Statewide ITS Architecture Assessment and Support

Summary Report

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Introduction

Preparing for Future Technology in Transportation

Transportation in California and around the country is evolving at a rapid pace. The future of transportation is being influenced by the convergence of numerous technologies, including Connected and Automated Vehicles (CAV), vehicle electrification, shared ride and shared vehicle services, data acquired from vehicles as well as more traditional roadside sensors, and smart phone applications for mobility as well as traveler information. Many of the above initiatives are driven not by public sector investment, but by the private sector.

At the same time, Caltrans has made a significant commitment to enhancing multi-modal transportation systems management and operations (TSMO) activities along with "Connected Corridors" strategies that utilize technology and data analytics to manage traffic flow in major commuter corridors, both along freeways and major local streets, with an emphasis on improving transit operations on these routes.

But have our public agencies planned adequately for a technology-based transportation future? Central to any technology deployment is assuring that all vehicles, users and roadside components can work together in an integrated fashion and exchange data using a common language that is secure and resilient, much as computers, mobile phones and other electronic devices communicate across a combination of Internet, data processing, and wireless services. To accomplish this for public-sector transportation infrastructure, a functional, interagency, and technological framework is required.

Nearly two decades ago, the U.S. Department of Transportation recognized the need for, and mandated the development of, Regional Intelligent Transportation System Architectures (RITSAs). A RITSA can be characterized as broadly defining what transportation operations agencies in a region are doing with technology and what they would like to do, and who would be engaged in providing and benefitting from the related services.

As with many federal mandates, regions across the country have complied with these requirements. But often, RITSAs have not been integrated into regional transportation planning and programming processes. Today, with the mix of public and private sector transportation initiatives and opportunities to leverage various services and data, it is now more beneficial than ever to embrace the concept of a system architecture as a framework for regional transportation operations. Because of the rapid changes occurring, architectures developed a decade or more ago have become increasingly obsolete. As such, a RITSA requires continuous maintenance and updating to reflect not only regional policies but emerging opportunities to improve mobility and safety.

Purpose of this Document

Last year, Caltrans initiated a *Statewide ITS Architecture Assessment and Support* project to assess how statewide and regional ITS architectures have been used in support of both regional transportation planning activities and actual transportation investments. The Project Team identified a number of institutional barriers preventing RITSAs from being used more effectively, ranging from inadequate funding for architecture maintenance and training to fundamental differences in perspective between technology experts and more traditional transportation experts.

This document addresses the outcomes of the study, including the definition of a Business Case for dedicating resources to RITSAs in California, along with planning guidance for ITS activities. These include the integration of RITSA development, updates and maintenance with regional and statewide transportation planning activities. A key component in this is addressing the role of Caltrans districts in working with regional stakeholders to define common interests and projects that will benefit both a region and the State Highway System (SHS).

The Business Case for ITS Architectures

Leveraging Technology to Support Transportation Needs

Regional transportation agencies inherently understand the need to meet Federal requirements for the purposes of obtaining funding support for various investments. But there has been less understanding of how to truly leverage technology opportunities to operate the multi-modal transportation system more effectively. And with support of performance-based transportation management activities essential to justifying Federal and other funding support, projects targeting operational improvements require the ability to manage and monitor operations using real-time data. This is a core element of ITS.

Effectively integrating technology-based transportation systems management and operations (TSMO) into the transportation planning process requires significant inter-agency collaboration and a regional view of the area's multimodal transportation system. Because ITS technologies underpin most TSMO strategies, both technical and institutional coordination of transportation planning among agencies is essential. RITSA development and update activities present a significant opportunity to support planning for operations, and in turn more effective transportation technology deployments. In particular, RITSAs help answer the following important questions:

- What TSMO strategies supported by ITS may be available to help achieve the region's operations objectives?

- What data is available in the region to monitor transportation system performance and track progress toward operations objectives?
- What are the gaps in providing transportation system management and operations across our region?
- How can the region most effectively integrate a new TSMO strategy supported by ITS with other existing or planned technology deployments to provide a greater level of service for the customer?
- How can the region define the resulting TSMO projects or programs in terms of functional requirements, operations concepts, supporting ITS standards, etc.?

In addition, the development of an ITS Strategic Plan or Regional Concept of Transportation Operations (RCTO) enables collaboration between transportation planners and operators in order to fulfill regional operations objectives. The RCTO identifies strategies for implementation of particular programs and projects that in turn can serve as building blocks for the RITSA.

Two Types of Benefits

The Business Case for developing, maintaining and updating ITS Architectures includes the following:

- Cost and time savings to regional and local stakeholders, as well as Caltrans, for definition, development and implementation of transportation technology projects that involve multiple stakeholders, interagency information exchange, and coordination of operational activities along with projects that are oriented to support of regional performance measures.

- Ability to incorporate and utilize new and emerging technologies as part of architecture updates, taking into consideration current and emerging industry communications and functional standards. This is particularly timely with relationship to Connected and Autonomous Vehicles (CAVs), Connected Corridors and other initiatives that will require both statewide and nationwide standards.

Savings in Cost and Time

Cost and time savings to public agencies are possible through developing ITS architectures that accurately reflect existing investments and institutional interfaces, as well as providing subsequent maintenance, support and update activities. Development of multi-agency, corridor-based projects (e.g., Connected Corridors, regional data hubs) require an understanding of how each agency operates its part of the corridor, their roles and responsibilities, their available resources, and the ability of the different operational systems (such as traffic signal systems, freeway management systems, transit services) to work together in an integrated fashion. Without the documentation and framework provided by the RITSA, substantially more time and resultant work effort (resulting in additional costs) are needed to develop, design and integrate the project.

A RITSA that does not support regional planning, programming, and implementation of operations programs and projects has an extremely limited impact after the initial collaborative benefits of RITSA development fade. This represents a significant opportunity loss. Connecting the architecture to regional transportation goals and objectives (and resultant performance measures) reduces the duplication of effort that goes into both developing the regional ITS architecture and planning for operations. This is particularly important for smaller and less complex regions and regions with scarce resources.

Incorporation of New and Emerging Technologies as part of Architecture Updates

With the advent of CAV's and Connected Corridor projects in California, ITS will impact multiple travel modes as well as the transportation infrastructure, and will introduce requirements including electric charging stations, multimodal facilities such as park-and-ride lots, express bus facilities within managed lanes, and in the future, road-user charging. Much of this will require standardization of functionality, information flows, and communication / interface standards across the State. The implementation of these activities may involve a combination of public sector and private sector investment. As with any transportation project, ITS projects should fulfill higher-level transportation user needs for a region as well as overall transportation policies.

Role of Statewide ITS Architecture. To assure that regions are not performing redundant activities amongst each other, a Statewide ITS Architecture (SWITSA) can help identify more uniform standards for developing and implementing CAV, and Connected Corridor projects that could be reflected in each RITSA in a standardized fashion. The SWITSA would provide an overall framework for activities and components requiring standardization statewide, or that need to be compatible with national requirements (the latter being critical relative to vehicle-focused applications such as electric vehicle charging and vehicle-to-infrastructure).

Regional Standardization of ITS Applications. Likewise, RITSAs should define Connected Corridor activities as distinct applications that could be replicated throughout a given region for different groups of stakeholders contained within specific corridors. This may include standardized roles / responsibilities for Caltrans, transit agencies, county and local agencies operating traffic signals and other ITS elements. For example, while there may be distinct project architectures provided for individual Connected Corridors within a RITSA, a standardized framework and applications could be used for each of the Connected Corridors, defining the specific functions and information flows needed as a minimum requirement for all Corridors and then tailored to each individual corridor project. This would reduce the time and effort needed to develop the individual Connected Corridor projects at a later stage.

Framework for Integrated Data Sharing Throughout Each Region and Statewide. Finally, many regions are utilizing the concept of data hubs and standardized data buses to enable private sector and public sector entities alike to access real-time operations data. The Project Team found that a consensus of stakeholders felt that reflecting this functionality within a RITSA would assist in helping engage and clarify a role for the private sector in regional ITS development. This is crucial given that CAV research and development along with other transportation services are increasingly being led by the private sector with market support, and not necessarily by public policy. In turn, the SWITSA can identify where different regions' data hubs need to provide connectivity with one another to support traveler information sharing and critical data needs.

Guidance for Integrating ITS Architecture and Planning Activities

To realize the Business Case for ITS architectures, there was clearly a need for updated guidance to both Caltrans and other public agencies on planning for ITS deployment utilizing RITSAs, as well as corresponding activities associated with planning for operations. The key principles associated with integrating ITS architecture and transportation planning activities are presented below.

Coordination of RITSAs with Planning for Operations

RITSAs can be leveraged to support planning for operations activities (see Figure 1) as follows:

- **Utilize agency roles and responsibilities, system interfaces, and collaboration activities** defined within the RITSA, to: (a) identify the agencies that need to be involved in a particular project, (b) what systems, interfaces, and services are incorporated and (c) how the project can leverage those other investments to increase mobility and safety benefits for the public and improve agency performance.

- **Serve as the basis for ITS strategic plans or RCTOs by identifing services, functional requirements, and project concepts that support regional transportation goals and objectives.** Example RITSA services include activities such as arterial traffic control, incident management, and traveler information dissemination. ITS strategic plans or RCTOs outline TSMO roles, responsibilities and needs, funding opportunities and availability, and regional technology choices; such efforts support the ability to obtain Federal funding for particular initiatives.

- **Gather information on operations needs from the architecture and ITS stakeholders.** The same ITS stakeholders may also be able to contribute their expertise in targeting specific issues – notably, identifying where, when, and why transportation system performance does not meet current operations objectives. Interfaces defined in RITSAs can be used to identify data sources that can help determine operational needs.

- **Examine RITSA services when identifying ITS-based TSMO strategies,** so that planners and their regional operations partners can ensure that all possible ITS-based operations strategies address TSMO needs and deficiencies. In those cases where the RITSA is not up-to-date, TSMO strategy development should be coordinated with identification of updated ITS services to be contained in the RITSA, to assure no duplication of activities.

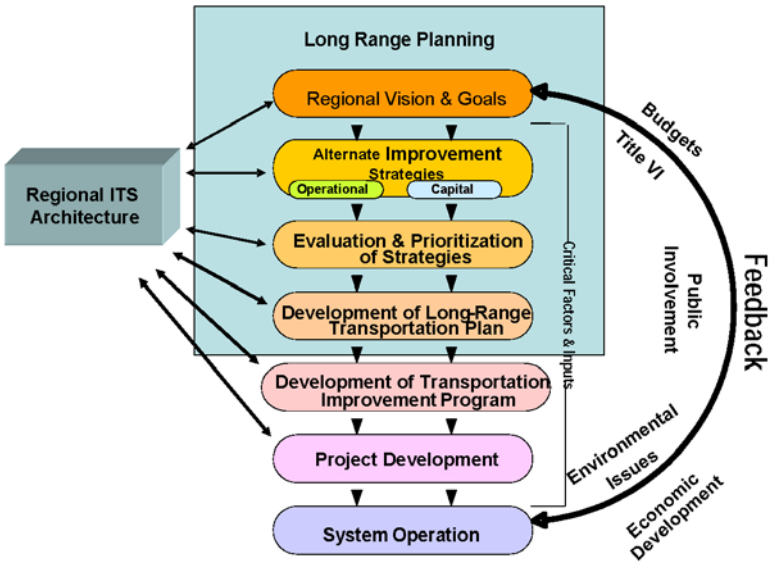

Figure 1 – ITS Architecture & Transportation Planning Process

- **Use the RITSA as part of the transportation improvement program (TIP) application process.** Several metropolitan areas and States, as a standard practice, use their RITSAs to define regional ITS programs and projects. RITSAs provide a common reference that can transform a list of ITS-related programs and projects in a TIP or STIP into a coordinated set of projects fulfilling regional operations objectives and strategies defined in the transportation plan. The RITSA thus provides a regional context for local ITS and operations projects through its project definition and sequencing recommendations.

- **Use the architecture's operational concepts, functional requirements, and other contents to kick-start project development.** These components can inform the systems engineering process that enables the creation of project documents, including RFPs, and architectural details can inform the project's scope of work. See Figure 2.

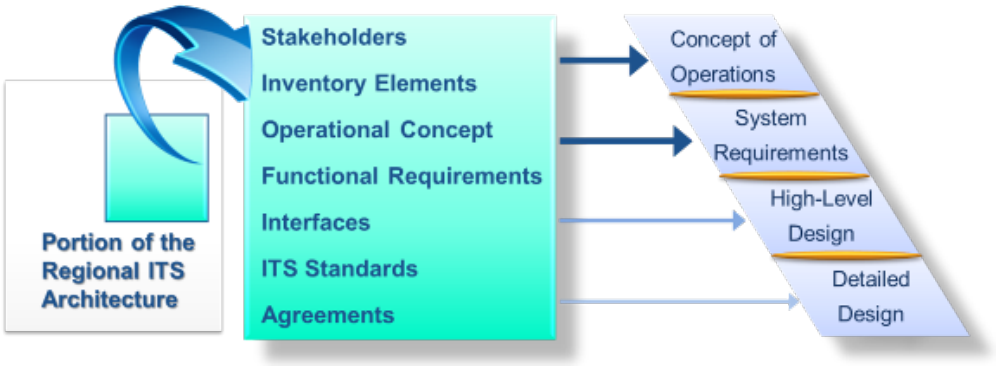

Figure 2 - Using the Architecture to Support Systems Engineering for Project Development

Coordination of ITS Project Development at Regional and State Levels

The guidance activities further takes into consideration the statewide goals and objectives as presented in the California Transportation Plan 2040 (CTP) and as legislated under the approved Senate Bill 1, The Road Repair & Accountability Act of 2017. This legislative package invests fuel taxes and other transportation-related fees to fix roads, freeways and bridges and puts more funding toward transit and safety in communities across California. These funds will be split equally between state and local investments. SB1 defines specific program activities for operations and congestion management that include the following program areas that are relevant to ITS:

- Congested Corridor Program ($250 million annually)
- Freeway Service Patrols ($25 million annually)

Caltrans District-level Operations projects at the district level are eligible for inclusion in the Statewide Highway Operation and Protection Program (SHOPP), typically as a Long Lead program within the SHOPP Ten Year Plan. ITS projects may be included as "anchor" (or primary projects) as well as for inclusion as part of other projects, consistent with District targets. Examples of ITS-oriented operation improvement projects include the following:

- Intersection modifications including traffic signals
- Traffic Management Systems including ramp metering
- Traffic Management Centers
- Multimodal corridor projects

Each project definition should identify specific outcomes and performance measures derived from the ITS services contained within the project and related goals and objectives fulfilled as addressed in the RITSA and incorporated as part of the planning process. Annual SHOPP project lists are developed one or more years in advance of expected funding allocations for projects contained in the SHOPP Ten Year Plan.

Regions and Caltrans Districts should work in coordination to develop lists of high-priority ITS projects as a basis for coordinating with partners and project nominations. Sections 1 and 2 of this document address ITS planning and architecture-related activities that would result in these project nominations. The development process must ensure that (a) proposed projects are consistent with the regional ITS vision (involving Caltrans and regional stakeholders) as reflected in their RITSAs, and that conversely, (b) the architectures reflect the proposed projects that are needed by the Districts or that include them as key partners.

Figure 3 provides an overview of a four-step process that links ITS project definitions (including regional definitions and Caltrans District ITS projects) to both regional and statewide ITS programs. This view addresses the relationship of projects to regional architectures (Step 1) as well as to a statewide ITS prioritization effort (Step 2) documented through the SHOPP. Regional ITS Architectures identify key standards and interfaces with statewide activities (Step 3). In turn the SHOPP ITS projects may be related (Step 4) to the Statewide ITS Architecture (SWITSA) that provides a statewide framework for pertinent standards relevant to all regions, interfaces between regions, and programs/projects that may occur in parts of the state that are outside the realm of an MPO.

The most significant priority in developing a statewide list of ITS projects (using SHOPP as the vehicle) is assuring that the regional architectures incorporate the Caltrans Districts in a key role.

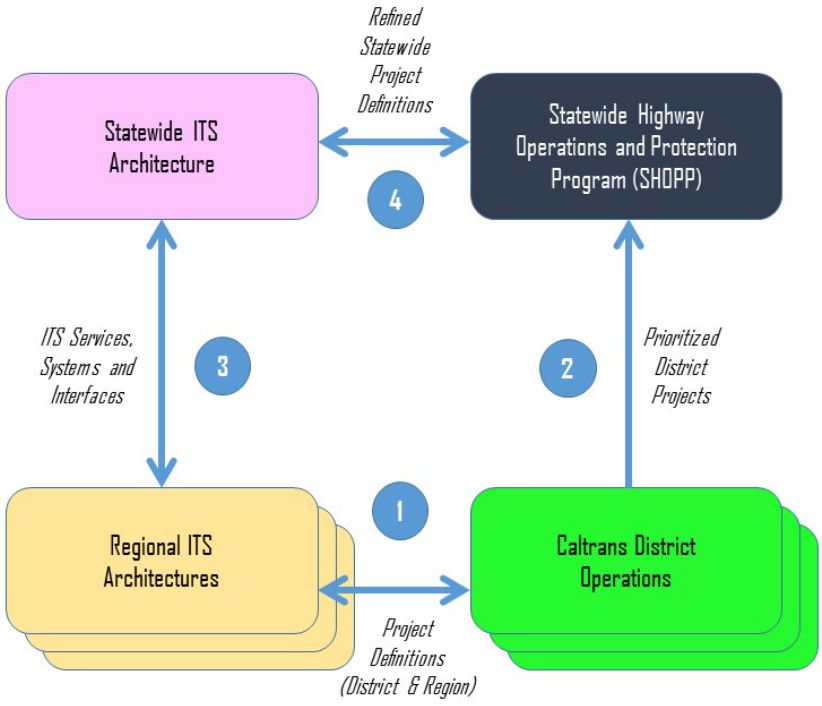

Figure 3 - Statewide and Regional Project Development and ITS Architecture Coordination

Key Products of the Study

- Caltrans Planning for ITS Guide: 2018 Edition
- Process for Developing Statewide ITS Strategic Development Plan
- White Paper: The Business Case for Statewide and Regional ITS Architecture Activities
- ITS Architecture Development and Maintenance: Barriers and Opportunities
- Statewide and Regional ITS Architecture Compliance and Use
- White Paper: Federal Policy, Rule Making and Guidelines Related to ITS Architecture Activities