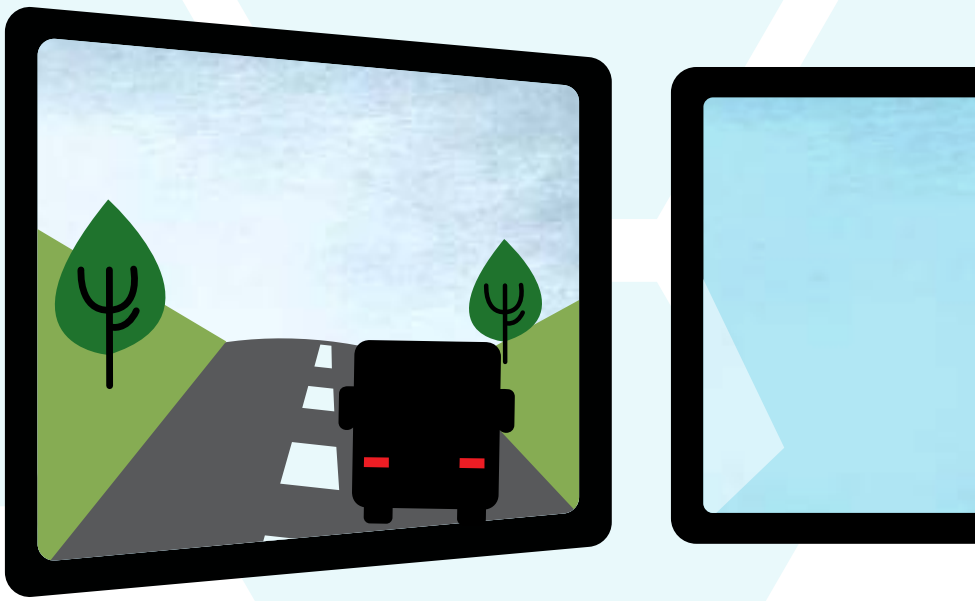
Caltrans

Within the Tahoe Basin, Caltrans' backhaul communication to ITS field installation typically occurs over a DSL connection. Caltrans has also used wireless cellular communication where DSL is not available. Caltrans' signal network currently communicates back to the RTMC and Kingvale SOC over traditional phone lines. However, with the availability of DSL lines, Caltrans is transitioning to this technology to provide a more reliable form of backhaul communication. Copper signal interconnect also exists locally for select traffic signal controllers within the south shore signal system. Outside of the Basin, Caltrans has a fiber backbone along I-80 that provides connectivity for ITS elements approaching the Basin.

NDOT and Nevada Counties

NDOT is implementing a licensed dedicated radio system. This is a point-to-multi-point carrier-grade system that utilizes backhaul radios for data transmission. This communication system has been primarily used for the Wind Warning System in Washoe County. The mountain-top radio application currently provides coverage for the following roadways: Mt. Rose Hwy, US 395, I 80 and the McCarran loop. As a potential cost effective means of expanding communication in the Basin, NDOT is considering the placement of a new radio tower that would potentially service the South Shore.

NDOT currently utilizes 3G/4G cellular connections where approximately 70 cameras communicate back to their District 2 TMC using this network. Land mobile radios (operating on the 800 MHz frequency) are also used for voice and RWIS information and have reached their end-of-life based on the original inception date and current data streaming needs.



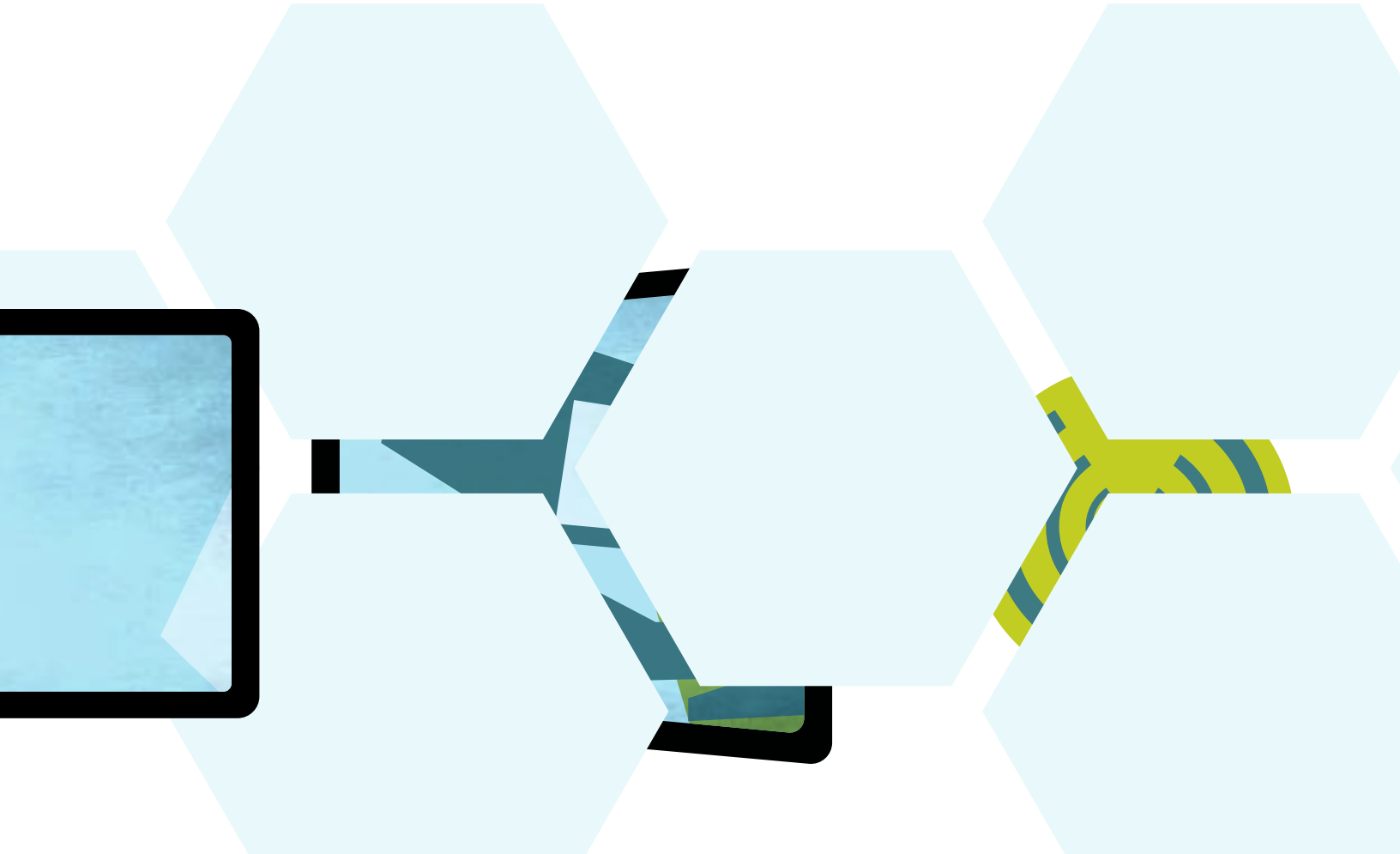
On the Nevada side of the Basin, the local counties are responsible for signal maintenance. Without the availability of signal interconnect or another means of communication, signals in Washoe County and Douglas County are operated and maintained locally at the intersections. In order to provide additional communication outside the Basin, NDOT has established fiber agreements with private telecommunications providers along US 395 from Carson City, NV to Barstow, CA. NDOT also utilizes fiber communication along I-80 to Reno, NV, however, no communication link from this backhaul fiber to the Basin exists (similar to Caltrans).

Exhibit 4.5

ITS Field Communications Links

Fields Device	Control Center		
	Caltrans (Regional TMC)	NDOT (District 2 TMC)	Local
Traffic Signals	Phone line (POTS and DSL)	N/A	Washoe - None Douglas - One signal equipped with radio communications
Traffic Monitoring Stations	Phone line (SL) Cellular	Cellular	N/A
CCTV Cameras	Phone line (DSL) Cellular	Cellular	N/A
RWIS Stations	Phone line (DSL)	800 MHZ Radio	N/A
DMS	Phone line (DSL)	Phone line (DSL)	N/A
HAR Sites	Phone line (DSL)	Cellular	N/A

Source: Transpo Group



Challenges and Opportunities

Over the course of the last decade, significant ITS advancements have been made in the Tahoe Basin to address many of the region's transportation-related challenges. Most importantly, a mindful effort has been taken by regional project stakeholders to strategically deploy ITS with benefits to safety, mobility and the environment. While much has been accomplished, recently conducted outreach meetings in May 2014, have identified both new and recurring challenges and opportunities that will constitute the core objectives of the ITS Strategic Plan update. The advancement in transportation technology, growth in the mobile device era, and transportation data applications will play a crucial part in addressing these needs and challenges.

KEY FACTORS

Several factors contribute to the congestion levels experienced in the Tahoe Basin:

- Safety
- Traveler Information Needs
- Congestion/ Roadway Operations
- Transit Efficiency and Effectiveness
- Emergency Response and Incident Management
- Better Planning Data
- Maintenance Activities
- Inter-agency Communication
- Environmental Considerations

The information presented is not intended as a treatment of all transportation challenges in the Tahoe Basin, but rather focuses on those problems that are most pertinent to ITS at the time of the latest update. Possible ITS applications that can help meet the identified challenges are described next.

Safety

Drawing a high volume of seasonal traffic for winter activities, traveler safety concerns have consistently been one of the highest priorities for the Tahoe Basin's regional highway and roadway systems. Factors influencing safety include:

- Adverse weather
- Mountain driving conditions
- Driver experience
- Roadside parking

With respect to vehicular-related safety, agencies in the Tahoe Basin have collectively worked towards addressing safety concerns by implementing both operational and ITS improvements. Examples of safety improvements include the expansion of RWIS systems, pedestrian and bicycle signal enhancements, traveler information systems and inter-agency data sharing portals. With the transportation industry trending towards the use of mobile applications and the wider acceptance of data sharing, new opportunities to disseminate real-time roadway conditions and weather advisories are now available to promote safer travel in the basin.

While safety predominantly relates to vehicular modes, non-motorized accidents are also a safety concern in the region. Pedestrian and bicyclist safety has been identified as a major concern in urban and recreational areas. Most recently, stakeholders also identified roadside parking as a major concern. Within Tahoe Basin several prominent points of interest and activity areas such as Sand Harbor, Zephyr Cove Resort, and Emerald Bay have raised recent concerns for pedestrian safety. Due to the limited parking availability and consequential increase in roadside parking, additional pedestrian cross-street traffic creates a safety concern for both passing motorists and pedestrians. ITS systems that enhance parking guidance, way-finding, and pedestrian safety provide potential strategies to mitigate these safety concerns.

Traveler Information Needs

The availability of traveler information is especially important in the Tahoe Basin because the region attracts a significant number of visitors who may not be fully aware of the transportation options and alternatives in the Tahoe Basin. The type of information that may be useful to the traveler includes roadway conditions, incidents, construction activities, alternative routes, transit schedules, and weather conditions. In the past, traveler information has been disseminated through traditional means such as variable message signs, chain-up signs, RWIS, and HARS signs.

Consistent with the recent proliferation of mobile traffic data applications, the expectation for real-time and accurate traveler information has become a norm for many travelers. In the recent years, travelers nationwide have depended on new traffic data resources such as Google Maps, Waze and Inrix to provide up-to-the minute information on travel options and operating conditions. In the Tahoe Basin, these new systems supplement traditional ITS to provide roadway users with additional resources to make informed travel decisions. Compared to traditional ITS deployments, mobile data applications provide a cost effective means of data dissemination since they leverage the availability and accessibility of mobile devices. It is expected that future expansion in vehicle probe data, mobile application development, and emerging connected vehicle technologies will provide more comprehensive en-route and pre-trip information to the public. With respect to traveler information needs, the key to success will be improved data sharing between agencies and data distribution to third party developers to drive innovation in the both the private and public sectors.

Congestion/ Roadway Operations

Unlike the predictable peak-period congestion that is typically experienced in many urban settings, congestion in the Tahoe Basin is largely influenced by seasonal and recreational activities. The primary congestion periods include Sunday afternoon on routes out of the Basin as visitors return home, and Friday evening inbound when visitors arrive. In the winter, many locations can become congested in the late afternoon as skiers leave the various resorts and return to their lodgings. In the summertime, traffic may be more evenly distributed through the day, but the higher volumes, especially on weekends, can result in system breakdowns at any time.

Several factors contribute to the congestion levels experienced in the Tahoe Basin:

- Network constraints, including limitations on alternative routes
- Adverse weather events such as snowfall and high wind
- Incidents including traffic accidents and weather-related disasters
- Trips generated by activity centers and special events.

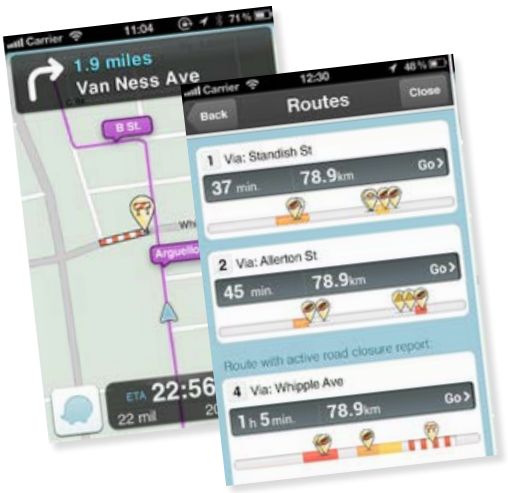
The Tahoe Basin is challenged by both recurring and non-recurring congestion. Areas of primary concern for recurring congestion included SR 50 within the vicinity of South Lake Tahoe and Stateline, along SR 28 near the junctions with SR 89 and SR 267, and on SR 89 at the access roads to the Squaw Valley and Alpine ski resorts. In past years, investments in transit systems have contributed to seasonal traffic demand management and reduce the overall number of vehicular trips. Deemed effective, many private ski resorts have implemented and planned future private transit and shuttle services for their customers. Beyond transit, future deployments of advanced traffic signal control systems, active traffic management, and enhanced traveler information systems are other means of ITS that can help mitigate recurring congestion for the Basin's regional transportation system.

Non-recurring congestion and incidents are region-wide issues, affecting all facilities and agencies, but the impact is greatest on the high- volume gateway roads such as US 50 in both states and SR 89 and SR 267 in California that are prone to lane closures or severe weather conditions. Advanced incident management techniques and traveler information systems are some of the ITS measures that can help mitigate the effects of weather-related congestion by proactively managing incident as they arise and informing the roadway users of alternative travel options.

Transit Efficiency and Effectiveness

Transit agencies and private resorts have made incremental investments in the region's transit system, including a new transit center, transit information systems, payments systems and AVL systems. These investments have contributed greatly towards improved transit efficiency and effectiveness. While transit systems have improved in the region, many of the transit operators as well as private coach and shuttle services currently operate independently of each other for the most part. Consistent with the input gathered from regional stakeholders, the need for a unified transit system will help transit system managers in the region to make better use of the limited resources and make transit a viable alternative to personal vehicle use in the Basin. In addition to a unified system, potential ITS deployments that can aid in the management and operation of transit services include Automated Vehicle Location (AVL) systems, electronic fare payment systems (e.g. SMART Cards), Transit Signal Priority (TSP), advanced vehicle maintenance systems, computer-aided dispatch (CAD) systems, and automated passenger-counting systems.

Convenience and ease of use are two factors that encourage users to consider transit options. Traveler information and trip planning systems are ITS elements that directly address this requirement. In the recent years, web-based transit applications and information portals have provided a wide array of trip planning tools for transit system users. Applications such as Google Maps, NextBus, and TransitScreen are capable of providing set schedules and routes, real-time information about vehicle location and transfer information. Available on most mobile devices, these tools provide transit users with information at their fingertips to plan trips across various operating agencies.



Emergency Response and Incident Management

This need refers to the ability to identify and react to emergencies or incidents. In the Tahoe Basin, emergency response and incident management is crucial because of the isolated nature of some roadway segments, and the severe weather that can impact those involved in an incident as well as hamper response efforts. There are several issues that contribute to this challenge. The first is the ability to identify and verify incidents. The second issue is the execution of the appropriate response.

One part of this issue can be that the necessary information is not shared between all affected agencies and service providers. Leveraging advancements in mobile applications where incident data is reported by other motorists, such as Waze, will also help promptly notify first responders in the event of accidents.

Again, a variety of ITS applications can help address this challenge. For example, data received from traffic monitoring and CCTV stations can help system operators detect the occurrence of incidents. Well-defined protocols for information sharing between agencies, advanced communications systems, and use of a TMC as the focal point for the dissemination of information can help improve incident response. Emergency vehicle signal pre-emption is another strategy that can be used to improve emergency response. The application of this strategy in the Tahoe Basin may be limited due to the small number of signals in the area.

Better Planning Data

Transportation improvements are commonly identified through a variety of short- and long-range planning efforts. Similar to the objectives of this ITS Strategic Plan, transportation planning requires accurate and comprehensive data that can be used to identify problem locations, to quantify magnitude of current problems, to help assess potential benefits, and to evaluate actual impacts. In the last decade, agencies surrounding the Tahoe Basin have put a greater emphasis on obtaining planning data. As an example, Caltrans and NDOT have developed public-facing database systems at no charge, thereby providing other agencies or third-party developers with data for transportation planning and development purposes.

Technological advancements in data collection have resulted in ITS systems that are capable of processing traffic data at high volumes and speeds, commonly referred to as Big Data. In the recent years, Transportation Big Data has been derived from the end user's expectation of reliable and accurate data. Consequently, the methods in which data is collected, managed, and analyzed has transformed significantly.

While many of the traditional systems such as loop detectors, video detection systems and AVL are still widely used and provide valuable data for transportation managers, new data collection means such as crowd-sourcing, probe data collection, social media data collection provide new opportunities to collect a larger and more comprehensive set of data for a variety of transportation use cases. An example of a Big Data development includes predictive algorithms that notify the end-user of when to schedule a trip to save the most time on a commute. When coupled with developments to apply and analyze these raw data sets for useful transportation planning applications, transportation managers will be equipped with new real-time data solutions to meet modern day transportation challenges.

Within the Tahoe Basin, another consideration in the design of these systems is coordination with environmental quality monitoring systems (e.g. air quality, water quality, etc.). Areas of coordination or integration may include monitoring locations, housings or supports for field devices, communication links, and central data archiving systems. In some instances there may also be commonality in the type of data collected.

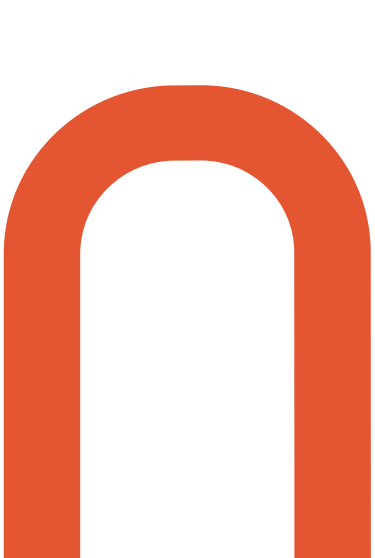
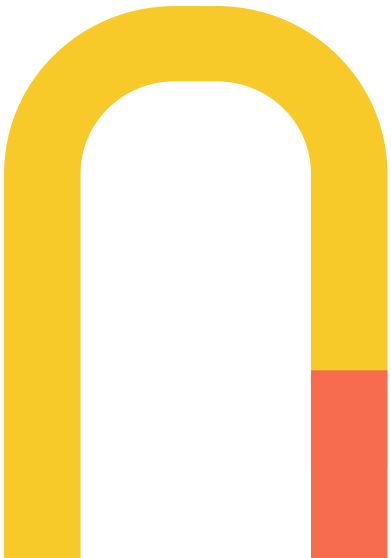
Maintenance Activities

Improved maintenance of the street and highway system is a challenge that affects all facilities and agencies within the region. For many agencies, maintenance can account for between thirty and forty percent of expenses. The weather in and around the Basin has a significant impact on the region's maintenance activities not only as it relates to snowfall, but also the number of days each year that are available for other maintenance and construction efforts. Maintenance activity improvements can reduce disruptions to traffic flows, improve safety for both vehicles and maintenance personnel, and increase the efficiency of these activities.

There are a number of technological applications that can impact highway maintenance operations. Advancements in RWIS and maintenance vehicle roadway monitoring analytics are valuable for the effective and efficient allocation of maintenance resources. NDOT's connected vehicle pilot study is an example that utilizes on-board weather monitoring instrumentation and mobile communications to weather and road condition reporting.

With regards to construction activities, technological developments such as smart work zones can improve the efficiency and safety of highway maintenance and construction activities. Smart work zones apply technologies such as sensors and messaging equipment to alert roadway users of upcoming construction hazards to encourage safe movement through construction zones. In addition, the use of travel information systems can alert drivers and enhance work zone safety. Information systems can also help direct travelers to alternative routes or times and avoid traffic disruptions, thereby reducing the congestion and delays experienced by travelers.

It should be recognized, that the implementation of ITS components might result in a relatively new set of maintenance challenges for state and local agencies to solve. Additional maintenance burdens can be anticipated in the areas of personnel training, inventory management, and equipment calibration.


Inter-Agency Communication

Inter-agency communication and cooperation are critical to the effective management of the transportation system. An effective communications system allows all interested agencies to share important data in a timely manner thereby allowing the personnel to coordinate operations safely and efficiently. Improved communication was identified as a recurring need for the Basin during 2014's stakeholder consultation process.

There are a number of technical and institutional factors that influence the effectiveness of the communication network. Technical issues include gaps in the coverage areas of wireless systems (radio and cell phone), and the compatibility of different radio systems. Discontinuous coverage areas vary between the different systems or providers also provide limitations, and can be addressed through the installation of additional transmission and relay towers.

Recognizing that the communication infrastructure is critical to the success of many other ITS systems and inter-agency coordination, agencies in the Basin have worked closely with communication providers to enhance coverage. Additionally, agencies have also improved the wireline systems to include new fiber optics and DSL links, contributing to regional expansion of the communication system as well. While many communication improvements have been made in the last decade, continual expansion will help to fill in the gaps that still exist in many sections around the basin. With the anticipated expansion of communication network, the need for regional communication standardization and protocol development across all operating agencies will also be vital to ensure operational efficiencies.

Environmental Considerations

Sensitivity to the environment is an important factor that shapes all transportation programs within the Tahoe Basin.

With the elevated concern about environmental quality, there is little interest in expanding the Basin's roadway system. As a result, the importance of managing the existing infrastructure is increased with ITS being a potential tool in that management effort. Several of the ITS applications described previously can help reduce prolonged congestion and enhance the use of alternative modes of transportation. In doing so, the need for additional major construction along the system may be reduced along with environmental impacts. ITS applications could also include those for monitoring vehicle emissions, and reducing the likelihood and impacts of incidents such as hazardous material spills. Additionally, the wide use of mobile communication technology provides a new means and opportunity to collect and disseminate data to the public, reducing the need for many traditional ITS systems such as data stations and dynamic message signs that have a larger environmental footprint.

chapter 5

Regional ITS Architecture

THE REGIONAL ITS ARCHITECTURE IS A PLANNING TOOL THAT PROVIDES A FRAMEWORK FOR IMPLEMENTING ITS SYSTEMICALLY AND ACCOUNTS FOR A WIDE ARRAY OF SYSTEM FUNCTIONS AND DATA INTERFACES.

The ITS Architecture provides a shared vision of how the regional stakeholders can implement ITS in a manner that integrates the use of resources and information to provide a safer and efficient transportation system in the Basin.

Chapter 5 presents an overview look at the Architecture, highlighting key points and providing an initial level-of-detail to further illustrate the use of the ITS Architecture at the project level.

What is an Architecture?

The FHWA describes the Architecture as “a common framework for planning, defining, and integrating ITS.” The ITS Architecture seeks to illustrate and document regional integration efforts and develop a roadmap to implement ITS in a timely manner. At a regional level, the ITS Architecture considers institutional agreements and technical integration to address the specific transportation needs and how these needs can be addressed using ITS. It also aims at gaining consensus between regional stakeholders to establish a guiding principal for deploying ITS in a collaborative manner.

The ITS architecture builds upon existing ITS investments and deployments to illustrate the integration dependencies with new ITS systems that are planned in a regional setting. The complex interactions across the entire ITS system are simplified into system groupings with similar functionality to support system interoperability and system-wide integration. In its most basic form, an architecture is a set of rules that facilitates the building of systems and that allows these systems to communicate and inter-operate after being built.

National ITS Architecture

The National ITS Architecture provides a framework and common vocabulary for planning, defining, and integrating ITS systems within different modes of travel and geographic areas. The set of tools that comprise the National ITS Architecture provide a framework to help the following tasks:

TOOLS

1. Identify key stakeholders and their relationships.
2. Describe required activities, functions, and system components.
3. Define interconnections and interdependencies between systems/ functions.
4. Define a blueprint for integration of the systems (Planning-Level Architecture).
5. Provide guidance to identify integration opportunities during project definition (Project- Level Architecture).

The National ITS Architecture's main objectives are to describe what functions/processes are needed, decide where these functions should be located, and identify who needs to be involved and/or is responsible. In short, the Architecture consists of a series of diagrams/ figures that show the relationships within/between components, subsystems, and Agencies. While the National ITS Architecture is not region-specific, these diagrams represent sample figures that can be tailored to a specific area such as the Tahoe Basin. Furthermore, Section 5206 (e) of TEA-21 requires that ITS projects carried out using funds made available by the Highway Trust Fund conform to the National ITS Architecture, applicable provisional standards, and protocols. This is now more commonly referred to as "conformance" with the National ITS Architecture.

Benefits of a Regional ITS Architecture

The main benefit of developing and maintaining a Regional ITS Architecture is that is enables regional stakeholders to proactively plan for ITS implementation following guidance from the USDOT. Since the Tahoe Basin covering two states and five counties, an ITS Architecture is especially important for coordinating the unique ITS needs and functions of neighboring agencies. The limited number of travel options around the Basin also warrants the need for an ITS system that is deployed in a cohesive manner where resources are shared to the fullest extent possible. Implementing ITS deployments in accordance with the Regional ITS Architecture also provides the following supplemental benefits.

SUPPLEMENTAL BENEFITS

1. Ensure that ITS Projects meet MAP-21's Architecture conformance requirements for Federal funding eligibility.
2. Lower costs and risk, both during design and over the entire project life-cycle.
3. Encourages timely implementation of ITS.
4. Orderly and efficient expansion of systems/technologies.
5. Economies-of-scale by using technologies from multiple vendors that can still work together as a system.
6. Highlight and improve the integration of systems.
7. Use of a common set of standards to better coordinate operations, integrate systems, and share data/information.

Primary Architecture Components

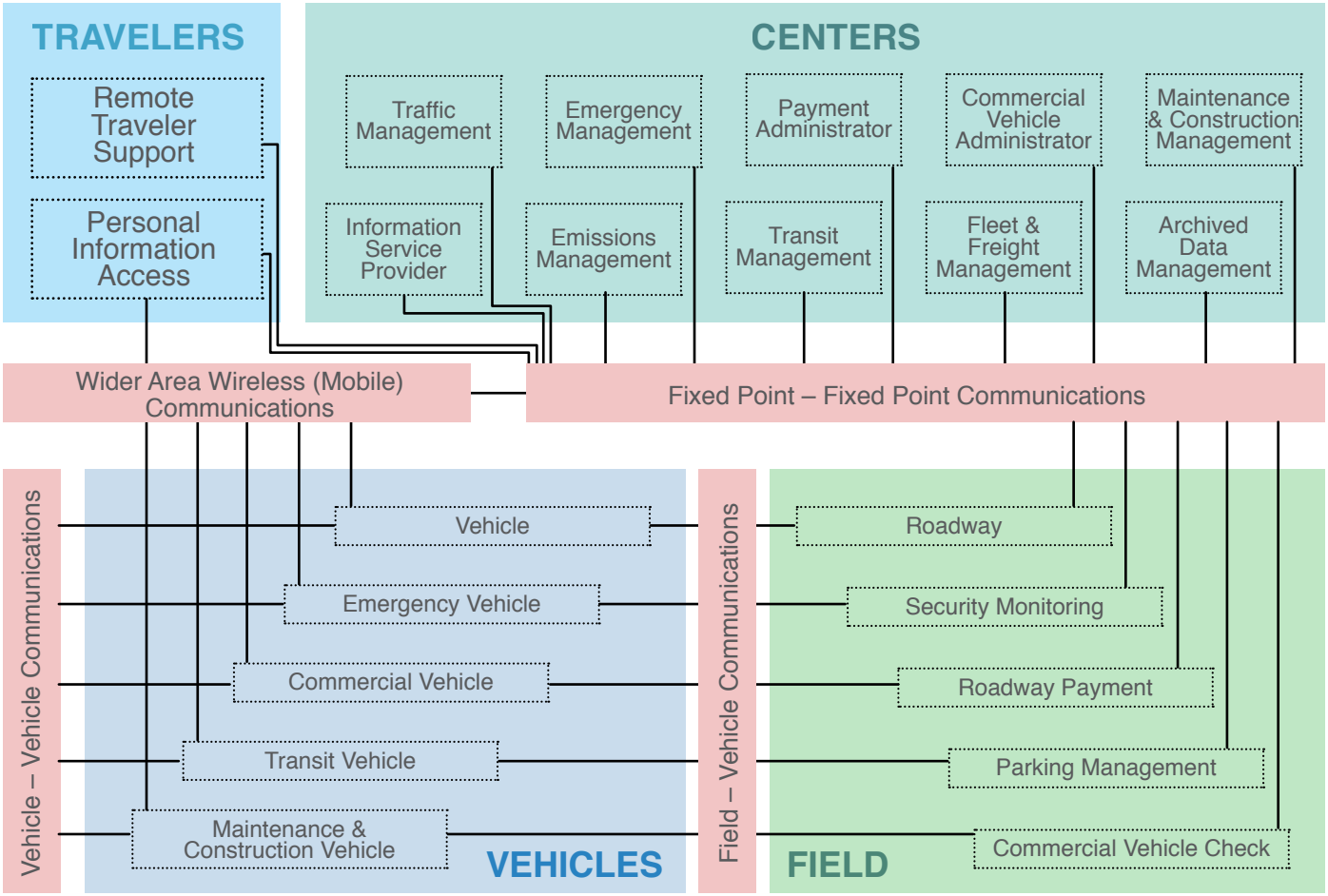
The National ITS Architecture is comprised of relationships among subsystems. The related subsystems are connected through the communications infrastructure to complete a system. There are twenty two (22) subsystems in four (4) classes:

1 **CENTER** subsystems provide management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions as well as to monitor and control roadside devices.

2 **FIELD** subsystems consist of intelligent infrastructure distributed along the transportation network that perform surveillance, information provision, and plan- equipment control functions. Roadside subsystem operations are controlled by center subsystems.

3 **VEHICLE** subsystems cover ITS-related elements on vehicle platforms. Vehicle subsystems include general driver information and safety systems applicable to all vehicle types.

4 **TRAVELER** subsystems are equipment used by travelers to access ITS services pre-trip and en-route. This includes elements that are owned and operated by the traveler as well as elements that are owned by transportation and information providers.



Tahoe Basin Regional ITS Architecture

The National ITS Architecture is comprised of relationships among subsystems. The related subsystems are connected through the communications infrastructure to complete a system. There are twenty two (22) subsystems in four (4) classes:

Overview

The Regional ITS Architecture describes the planned ITS services and functions, incorporates the relevant subsystems and organizations, and describes the information exchanges planned between them. These relationships are illustrated by tailoring specific National ITS Architecture diagrams. From these tailored diagrams, a deployment plan structure is established that provides a basis for long-term transportation planning in the region. ITS Projects are then mainstreamed into the planning process where stakeholder buy-in and project promotion can easily occur with all stakeholders in agreement.

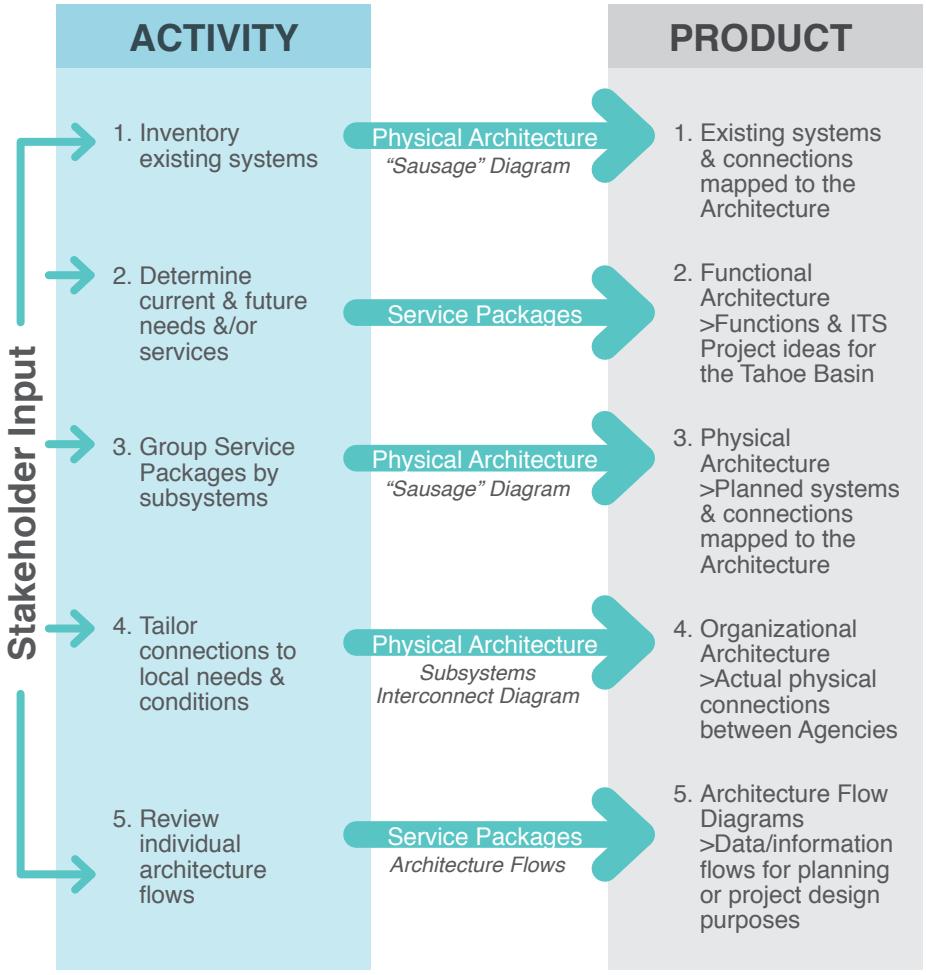
Another purpose of the Tahoe Basin Regional ITS Architecture is to describe how individual ITS projects/applications work together as a system. In a sense, this would be the high-level ITS concept-of-operations for the Tahoe Basin. The Regional ITS Architecture starts with the ITS Strategic Functional Areas, then adds those selected ITS Projects and functional pieces for a complete ITS deployment approach. In this manner, the National ITS Architecture was tailored to reflect the list of ITS Projects selected for the region. Therefore, the Tahoe Basin Regional ITS Architecture was designed to accommodate anticipated projects (as described in Section 3), and vice-versa. By analyzing these selected projects, tailoring their functionality, and placing them within the framework of the Regional ITS Architecture, a clear picture of the Tahoe Basin Agencies' intended operations becomes apparent.

Development Process

Typical with the preparation of Regional ITS Architectures, the development process was an iterative one that required input and review from multiple stakeholders. The strategic plan update process underwent a flow of tasks required to seek the necessary stakeholder input to establish a system concept of operations. The multitude of complex interactions between different participating agencies lends itself to this iterative process as it provides several opportunities for revising the intended plan to meet the regional needs.

Exhibit 5.1

Process form the National ITS Architecture to the Tahoe Basin ITS Architecture



Concept of Operations

The operational strategies and ITS infrastructure investments identified through development of the Tahoe Basin ITS Strategic Plan depend upon cooperation of multiple agencies across multiple jurisdictions for effective implementation. Inter-agency partnerships in the planning, funding, deployment, operation, and maintenance of all ITS strategies in the Tahoe Basin are absolutely necessary to maximize the return on investment to the public.

Main Objectives of the Concept of Operations

Provide an overview of the key functional areas in the Tahoe Basin identified by stakeholders.

Identify both current and future stakeholder roles and responsibilities in the future implementation of regional ITS systems and operational strategies.

Illustrate how agency personnel, ITS systems, and other resources interact, as a basis for developing the updated ITS Architecture.

Strategic Functional Areas

The operational concept is divided into the five functional areas that expand on the Tahoe Basin's future ITS vision. Each functional area covers a particular aspect of regional transportation system management and operations.

Roadway Traveler Information

Transit Accessibility and Service

System Integration & Coordination

Traffic Management & Safety

Maintenance Activities

Each functional area Concept of Operations includes the following:

OVERVIEW Introduction to the functional area, a description of the existing ITS deployed throughout the Tahoe region within the functional area, as well as how these applications are currently operated and any existing issues identified within the functional area.

FUTURE VISION Describes the 10-year vision for ITS implementation in the region.

ROLES AND RESPONSIBILITIES Describes the responsibilities for each stakeholder within the functional area, and the existing status of each.

INFORMATION EXCHANGE DIAGRAMS "Flow diagrams" depicting the both the type and flow of information to be exchanged between the systems and operators in the functional area.

Roadway Traveler Information

Roadway traveler information for the Tahoe Basin aims at providing interregional and local travelers with real-time and accurate information about their journey before or during their trip. Due to the cross-jurisdictional geography of the Tahoe Basin, there is a heightened need to consolidate data to better serve the travelers in the area. A unified platform, such as a combined system between California and Nevada 511 systems, has been presented in this strategic plan as a means to address such needs.

As mobile technology improves and cellular communication becomes commonplace, the role of third-party web-based traveler information dissemination services, such as Google, Waze, RideScout, and Here will become a mainstream resources for providing for traveler information. Exposing relevant agency-collected data will enable these applications to improve system accuracy and dependency. As web-based solutions, these third-party applications utilize mobile and cellular data to reach travelers through a wide variety of easily accessible media formats. The stakeholders of the Tahoe Basin recognize the reality of this technology usage and support further traveler information data sharing.

Vision

The vision for traveler information in the Basin is to disseminate comprehensive static and real-time multimodal traveler information across California and Nevada to enable travelers to make informed choices about mode, route, trip time, and services. Goals that support this vision include:

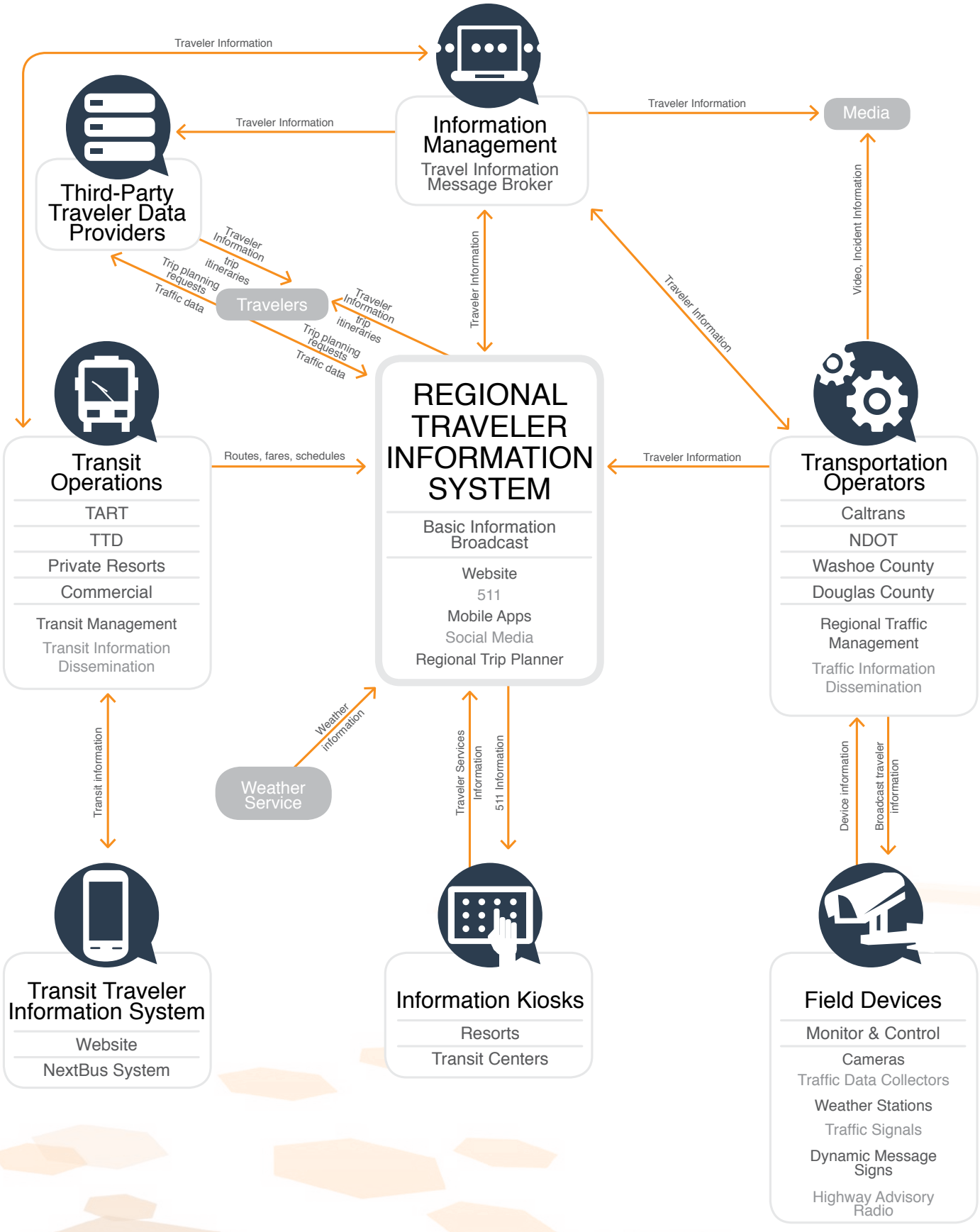
- Educate the traveling public about the available traveler information resources such as Internet, social media, mobile devices and applications, information kiosks, highway advisory radio, dynamic message signs, 511 systems, and third-party data applications.
- Support public and private partnerships for information and data sharing and information use
- Streamline data collection, data sharing, and traveler information dissemination
- Provide the ability for travelers to customize information to better support their individual travel decisions, especially with pre-trip information planning.
- Provide information that supports travel between California and Nevada
- Provide comprehensive roadway information especially major routes including I-80 and US 50 which serve as the main roadway facilities for accessing the Tahoe Basin
- Enhance the availability and accuracy of weather information systems to help travelers manage their pre-trip planning process.

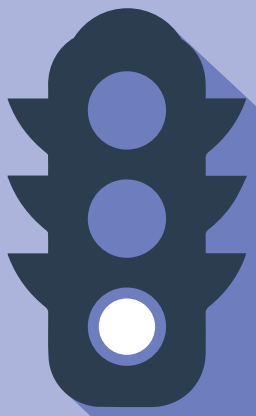
Roadway Traveler Information

Stakeholder Roles and Responsibilities

Agency	Roles & Responsibilities	Status
ITS Coordinator (TTD)	Improve, ongoing interagency communications and coordination for all ITS planning and implementation in the Tahoe region	Future
	Research and secure project funding	Future
	Lead/assist and solicit input from the regional ITS Coordinating Committee	Future
	Support multi-agency interoperability and facilitate the development of inter-agency agreements	Future
	Lead/coordinate project implementation	Future
	Support updates to the Tahoe ITS Strategic Plan	Future
TRPA/TMPO	Serve as a regional coordinator of real-time dissemination of regional traveler information	Future
	In partnership with TTD, manage region's use of social media to disseminate traveler information	Future
Caltrans/NDOT	Design/construct/maintain/operate ITS equipment to support traveler information (e.g. cameras, system detectors, dynamic message signs, highway advisory radio, weather stations)	Existing
	Operate and maintain servers and equipment for state websites and regional communication connections	Existing
	Manage region's use of the DOT's statewide traveler information system (web and 511) and disseminate traveler information through the system	Existing
	Evaluate message display content policy	Future
	Lead effort to provide travel time information on DMS	Future
	Expand availability of chain-up requirements and winter weather conditions	Future
	Coordinate with third-parties to share and market available traveler information	Existing/Future
	Coordinate with local partners to expand local traveler information coverage and availability	Future
	Synchronize HAR messages at all locations within the Basin	Future
	Promote the sharing of CCTV images with local agencies and media outlets	Future
TART/TTD	Expand real-time transit traveler information system to the South Shore	Future
	Promote installation of cellular towers to increase transit information reliability	Future
	Install information kiosks at major transit centers	Future
Media and Third-party ISPs	Disseminate public agency-generated traveler information through the media and third-party applications	Existing/Future
Resorts/Event centers	Provide event information of dissemination via regional and third-party systems	Future
	Provide comunication connections for traveler information kiosks	Future
	Coordinate with local transit agencies regarding transit service	Existing
	Implement parking guidance systems	Future

Roadway Traveler Information





Traffic Management & Safety

The traffic management and safety functional area is comprised of multiple sub-group operations including regional traffic control, road weather, and incident management. Regional traffic control operations includes devices and operations for managing the major arterials and state routes around the Basin, including operational considerations for transit signal priority, emergency vehicle preemption, and centralized signal control at each traffic management center. Numerous CCTV and dynamic message signs have been deployed throughout the Basin for roadway monitoring and traffic information dissemination.

Road weather operations involve the management of severe weather events that cause disruption to the regional transportation network. Given the Basin's more extreme seasonal weather patterns (especially during the winter months), roadway weather information systems (RWIS) have been a key ITS application for making traffic management decisions. Snow plows in the region play the largest role in maintaining traffic flow during these winter months. Most recently, snow plow operations in Nevada have adopted smart sensors for pavement sensing and de-icing materials application. Incident management operations include both planned (public events) and unplanned (accidents) that cause congestion on the Basin's roadways. Prevention, detection, response, and clearance are all aspects of incident management that require coordination with regional traffic management centers and emergency dispatchers and responders. Incident alerts (i.e. chain-up information, road closures, re-routes) are provided to the public via the roadway traveler information functional area.

Vision

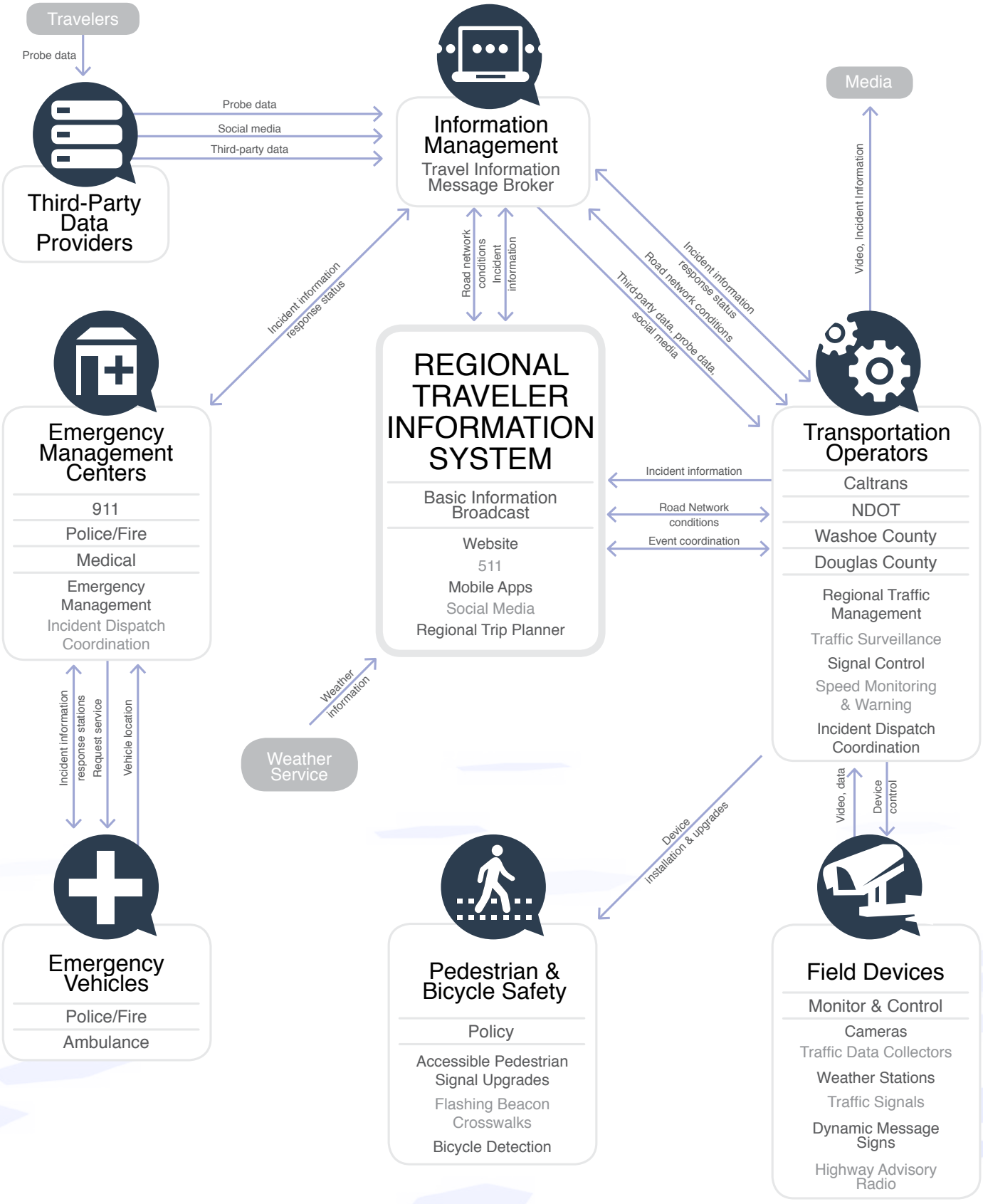
The vision for the traffic management and safety functional area is to increase the safety and mobility of the users of the Basin's roadway by obtaining data (weather conditions, roadway information, accidents), managing this data at a dedicated management center, and translating this data to other ITS systems such as traveler information systems. Goals that support this vision with respect to ITS include:

- Manage traffic signal control remotely using one common central control system.
- Use common standards-based traffic control hardware and systems to support regional traffic control and network surveillance.
- Improve public transportation efficiency along key travel corridors.
- Reduce operating costs by efficiently managing and scheduling road weather maintenance activities.
- Deploy weather gathering systems to support operations and aid in traveler decision making.
- Improve the safety of roadways typically impacted by severe weather events.
- Provide current and forecasted road and weather conditions from one central automated system.
- Improve and enhance the safety and security of emergency responders, the traveling public, and the environment.

Stakeholder Roles and Responsibilities

Agency	Roles & Responsibilities	Status
Caltrans/NDOT	Serve as a back office for implementation of central signal system	Existing/Future
	Collect traffic data needed for development of traffic signal timing plans at resort entrances and high volume intersections	Future
	Monitor CCTV cameras, system detection, and state patrol CAD feeds for incidents	Existing
	Verify incidents reported from the field and via system detection using CCTV cameras and direct communication with incident responders and partner agency field crews	Existing
	Operate ITS devices as needed to alert travelers and control traffic (DMS, traffic signal timing)	Existing
	Design/construct/operate/maintain RWIS sensors	Existing
	Access and utilize RWIS and weather data sources to forecast severe winter conditions and prepare maintenance resources and response	Existing
	Disseminate road weather hazard information, travel restrictions and chain-up requirements via traveler information resources	Future
	Dispatch maintenance crews and other state resources to incident sites as needed	Existing
	Implement alternate routes for major incidents	Existing
	Develop coordinated traffic signal timing plans for incident operations	Existing/Future
	Publish traveler information alerts and incident mapping via statewide traveler information systems (such as 511)	Existing
	Coordinate with emergency responders	Existing
	Implement preset traffic signal timing plans based on pre-determined criteria from Caltrans and NDOT for weather related and recreational travel conditions	Existing/Future
	Design/construct/maintain/operate surveillance and traffic control equipment on state freeways, highways, and arterial roadways	Existing
	Share real-time traffic information and device control (as applicable) with partner agencies	Future
	Contribute to regional and interstate traffic control planning, including device upgrade and expansion	Existing/Future
	Expand vehicle location tracking systems to all winter maintenance vehicles to support weather operations decision-making (NDOT only)	Future
	Design/construct/operate/maintain automated roadway systems for inclement weather, including automated roadway closures, variable speed limits, and chain-up signs	Future
TART/TTD	Coordinate with regional partners to receive information on severe weather conditions	Future
	Disseminate service changes and cancellations due to weather via traveler information systems	Existing/Future
	Coordinate with Caltrans for potential implementation of transit signal priority that would be usable for both transit and plow vehicles	Future
TRPA/TMPO	Lead regionalization of snow plow activity map	Future
	Coordinate with Caltrans/NDOT for dissemination of alerts and restrictions due to weather	Future
Media and Third-party ISPs	Disseminate transportation weather alerts, closures, and transit service changes provided by regional partners	Future

Traffic Management & Safety



Transit Accessibility & Services

Within the Tahoe Basin, a unique variety of public and private transit options exist to move people to and from the major points of interests and activity centers. As public transit options, the Tahoe Area Regional Transit (TART - Placer County), the Town of Truckee, and the Tahoe Transportation District each provide transportation services across the region, including fixed-route and demand responsive services (i.e. Night Rider, East Shore Express). In the recent years, TART has progressively implemented new ITS enhancement to provide their travelers with real-time arrival information, on-line trip planning, and display kiosks at the major transit center in Tahoe City. These technologies are designed to improve the quality, efficiency, and safety of service that each transit agency provides to its riders.

In addition to the public transit options, many of the resorts in the Basin offer demand-responsive shuttle services to supplement the connections provided by public transit. While there currently isn't an established operational protocol between the public and private transit options, improved data sharing and coordination could help to provide enhanced transit connections in the area to service the activity centers better.

Vision

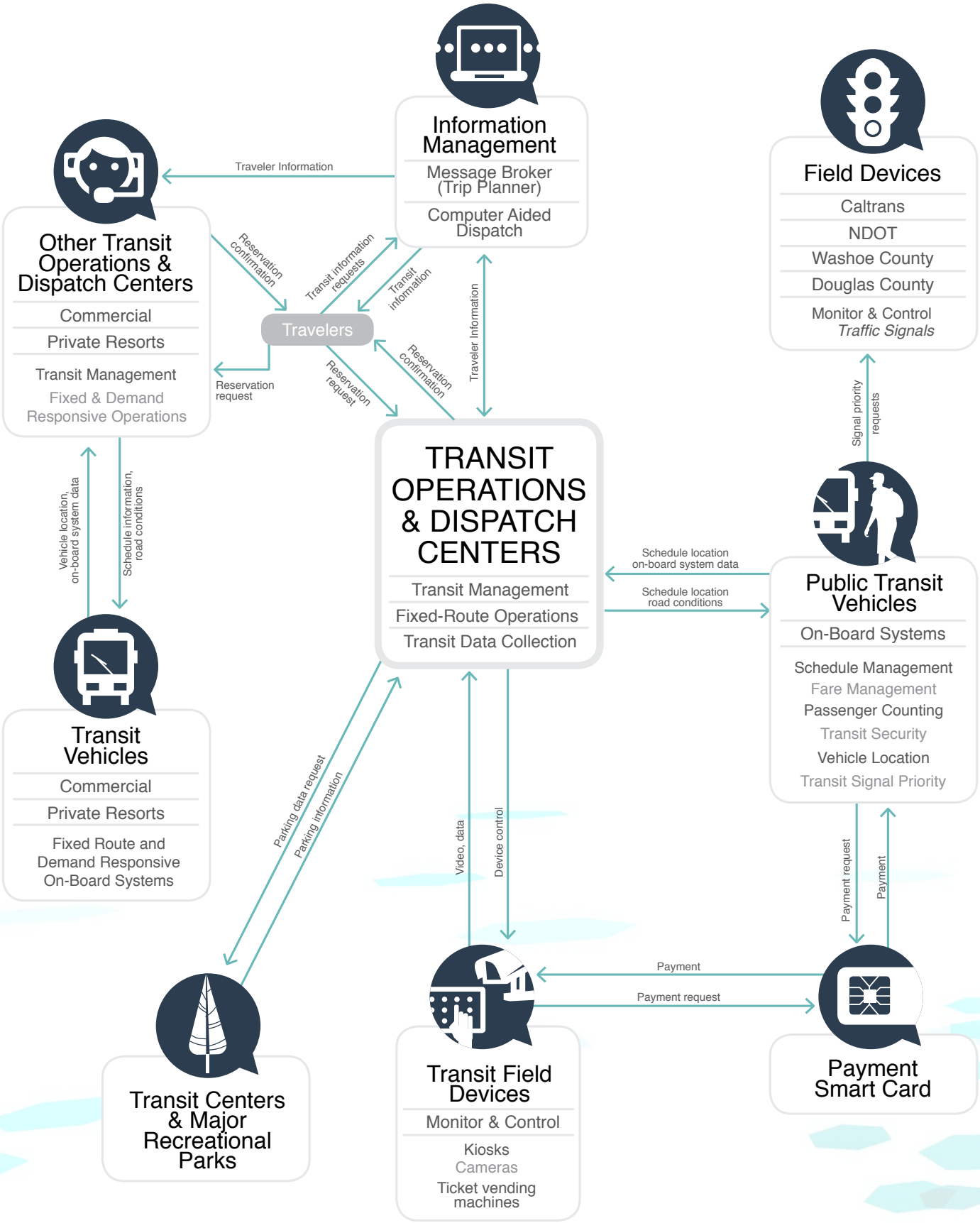
The vision for the transit accessibility and services functional area is to provide safe, convenient, and accessible transit services to the region in a unified transit system that promotes increased ridership Basin-wide. Goals that support this vision with respect to ITS include:

- Actively manage and respond to transportation system conditions and passenger demand to maintain transit travel time reliability.
- Support the traveler information service area with information regarding real-time bus arrivals, route options, stop announcements, fares, and multi-modal trip planning (including the cross lake ferry).
- Standardize transit ITS in the region to promote deployment of common systems and payment systems (i.e. smart card fare payment).

Stakeholder Roles and Responsibilities

Agency	Roles & Responsibilities	Status
TART/TTD	Own, operate, and maintain public transit system and field devices	Existing/Future
	Coordinate with TRPA/TMPO to mitigate impacts of traffic events and construction on transit operations (e.g. winter conditions, special events, construction, accidents)	Future
	Maintain and expand electronic payment options	Existing/Future
	Lead implementation of Basin wide accepted smart card payment media	Future
	Expand transit pass partnerships with employers, government agencies, and resorts	Future
	Expand AVL/CAD system throughout the Basin (including Truckee and South Shore)	Future
	Deploy information kiosks at major transit centers	Existing/Future
	Unify all transit agency under one brand	Future
	Support the expansion of cellular coverage for agency-level operations and performance measurement (especially in the South Shore)	Future
	Support the expansion of cellular coverage for agency-level operations and performance measurement (especially in the South Shore)	Future
Caltrans/NDOT	Coordinate for potential TSP implementation along signalized corridor routes	Future
	Share video surveillance cameras for transit operations support	Existing/Future

Transit Accessibility and Service



Maintenance Activities

Caltrans and NDOT are the primary agencies responsible for roadway maintenance in the Tahoe Basin. Roadway maintenance is especially important in the winter months as maintenance crews are responsible for keeping the roads clear for the large amount of traffic accessing the region's activity centers. Prior to the winter season, Caltrans and NDOT host an annual joint snow maintenance meeting where roles and responsibilities are identified to mitigate impacts of heavy snow fall. The Basin region's RWIS information helps maintenance personnel make environmentally conscious decisions to optimize the level of applied sand and salt. Recent enhancements to the regional maintenance capabilities include new in-vehicle road sensors and on-board communications on a select number of NDOT maintenance vehicles to relay roadway condition information back to their maintenance facility.

In addition to winter roadway maintenance, individual maintenance and construction events typically involve traffic mitigation planning through pre-construction meetings with coordination between the state agencies, first responders, and construction crews. Traffic control and maintenance of traffic strategies as well as law enforcement support are discussed. The application of new Smart Work zones in the Basin has also helped to improve safety for construction zones, while better informing motorists of upcoming hazards.

Vision

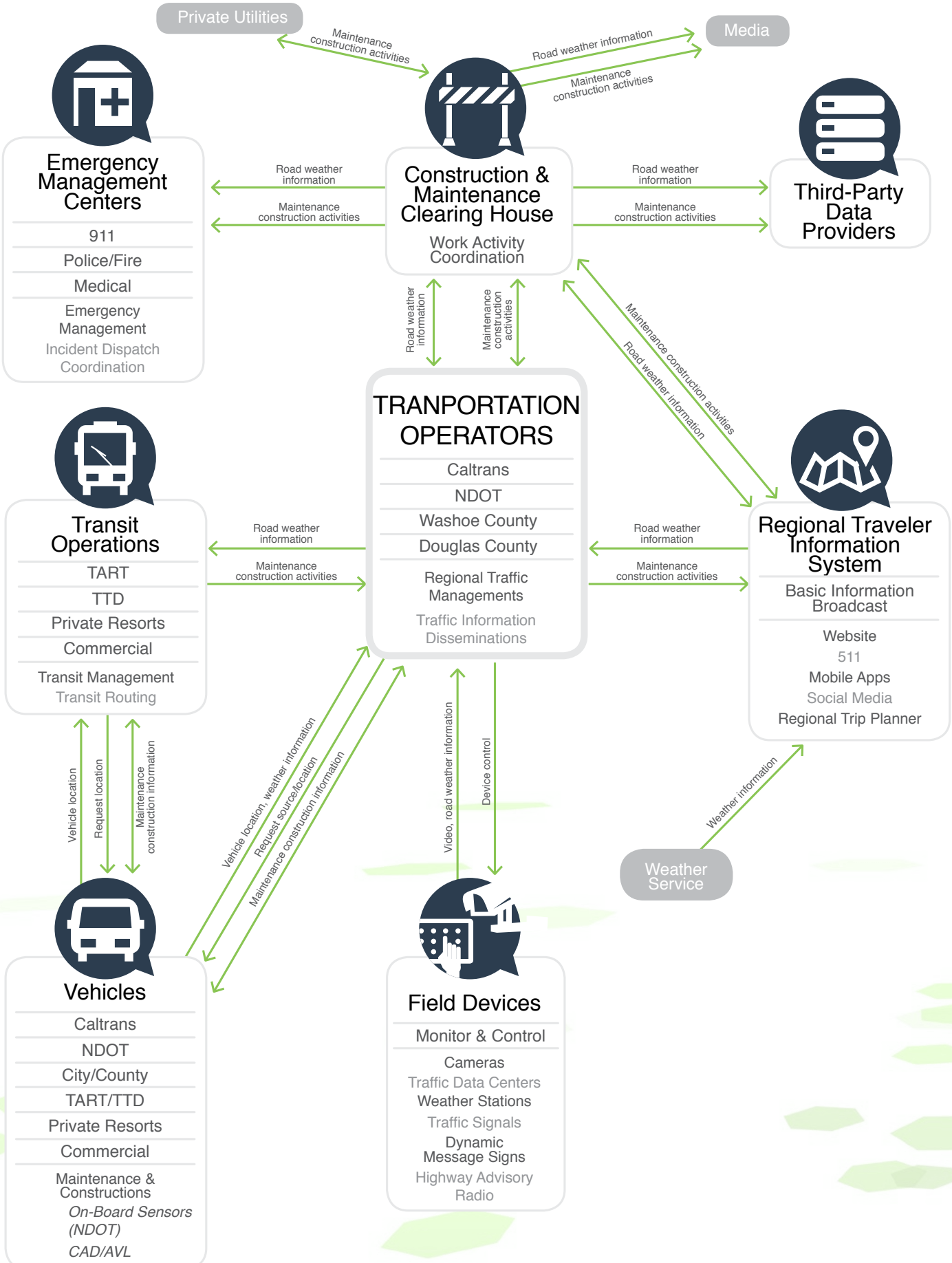
The vision for the maintenance activities functional area is to coordinate maintenance and construction activities, especially during the winter season, to enhance operational efficiency, improve safety, and inform the public of potential travel impacts. Goals that support this vision with respect to ITS include:

- Provide mobility by maintaining major state routes in and out of the Basin including I-80 and US 50.
- Improve coordination between states, counties, and cities maintenance and construction activities, support emergency and public transportation vehicle routing, and provide data to traveler information systems.
- Inform travelers of anticipated travel times through work zones and during high-volume seasonal periods.
- Promote signal timing updates and traffic control strategies to better prepare for winter weather traffic mitigation (chain-up information, snow plows, tow trucks, highway patrol support).
- Maintain and expand public and private partnerships to support coordinated cross-jurisdictional traffic control and event response especially during winter months with heavy snowfall.

Stakeholder Roles and Responsibilities

Agency	Roles & Responsibilities	Status
Caltrans/NDOT	Serve as regional hub for coordination of maintenance and construction activities	Existing
	Coordinate maintenance and construction activities with regional partners and TTD; ensure closures and detours are communicated in advance to transit agencies and emergency responders	Future
	Manage work zones using cameras, dynamic message signs, highway advisory radio, and variable speed limits. Provide travelers with delay and detour pre-trip and enroute information	Existing/Future
	Monitor travel times through work zones and provide travel time information to the public.	Future
	Develop an electronic work zone database for regional usage and sharing	Future
	Standardize smart work zone requirements	Existing/Future
Cities/Counties	Coordinate snow plow maintenance activities with Caltrans/NDOT and private companies	Future
	Participate in planning and deploying a regional work zone database	Future
TART/TTD	Coordinate with regional partners to receive advance notification of road closures and detours.	Future
Emergency Responders	Coordinate with regional partners to receive advance notification of road closures and detours	Future
	Deploy a unified Basin-wide radio communication network	Future

Maintenance Activities



System Integration & Coordination

The system integration & management functional area encompasses traffic management centers, the communication infrastructure supporting ITS deployments, and the data produced and shared from these deployments. Both California and Nevada operate their own traffic management centers which are capable of communicating between ITS installations within the Basin such as CCTV, dynamic message signs, RWIS, and traffic signal controllers. Each traffic management center acts as a hub where data is stored and shared. Recently, Caltrans and NDOT have both introduced data management systems that allow third-party interface to their data. With the growth in mobile application and handheld device use, this shared access will further promote traffic application development as well as create opportunities for agencies to leverage the use of probe-based data.

To maximize system reliability and resiliency, ITS deployments also rely upon a secure and dedicated communications network between field devices and control centers. Communication has been deployed in many different mediums around the Basin. While hardwired communication is ideal, it exists in only a few locations within California, a majority of ITS deployments in the Basin rely on radio and cellular communication. The Tahoe Prosperity Center has identified the Basin's overall communication network to have numerous dark spots as a result of gaps in cellular coverage. A strategic and coordinated build-out of communication infrastructure will be crucial for the success of ITS deployments in the Basin.

Vision

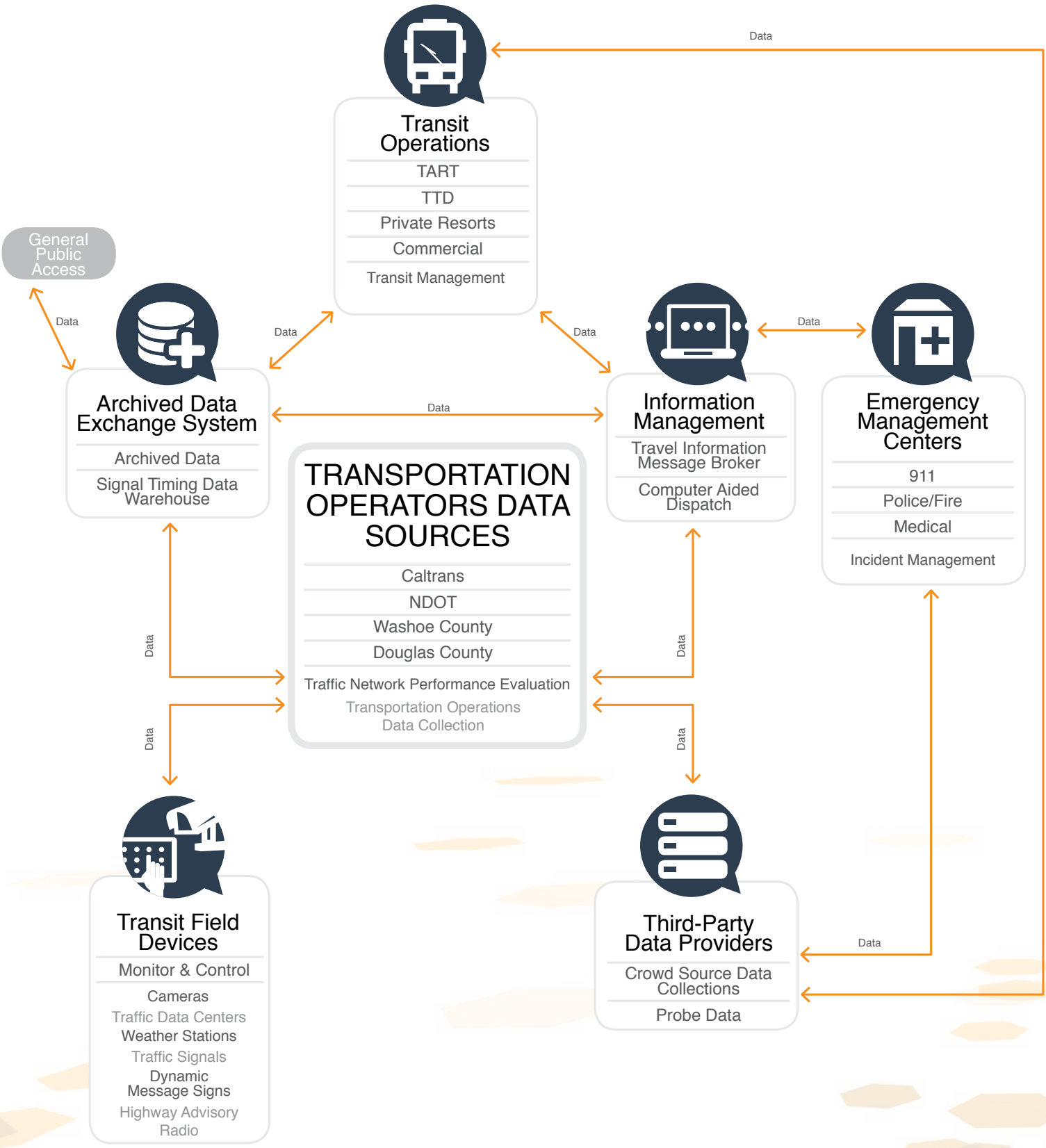
The vision for the system integration & coordination functional area is to actively coordinate and support the transportation network across jurisdictional boundaries in order to reduce congestion and maximize safety. This can be accomplished by expanding and maintaining a secure, cost-effective regional communication network and archived data management system to promote data sharing amongst agencies to improve operations, maintenance, and overall transportation system performance. Goals that support this vision with respect to ITS include:

- Develop a single integrated data warehousing platform to share information related to all modes of traffic with respect to traffic management, incident management, road weather operations, and maintenance and construction operations to support efficient and safe travel and information dissemination.
- Develop analytical planning tools for data validation, performance measurement, operational evaluation, asset management, regional planning activities, and financial decision making. Automate these tools as much as possible.
- Increase data sharing between state traffic management centers, local agencies, and third-party developers
- Expand existing communication system coverage and develop formal agreements for responsibilities, service level agreements, and funding for sharing fiber optic, DSL, and wireless communications and associated infrastructure.
- Include provisions to install communication infrastructure with roadway capital improvement projects.

Stakeholder Roles and Responsibilities

Agency	Roles & Responsibilities	Status
ITS Coordinator (TTD)	Improve, ongoing interagency communications and coordination for all ITS planning and implementation in the Tahoe region	Future
	Research and secure project funding	Future
	Lead/assist and solicit input from the regional ITS Coordinating Committee	Future
	Support multi-agency interoperability and facilitate the development of inter-agency agreements	Future
	Lead/coordinate project implementation	Future
	Support updates to the Tahoe ITS Strategic Plan	Future
Caltrans/NDOT	Serve as operational hub for new traffic control devices to be installed in the Basin	Future
	Serve as the operational hub for managing the region's response to severe weather events	Existing
	Serve as the operational hub for road/weather operations systems such as snow plow tracking, variable speed limits, automated roadway closures and chain-up requirements	Existing/Future
	Serve as the operational hub for detecting, and coordinating a response to, planned and unplanned incidents throughout the region	Existing
	Maintain existing backhaul communications (center to field device)	Existing
	Expand connectivity for ITS devices (i.e. traffic signal controllers)	Future
	Expand wireless communications to enhance communication coverage	Future
	Develop partnerships with cellular providers to identify cellular coverage gaps	Existing/Future
	Provide interface to local emergency responders (police/fire/ambulances)	Existing
	Serve as regional hub for ITS data storage and management	Existing
	Collect and archive data from regional data sources	Existing
	Identify opportunities for integration with other regional/state data warehouses	Future
	Design/construct/operate/maintain field equipment that supports automated data collection	Existing/Future
	Increase accessibility and usability of data marts	Future
TART/TTD	Support expansion of additional cellular towers to support transit data acquisition	Future
	Provide transit data to regional warehouse	Future
TRPA/TMPO	Work with regional partners to identify performance measures for the transportation system	Future
Emergency Responders	Deploy a unified Basin wide radio communication network	Future

System Integration & Coordination



Using the Architecture

The Architecture provides a blueprint for deployment of all the selected ITS services in the Tahoe Basin and should be both referenced at the onset of an ITS project design and development. Its primary value is to serve as a guide that reduces redundancy and helps implementers create synergy between existing and planned ITS.

As ITS projects evolve through the planning, design and operational phases, the Architecture should be consulted to identify the Agency connections and data flows involved. The Architecture defines all of the subsystems, Service Packages, and data flows that make up the short-, medium-, and long-term projects in this plan. Project participants should focus on their respective project roles and responsibilities and collaborate with partnering stakeholders to ensure conformance to with regional goals. The following bullets summarize the Architecture's use during various stages of a typical ITS project lifecycle.

ARCHITECTURE STAGES:

DURING PLANNING

The ITS Architecture allows stakeholders to organize and arrange data to identify the most effective means of achieving the project objectives through ITS and comply with applicable standards.

DURING DEVELOPMENT

Provides deployment guidance with respect to the established and agreed upon ITS functions and deployment standards to ensure system interoperability.

DURING INTEGRATION

Identifies the interaction and compatibility requirements between new and legacy systems and how the legacy systems can be modified to conform to the regional ITS architecture to support unified operations.

Relationship to Other ITS Architectures

As previously stated, the Tahoe Basin Regional ITS Architecture is consistent with the National ITS Architecture.

However, there are several other Regional ITS Architectures and ITS activities that the Tahoe Basin should coordinate with as ITS technologies are deployed. These include:

- California Statewide
- Statewide Nevada ITS Architecture (updated 2013)
- Sacramento Regional ITS Architecture (updated 2005)
- Tahoe Gateway Counties Regional ITS Architecture (May 2002)
- San Francisco Bay Area Regional ITS Architecture (updated 2011)
- Sierra Nevada Region
- San Joaquin Valley Regional ITS Architecture (September 2001)
- Fresno County Regional ITS Architecture (2014/2015 update)
- I-80/US 395 Corridor
- California/Oregon Advanced Transportation Systems (COATS) Region
- FEMA/OES architectural requirements

By coordinating with these activities and architectures as ITS is planned and designed, the region can identify potential opportunities for integration and data exchange. Additionally, with an awareness of other key architectures, critical information flows can be designed to insure that uniform, accurate information is available across jurisdictional boundaries. For these reasons, it is recommended that the Tahoe Basin exchange the current version of their Regional ITS Architecture with these areas, and work with outside Agencies to ensure consistent and effective coordination.

As the Tahoe Basin and the neighboring areas continue to move forward with ITS implementation, further development toward direct integration of the respective architectures will need to occur. This is necessary to accomplish effective information sharing in a connective data exchange network.

The most prominent features of such a network include a central data repository, established center-to-center data protocols, agreed communications standards, and a degree of commonality regarding operational concepts.

IT IS IMPORTANT TO REMEMBER THAT THE REASON FOR THIS ARCHITECTURE INTEGRATION IS TO EXCHANGE DATA AMONG PARALLEL INFORMATION CENTERS WHILE NOT RELINQUISHING CONTROL OF SYSTEMS OR CENTERS.

The practical approach to architecture integration can be accomplished through further refinement of the regional architecture during maintenance operations. The architecture development software, Turbo Architecture, is equipped with the capability to link regional architectures. This link would be shown in the physical architecture most prominently via information flows between the respective Traffic Management and Archive Data Management subsystems.

chapter 6

Deployment Considerations

Project Considerations

The implementation of the projects identified in this Strategic Plan will be carried out by a broad spectrum of agencies and private interest groups. To facilitate the efficient and effective implementation of ITS in the region, the following factors must be considered during both the design and deployment of these projects:

1 Interoperability

Most ITS applications will need to accommodate communication linkages to other systems and coordination between different agencies. Related to this, a goal of the federal ITS program is to ensure that mobile users can travel across the Region and the Nation and retain the same level of ITS services. There are three types (levels) of ITS interoperability that the Tahoe Basin ITS Program needs to be concerned with:

Technical

The capability for equipment (hardware and software) to communicate effectively (i.e., send and receive information)

Procedural

Common procedures to exchange meaningful information

Institutional

Administrative and/or contractual agreements between operators and users of the information.

The regional architecture and ITS standards provide a framework for achieving technical interoperability. Close coordination and cooperation between various agencies will be required to ensure procedural and institutional interoperability. This may be achieved, in part, through the on-going activity of an ITS Coordinating Committee for the region, and the development of inter-agency agreements.

2 Project Conformance

FHWA's Final Rule (Federal Register, January 8, 2001) and FTA's National ITS Architecture Consistency Policy for Transit Projects (April 8, 2001) require that Federally-funded ITS Projects conform to the National ITS Architecture and approved standards. At a regional level, conformance with the National ITS Architecture is accomplished through the development of a Regional ITS Architecture.

During project implementation, the following results are expected from a project conformance analysis:

System Engineering Analysis

A system engineering analysis must be done for development of individual projects conducted on the same scale as the project scope. The analysis shall include:

- Identification of portions of the regional ITS architecture being implemented
- Identification of participating agency roles and responsibilities
- Requirements definitions
- Analysis of alternative configurations and technology options
- Procurement options
- Identification of applicable standards
- Procedures and resources for operations and management

Project Specifications

The project specifications shall ensure that the project accommodates the interface requirements and information exchanges, and provides for the functionality and operations (both at the time of project implementation and in the future) between the agencies and jurisdictions as indicated in the Strategic Plan and Regional ITS Architecture. If a project is inconsistent with the regional architecture, the architecture itself should be updated accordingly.

ITS Standards

The project should use applicable ITS standards that have been published by the Standard Development Organizations.

3 Standards

Federal regulations state that all ITS projects using federal funds should use applicable ITS standards that have been published by the Standard Development Organizations. The goal of this regulation is to ensure that ITS applications achieve the interoperability necessary to function consistently and effectively nationwide. ITS standards are specifications that define how system components interconnect and interact with each other and within the overall framework of the regional ITS Architecture.

ITS standards guide the implementation of ITS systems to cost-effectively exchange pertinent data and accommodate equipment replacements, system upgrades, and system expansions.

THE TRAVELING PUBLIC CAN BENEFIT FROM ITS STANDARDS THROUGH PRODUCTS THAT WILL FUNCTION CONSISTENTLY AND RELIABLY ANYWHERE IN THE COUNTRY.

The U.S. DOT Standards Program provides a searchable database of standards

www.standards.its.dot.gov/StdsSummary

and a free 35-module ITS standards training course to evaluate, procure, and implement standard-based ITS devices and equipment

www.pcb.its.dot.gov/stds_training.aspx

At a regional architecture level, the Tahoe Basin's Turbo Architecture tool includes the capability to identify the relevant ITS standard activities associated with each architecture flow. This is a starting point for defining the specific standards that may be used for individual ITS projects and interfaces within the Tahoe Basin.

4 Inter-Agency Agreements

Most of the ITS deployments in this Plan call for cooperative deployment and operations efforts between multiple jurisdictions. These types of deployments most often require some sort of inter- agency agreement such as a bi-lateral letter of agreement or a Memorandum of Understanding (MOU). Regardless of the specific institutional tool decided upon by agencies, the agreement should attempt to achieve the following purposes:

Establish roles and responsibilities for the smooth operation and maintenance of system components that affect management of regional traffic and traveler information on a day-to-day basis.

Develop operational guidelines to regional agencies such that they follow consistent and common methods of operations, which benefit both motorists and the system operators.

Standardize operating procedures and strategies for various components of the system. These operating procedures can include:

- Type of information to be shared (type and content) between agencies,
- Resources to be shared between agencies and how, where, and to whom the information from the system can be distributed, and
- How operating costs for the system will be distributed

Establish contact personnel

during and after hours of business to manage emergency situations.

5 Funding Opportunities

The successful implementation of the Tahoe Basin ITS Strategic Plan will depend upon the availability of funding. Funding can be from private enterprise, public/private partnerships, or other arrangements such as special congressional ITS earmarks. However, it is more likely that funding for ITS projects will come from traditional transportation funding programs. As such, the ITS projects identified in the Strategic Plan will have to compete with other transportation projects for the same funding.

Obtaining adequate funding for the Strategic Plan elements in the Tahoe Basin will depend on the plan elements achieving a high enough priority in the regional planning and programming process. It will be the responsibility of the Tahoe Basin stakeholders to seek funding and make ITS implementation a priority in regional funding decisions. Stakeholders should also take into consideration the operation and maintenance costs associated with these systems.

A summary of the potentially applicable funding programs for the Tahoe Basin is provided in a series of tables. The summary tables highlight some of the funding programs available and indicate the purpose, criteria, and distribution of funds for each program.

Note: The Federal Transportation Act is the Moving Ahead for Progress in the 21st Century (MAP-21) act expired on September 20th, 2014. The new federal transportation act superseding MAP-21 may result in changes to the programs identified in this document. Once the new act is developed, a re-assessment should be undertaken to identify these changes and how they may affect the availability of funding for ITS projects.

Federal Funding Sources

FEDERAL AID SYSTEMS – NATIONAL HIGHWAY SYSTEM (NHS)

Purpose
Provides funding for improvements to rural and urban roads that are part of the National Highway System (NHS).

Criteria
The improvements must be for facilities that are part of the designated National Highway System, but can include transit as well as highway improvements and can include ITS improvements. US 50 is part of the NHS network.

Fund Distribution
Money for all state NHS programs is allocated to each state by the federal government on a formula basis. The state then distributes the money through the STIP.

SURFACE TRANSPORTATION PROGRAM (STP)

Purpose
Provides funds to improve transportation facilities based on regional priorities.

Criteria
Projects are considered eligible if on federally functional roads classified above minor rural collectors. All modes of transportation eligible. The final criteria used in the application process are established by the MPOs and RTPOs.

Fund Distribution
Money for all state STP programs is allocated to each state by the federal government on a formula basis. The state then distributes the money to the MPOs and RTPOs.

CONGESTION MANAGEMENT AND AIR QUALITY (CMAQ)

Purpose
Fund transportation projects and programs that will contribute to attainment of National Ambient Air Quality Standards (NAAQS). Projects must be included in a conforming transportation plan and TIP and conform to the requirements of the Clean Air Act.

Criteria
Eligible projects include: Transportation control measures, management systems, activities that are innovative and based on promising technologies which will improve air quality, traffic monitoring, management and control, emission inspection systems, public transit projects, and project planning if leading directly to construction.

Fund Distribution
After the state receives their portion of the grant money from the federal government, it is distributed to the MPOs. The MPOs are then responsible for soliciting applications to receive CMAQ funds. In Nevada, NDOT administers the program statewide.

FEDERAL LANDS

Purpose
Provides funding for transportation in or to national parks, national forests and other public lands.

Criteria
Eligible projects include planning, design, construction, or reconstruction of the following: Roads, pedestrian and bicycle facilities, transit facilities into or within federal lands.

Fund Distribution
Distributed by Federal Highway Administration based on demonstrated need.

TRANSPORTATION ENHANCEMENT ACTIVITIES

Purpose
Provides funding for projects designed to enhance the compatibility of transportation facilities and services with their surrounding environment.

Criteria
Projects can include any that strengthen the cultural, aesthetic, or environmental aspects of the surface transportation system.

Fund Distribution
The MPOs are responsible for soliciting applications to receive TEA funds. In Nevada, the TEA funds are distributed statewide on a discretionary basis.

Federal Funding Sources (continued)

NATIONAL RECREATIONAL TRAILS

Purpose
Provides funding for projects to maintain, restore or develop recreational trails.

Criteria
Eligible projects include: Transportation control measures, management systems, activities that are innovative and based on promising technologies which will improve air quality, traffic monitoring, management and control, emission inspection systems, public transit projects, and project planning if leading directly to construction.

Fund Distribution
Funds are distributed nationally on a discretionary basis by FHWA.

TRANSPORTATION INFRASTRUCTURE FINANCE INNOVATION ACT

Purpose
Provide credit assistance on flexible terms directly to public-private sponsors of major surface transportation projects to assist them in gaining access to the capital markets.

Criteria
Any project that is eligible for STP funding can receive assistance from this program. ITS projects must cost a minimum of $30 million and be supported by user charges or other dedicated revenue streams. Federal credit cannot exceed 33%.

Fund Distribution
Funds are distributed by the US Department of Transportation.

FEDERAL TRANSIT ACT SECTION 5309 TRANSIT CAPITAL IMPROVEMENTS

Purpose
Provides funding for land acquisition, vehicle and equipment acquisition, and for transit facility construction.

Criteria
Funding must be for purchase of transit vehicles or transit facilities.

Fund Distribution
Funds are distributed nationally on a discretionary basis by FTA.

FEDERAL TRANSIT ACT SECTION 5310 SPECIAL TRANSIT NEEDS

Purpose
Provides funding to non-profit organizations and public agencies to purchase vans, buses and other equipment to serve individuals with special needs.

Criteria
Funding must be for purchase of paratransit vehicles and related equipment used in the provision of transit services to populations with special transit service needs.

Fund Distribution
Funds are distributed nationally on a discretionary basis by FTA.

FEDERAL TRANSIT ACT SECTION 5311 SMALL URBAN AND RURAL TRANSIT ASSISTANCE

Purpose
Provides capital and operating assistance for transit services in non-urbanized areas.

Criteria
Funding must be for purchase of buses and related equipment for the provision of transit services in rural areas.

Fund Distribution
FTA allocates funds to states on a formula basis. Caltrans determines Tahoe Basin funding for the California side.

State Funding Sources

FEDERAL TRANSIT ACT SECTION 5310 SPECIAL TRANSIT NEEDS

Purpose
Regional Transportation Improvement Program (CA)

Criteria
Provide funds for transportation infrastructure in regions.

Fund Distribution
Funds can be used for any surface transportation project but cannot be used for operations.

INTERREGIONAL TRANSPORTATION IMPROVEMENT PROGRAM (CA)

Purpose
Provide funds for transportation infrastructure that provides transportation between regions.

Criteria
Funds can be used for interregional roadway or rail programs.

Fund Distribution
Funds are distributed within California by Caltrans on a discretionary basis.

STATE TRANSIT ASSISTANCE (CA)

Purpose
Provide funds for transit capital and operating assistance.

Criteria
Funds can be used for transit and paratransit capital, operations, or regional transit coordination.

Fund Distribution
Funds are distributed to counties in California.

STATE HIGHWAY OPERATIONS AND PROTECTION PROGRAM (CA)

Purpose
Provides funds for the operation and rehabilitation of the state highway system.

Criteria
Projects must be on the state highway system and must relate to the enhancement of safety or the preservation of the roadway.

Fund Distribution
Funds used directly by Caltrans.

CALIFORNIA PARK BOND ACT

Purpose
Provides for the creation, preservation and maintenance of parklands.

Criteria
Funds can be used be used for acquisition, protection, development and rehabilitation of park properties on the California side of lake Tahoe. This can include the development and maintenance of bicycle trails.

Fund Distribution
The California Tahoe Conservancy distributes funds available to the Tahoe Basin.

State Funding Sources (continued)

NATIONAL RECREATIONAL TRAILS

Purpose

Petroleum Violation Escrow Account (CA).

Criteria

Projects must be able to reduce fuel consumption or provide restitution to the public impacted by oil price overcharges.

Fund Distribution

The California Legislature determines the manner in which the funds are allocated to regions and to specific projects.

NEVADA TAHOE BOND ACT

Purpose

Provides funding for erosion control projects and the restoration of natural watercourses in the Tahoe Basin.

Criteria

Projects must be directly related to erosion control or the restoration of watercourses.

Fund Distribution

Funds are distributed statewide on a discretionary basis.

Local Funding Sources

LOCAL GENERAL FUNDS

Purpose

Provide local transportation infrastructure and services.

Criteria

Not restricted.

Fund Distribution

Funds use Funds distributed by the local political jurisdictions. Directly by Caltrans.

LOCAL TRANSPORTATION FUND

Purpose

Provide local transportation infrastructure and services.

Criteria

Not restricted. Available only in California.

Fund Distribution

Funds distributed by the local political jurisdictions.

TAHOE-DOUGLAS TRANSPORTATION DISTRICT REVENUES

Purpose

Provide funds for local transportation projects within Douglas County's jurisdiction in South Lake Tahoe.

Criteria

Not restricted but most of the funding goes for bus operations and marketing.

Fund Distribution

The Douglas Transportation District determines the distribution of funds.

Local Funding Sources (continued)

TRANSIENT OCCUPANCY TAX

Purpose
Provide funds for projects that promote and accommodate tourism and recreational travel to the region.

Criteria
Project must be related to addressing the needs and impacts of tourism and recreational travel.

Fund Distribution
Funds are distributed to the jurisdictions where they are collected. Each jurisdiction is able to determine how their funds are to be used.

TRPA RENTAL CAR MITIGATION FUND

Purpose
Provide funds for transportation projects that mitigate the impacts of automobile travel within the Tahoe Region.

Criteria
Projects must be related to the reduction of automobile travel or to congestion reduction.

Fund Distribution
Funds are polled regionally and allocated to projects by the Tahoe Transportation District.

TRPA AIR QUALITY MITIGATION FUND

Purpose
Provide funds for transportation projects that mitigate the air quality impacts of automobile travel within the Tahoe Basin.

Criteria
Projects must have a demonstrated capability to reduce pollutant emissions.

Fund Distribution
Funds go to the jurisdiction where the mitigation fee is collected. TMPO/TRPA assesses the eligibility of projects but the jurisdictions make final allocations of funds among the eligible projects.

PRIVATE/PUBLIC PARTNERSHIPS

Purpose
To involve private business and organizations in the funding or operation of transportation projects.

Criteria
Not restricted.

Fund Distribution
Private/Public Partnerships can be structured in many different ways and the distribution of funds can be determined by the way the partnership is structured.

Source: DKS Associates

Procurement

The traditional procurement and contract procedures used by agencies vary and may not always be well suited to the unique characteristics of ITS projects.

ITS projects generally require extensive inter-agency cooperation, private sector personnel may need to be hired to support public facilities, public/private partnership agreements need to be determined, and privacy issues need to be resolved.

ITS projects also involve the acquisition and placement of high-tech equipment that may require special procurement considerations. Therefore certain aspects of traditional procurement and contract procedures of the public agencies may have to be changed to accommodate ITS projects. Many ITS projects will have their own unique characteristics that will need to be addressed. This section identifies some of the options and issues relative to procurement and contracting procedures of ITS projects and services.

The implementation of ITS projects will require the system components of each project to be designed, developed/ manufactured and installed. Unless the implementation phase is correctly planned and managed, long delays may occur in implementation.

Procurement options

The first two methods are traditionally used by public agencies. The latter three methods may require education of agencies for utilization of these techniques for implementing ITS projects. Each method is discussed in greater detail on the following pages.

Engineer (Consultant)/Contractor Approach

The Engineer (Consultant)/Contractor method represents the traditional procedure used by public agencies. Based on project requirements and preliminary studies, the Engineer (Consultant) prepares the final study and/or design plans, specifications and estimates (PS&E) for the proposed project. An agency employee or a consultant can act as the Engineer. The completed PS&E are then presented to the Contractor community and receive bids in accordance with established procedures. The Contractor bids on the PS&E and agrees to provide a complete system consisting of hardware and software procured, installed and implemented by the Contractor.

Hardware may be manufactured by the Contractor's organization and/ or subcontracted within the conditions imposed by the contract. The Contractor may also be responsible for system startup assistance. In the case of traffic control systems, the calibration of the system and the development and implementation of timing plans and other database elements may be required. The Engineer (Consultant) is responsible for inspecting and acceptance of project components and the entire system.

Systems Manager

The Systems Manager option requires the pubic agency to select a single firm or consulting team as Systems Manager. The Systems Manager is responsible for system design, PS&E preparation, systems integration, documentation and training. The project is divided into several sub-projects and each sub-project is contracted by using the agency's normal bidding processes. The Systems Manager oversees all work by the various contractors. The sub-project contractors can be selected on the basis of specific sets of skills required for each sub-project. This permits the selection of experts for various steps of the system. The Systems Manager is responsible for integrating the sub-projects into an overall operating system. The contract between an agency and the Systems Manager is typically a negotiated contract that allows contract flexibility when projects are refined.
This procurement method assigns responsibility of total system success to one entity and creates an environment to more easily meet project requirements.

Sole Source Approach

This form of procurement is used when there is documented existence of one technical or cost effective solution to the requirements of a certain project. Sole Source procurement is most often used when compatibility with existing equipment and/or systems is required. In the early stages of establishing components of an ITS system, Sole Source procurement should not be necessary. During the later stages of development, Sole Source procurement may need to be employed to ensure system-wide compatibility in certain circumstances.

Design/Build (Operate) Approach

The Design/Build approach requires the selection of a single responsible entity to perform all work associated with the deployment of the system and its components. The selected entity may also be responsible for ongoing operation of the system. The public agencies are responsible for monitoring the activity of the Design/Builder. The Design/Builder performs all design work, contracts and/or constructs the system elements and systems and turns over the operating system to the public agency. In some instances the Design/Builder will operate the system with oversight and monitoring maintained by the public agency.

For the public agency, the advantage of this option may be that it saves time and money, and reduces agency risk. However, a potential limitation of this approach is that the public agency may lose some control over the design of the project. The agency's sole role is reduced to oversight and monitoring of the Design/Builder and does not involve any of the design details that may impact the operational needs of the agency.

Private/Public Approach

The Private/Public approach is a newer procurement system that establishes a Public/Private partnership for financing and implementation of a project. Each project proposed as a Public/Private partnership would need to be investigated individually to determine that there are not issues such as conflict of interest, unfair advantage given to one competitor over another, etc. Many projects may appear to be good candidates for Public/Private partnership, but may be eliminated due to local, state and federal laws. Creativity and close study of regulations will be needed to insure Public/Private partnerships are viable projects that have benefits for all involved parties.

Operations and Maintenance

Successful ITS applications depend to a great extent on the approach taken to provide day-to-day operation of the systems. Operations can consist of activities ranging from deployment of portable devices to supervision of a traffic management center. These activities are often labor intensive raising staffing issues that will need to be addressed during implementation. Maintenance of ITS infrastructure typically entails systems calibration, software and hardware updates, reestablishing lost communications, and repair of damaged equipment.

Costs associated with these tasks can be as varied as the operations themselves and the technologies in question. In some cases, operations and maintenance costs associated with ITS can be high in comparison with more traditional transportation infrastructure, however, when viewed in light of the benefit provided, they can actually represent on going savings in other areas. Efforts are being made at the national level to account for this with the development of a new user service aimed specifically at operations and maintenance.

Project sponsors must have a plan for and devote resources to operations and maintenance. They cannot take a "set it and forget it" approach. They must think through not only how they will get a system running, but how they will keep it running, and how they will maximize its potential benefit. Key issues include the availability of staff, the need for special training, the development of operating procedures, and the budgeting of annual funding. However these issues are ultimately addressed, it is important to consider the impact of these requirements during both the planning and implementation phases.