Statewide ITS Architecture Assessment and Support

Statewide and Regional ITS Architecture Compliance and Use

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Statewide ITS Architecture Assessment and Support

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1. Introduction

1.1 Project Overview

The *Statewide ITS Architecture Assessment and Support* project provided technical assistance to Caltrans in assessing compliance of the Statewide and Regional Intelligent Transportation Systems (ITS) Architectures with federal requirements and the current state of the practice. Secondly, it assessed how the architectures are used in support of transportation planning activities and project development. For both of the above, the Project Team identified those areas where the architectures are in compliance and are being used as intended, as well as those areas where architectures are non-compliant, are not being maintained, or are not being used for integrated planning and project development. The primary outcome of this effort is updated guidance on the use of ITS architectures as part of transportation planning and project development activities.

1.2 Purpose of this Document

The purpose of this document is to assess and report on the state of California's current SWITSA and RITSAs (hereafter referred to collectively as RITSAs). The assessment was performed during the summer and fall of 2016 through a review of the most recent RITSAs, and a survey of their owners. The assessment identifies the current RITSAs, compliance with Federal requirements, their use and the RITSA owner's perception of the value and usability of the architectures as perceived by their owners.

2. Summary and Status of California SWITSA and RITSAs

Table 1 provides a high level summary of the most current California RITSAs that were identified for this project. The list was compiled through a review of federal RITSA documentation, discussion with California's Metropolitan Planning Organizations (MPOs) and a review of the available documentation from various sources. This list represents the RITSAs that were used to develop the architecture assessment in this document. The summary in the table provides:

- Architecture name
- Geographic coverage
- Architecture owner
- Year of most recent update or development

While Table 1 provides a comprehensive list of California regional architectures, not all RITSAs have been reviewed as part of this project. Some architectures were not reviewed because they were not accessible electronically or through contact with agency staff. Some architectures were not available on the owners' web sites. Some predate current owning agency staff, and the current staff were not aware of the architecture or how it was, or should be, used.

Also note that only five of the 20 RITSAs surveyed had been updated since 2010. Thirteen of the architectures were ten or more years old. The age of the architectures means that many have been developed based on versions of the National ITS Architecture and related development tools that had been superseded several times over the years. As a result, it is possible that the owning agencies have gone through major transportation planning exercises without integrating or updating their ITS architectures. **Figure 1** shows the ages of the RITSAs.

It is noted that one update (Bay Area) was underway during the period of the assessment, and a new "Upstate California" ITS architecture and strategic plan is being developed for the 16 northernmost counties in the State (covering all or parts of three Caltrans Districts), and which encompass five regional architectures shown on the list, all which were developed prior to 2006 except for Caltrans District 2 (in 2008). Updates for the San Diego and Sacramento regions are upcoming.

Also note that the Los Angeles Region has a Regional ITS Architecture and an Arterial ITS Architecture, both developed in 2004. The Arterial Architecture is a subset of the Regional ITS Architecture, and the Regional is assessed here. Since developing its ITS Architecture in 2003, the San Diego Region developed an ITS Strategic Plan in 2011. While the Plan identified ITS strategies and projects, it does not include an architecture. Therefore, the 2003 San Diego Regional ITS Architecture is assessed in this report.

Table 1: Summary of Current California ITS Architectures (Completed Fall 2016)

Architecture Name	Geographic Coverage		Architecture Owner	Year Developed / Updated
	Counties	Caltrans District		
Bay Area ITS Architecture	Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma Counties	4	Metropolitan Transportation Commission (MTC)	2016
Caltrans District 2 Architecture*	Caltrans 2, comprised of Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Tehama, Trinity	2	Caltrans	2008
Central Coast ITS Architecture	Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Cruz	5	Association of Monterey Bay Area Governments (AMBAG)	2010
California Oregon Advanced Transportation Systems (COATS)*	Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Plumas, Shasta, Siskiyou, Trinity	1, 2	COATS Consortium	2000

Architecture Name	Geographic Coverage		Architecture Owner	Year Developed / Updated
	Counties	Caltrans District		
Fresno County Regional ITS Architecture	Fresno	6	Fresno Council of Governments (Fresno COG)	2015
Imperial Valley Subregional ITS Architecture	Imperial	11	Southern California Association of Governments	2005
Inland Empire Subregional ITS Architecture	Riverside, San Bernardino	8	San Bernardino Association of Governments	2005
Los Angeles County Regional ITS Inventory and Architecture	Los Angeles	7	Los Angeles County Metropolitan Transportation Authority (Metro)	2004
Modoc County Regional ITS Architecture*	Modoc	2	Modoc County Transportation Commission	2006
North Valley Regional ITS Architecture*	Butte, Colusa, Glenn	3	Butte County Association of Governments	2005
Orange County ITS Strategic Deployment Plan	Orange	12	Orange County Transportation Authority (OCTA)	2013
Sacramento Regional ITS Architecture	El Dorado, Sacramento, Sutter, Placer, Yolo, Yuba	3	Sacramento Area Council of Governments (SACOG)	2005
San Diego Regional ITS Architecture	San Diego	11	San Diego Association of Governments (SANDAG)	2003
San Joaquin Valley ITS Strategic Deployment Plan	Fresno, Kern, Kings, Madera, San Joaquin, Stanislaus, Tulare	6, 9, 10	Fresno COG	2001
Southern California Association of Governments	Imperial, Los Angeles, Orange, Riverside, Ventura	7, 8, 11, 12	Southern California Association of Governments	2011
Shasta County Regional ITS Architecture and Strategic Deployment Plan*	Shasta	2	Shasta Regional Transportation Authority	2006
Sierra Nevada ITS Strategic Deployment Plan	Alpine, Amador, Calaveras, Inyo, Mariposa, Merced, Mono, Tuolumne	9, 10	Not determined	2002
Statewide ITS Architecture	All	All	Caltrans	2010

Architecture Name	Geographic Coverage		Architecture Owner	Year Developed / Updated
	Counties	Caltrans District		
Tahoe Gateway ITS Architecture	El Dorado, Nevada, Placer, Sierra	3	Placer County Transportation Planning Authority (PCTPA)	2002
Ventura County ITS Architecture	Ventura	7	Ventura County	2004

*-Denotes regional architectures that may be superseded by the Upstate California Regional ITS Master Plan

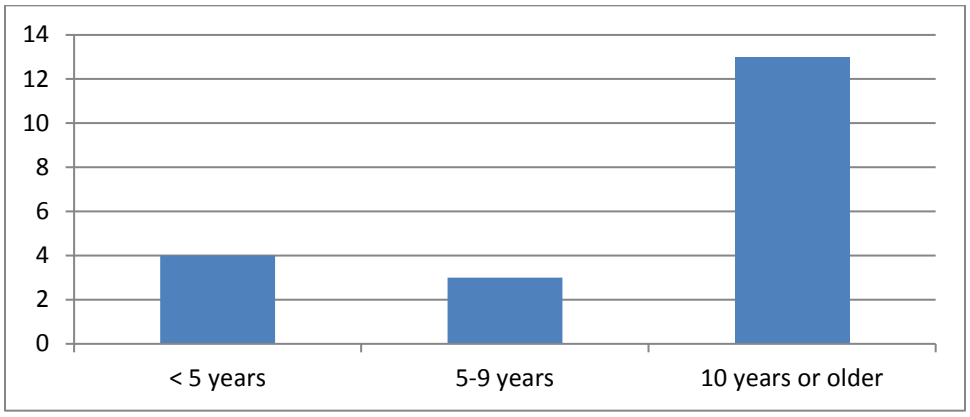


Figure 1: Age of ITS Architectures in California

3. SWITSA and RITSA Federal Compliance

3.1 Federal Requirements

The development, use and maintenance of California's RITSAs are required to meet federal requirements defined by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA).

Congress enacted the ***Transportation Equity Act for the 21st Century (TEA-21)*** on June 9, 1998. Section 5206(e) of TEA-21 required Intelligent Transportation System (ITS) projects funded through the highway trust fund to conform to the National ITS Architecture and applicable standards. One of the findings of Congress in section 5202 of the TEA–21 was that continued investment in systems integration was needed to accelerate the rate at which ITS is incorporated into the national surface transportation network. Two of the purposes of the ITS program, noted in section 5203(b) of the TEA–21, are to expedite the deployment and integration of ITS, and to improve regional cooperation and operations planning for effective ITS deployment.

In January 2001, to address the need to begin to work toward regionally integrated transportation systems, USDOT published ***Federal Highway Administration (FHWA) 23 CFR Parts 655 and 940 Intelligent Transportation System Architecture and Standards, Final Rule*** and ***Federal Transit Administration (FTA) National ITS Architecture Policy on Transit Projects; Notice*** to implement section 5206(e) of TEA-21. Conformance with the National ITS Architecture is defined in the final Rule/Policy as using the National ITS Architecture to develop a regional ITS architecture that would be tailored to address the local situation and ITS investment needs, and the subsequent adherence of ITS projects to the regional ITS architecture. Rule 23 CFR 940.5 requires that regional ITS architectures be "consistent with the (statewide and metropolitan) transportation planning process", although

parallel planning rules requiring an "ITS integration strategy" for a metropolitan area were not implemented.

Rule 23 CFR 940.9 described the requirement for regions to deploy RITSAs that allow for integration of information and services from different transportation entities and modes, for management and operations of regional transportation facilities. Given that 23 CFR 940 in general does not require or reference an integration strategy, the FHWA felt a need to provide more specific guidance on the definition of a region.

As such, the definition of a region was revised to indicate that a Metropolitan Planning Area (MPA) should be the minimum area considered when establishing the boundaries of a region for purposes of developing a RITSA within a metropolitan area. This should not be interpreted to mean that a region must be an MPA and no less, but the MPA and all the agencies and jurisdictions within the MPA should be at least considered for inclusion in the process of developing a regional ITS architecture within a metropolitan area. The FHWA also acknowledged it is possible that overlapping regions could be defined and overlapping regional ITS architectures could be developed to meet the needs of the regions.

For example, the Los Angeles-Ventura-Orange County-Riverside County area includes a regional architecture encompassing the entire Southern California Association of Governments (SCAG) region, and there are also more detailed, county-specific architectures (corresponding to metropolitan transportation organizations) that should be in effect subsets of the SCAG architecture. In one case, the Inland Empire Subregional ITS Architecture overlaps both the SCAG area (specifically Riverside County) and the San Bernardino Association of Governments (SANBAG) area.

While Federal policy requires development of regional ITS architectures as the basis for Federal funding of regional ITS projects, it does not mandate a statewide ITS architecture (SWITSA) unless the architecture is required to incorporate key operational roles, responsibilities and functions that may occur at the regional level. However, a SWITSA may have particular statewide roles and responsibilities that require interface and coordination with regional architecture elements, including interoperability, data and video sharing, and statewide or multi-regional functions such as performance management systems, traveler information, or statewide emergency management. As such, a SWITSA needs to be compliant with the National ITS Architecture in the same way as do regional ITS architectures.

Rule 23 CFR 940.11 required that a systems engineering analysis be utilized for projects (regardless of size or budget) to be Federally-funded, including the project ITS architecture being a part or subset of the RITSA. The specific rule, as illustrated in Figure 2, describes the steps required in defining and developing specific ITS projects. While the steps are a subset of the larger systems engineering analysis process, following the SE process assures that the Rule is being followed.

FHWA Rule/FTA Policy
1. Portion of Regional ITS Architecture
2. Participating agencies roles and responsibilities
3. Requirements definitions
4. Alternatives analysis
5. Procurement options
6. ITS standards and testing procedures
7. Operations and management procedures and resources

Figure 2: Summary of 23 CFR 940.11 (FHWA Rule / FTA Policy)

California was one of the first states to establish a process to carry out the requirements of 23 CFR 940.11. Several states have since patterned their own process to reflect the California guidance. Caltrans and FHWA developed a *Systems Engineering Guidebook for ITS* that assists the State and local agencies in applying Systems Engineering in a standardized process and recommends guidance through best practices and lessons learned. A Systems Engineering Review form (SERF) must be completed by the project sponsor at project initiation. This form, referenced in the *Caltrans/FHWA Stewardship and Oversight Agreement* and included in the *Caltrans Local Assistance Procedures Manual (LAPM)*, includes one question for each of the seven systems engineering requirements in 23 CFR 940.11.

3.2 California SWITSA and RITSA Compliance Assessment

The Project Team reviewed RITSAs in California with available documentation to determine their compliance with all aspects of the Federal requirements including the architecture content, use and maintenance and coordination with regional transportation planning. In addition, assessments reviewed stakeholder access to the RITSAs. Accessibility significantly impacts RITSA usability and stakeholders ability to review and provide updates. **Table 2** provides a summary of the compliance of the assessed RITSAs.

3.2.1 Development and Compliance

The assessment found that California's RITSAs have largely been developed in compliance with the FHWA rule and FTA policy. The RITSAs have been developed to include the key components of an architecture as identified in 23 CFR 940.9, including:

- Geographic and service coverage description.
- Stakeholder identification.
- Definition of an operational concept.

- Existing and needed agreements among stakeholders.
- ITS elements.
- ITS user services.
- ITS functional requirements.
- Interconnect and information flow descriptions among ITS elements.
- Identification of applicable ITS standards.
- ITS project sequencing.

3.2.2 Planning Compliance

Federal policy requires that RITSAs be consistent with the associated region's transportation planning process. In this area, many of the RITSAs lack clear documentation, such as mapping of projects and ITS services to regional needs, or goals and objectives. The lack of documentation does not necessarily mean there was no coordination between planning efforts and the RITSAs. At the time of their development, the RITSAs may have been aligned with regional transportation plans. However, for the older architectures (i.e., pre-2010) it is likely that transportation plans have been updated while the RITSA has not. If the RITSA was not updated at the same time, it may no longer be consistent with, or referenced to, the region's current transportation plans.

Another potential reason that some RITSAs do not demonstrate a link to the region's transportation plans may be a result of the tools used to develop the RITSA, which are discussed in more detail in Section 3.3. Turbo Architecture is a software tool provided by the Federal government to develop and maintain ITS architectures. It has been used to some extent for virtually all RITSAs in California. The current version of the tool provides the ability to map ITS components such as Service Packages (formerly known as Market Packages) to regional transportation plans, including specific needs, goals and objectives. However, earlier versions of Turbo Architecture (pre-2010) did not include planning tools. Therefore, RITSAs older than six or seven years may have linked ITS to regional planning, but used tools other than Turbo, with documentation of this mapping or of the tools used not be readily available.

3.2.3 RITSA Use and Maintenance

Most of California's RITSAs include plans for their ongoing use and maintenance as required by Federal rules and policy. However, in several cases there is little evidence that those plans have been followed. A review of California's RITSAs and the responses of RITSA owners in our Team's survey (see Section 4) indicate that few have been updated since their development to reflect regional changes. Or, if they have been updated, the changes have not been made with stakeholder participation.

One key reason for the lack of RITSA maintenance activity appears to be a lack of resources to perform the maintenance. As the survey discussed in Section 4 shows, many of the RITSA owners stated they lacked the staff resources or technical skills to maintain the RITSA.

Similarly, the use of many RITSAs is unclear. As Table 2 shows, some RITSAs are unavailable or not easily accessible to stakeholders for referencing in ITS project planning, design and development. In other cases, the RITSA is available, at least in part, but does not provide current contact information for a stakeholder to request support.

It is possible that stakeholders with limited ITS architecture knowledge may be intimidated or unaware of what a RITSA provides and how it can provide benefit to their ITS projects. Conversely, a stakeholder interested in deploying an ITS project today may determine that the latest RITSA may be out-of-date or irrelevant to their current needs, and may thus develop the project without reference to the most recent ITS architecture. It is noted that the mandated deadline for RITSAs being in place was April 8, 2005, or within 4 years of the first ITS project in a region advancing to final design.

3.2.4 RITSA Accessibility

In general, the most recent of California's RITSAs are more accessible. In fact, all of the RITSAs developed over the last five years are available on the Internet, some as fully interactive and searchable sites, while some older RITSAs do not have a physical presence and can only be found on the Internet as references in other regional planning documents. The actual architectures may not be available, nor is there contact information. Several reasons are possible for limited accessibility of certain RITSAs. Those reasons include:

- The tools to publish RITSAs to the Internet have continually improved over the last sixteen years, including the ability to generate interactive web pages directly from the Turbo Architecture software. More recent RITSAs may have interactive sites while older ones (that have not been updated) may not.
- Many RITSA owners have updated and rebuilt their agency web sites since they last updated their architectures, and the data wasn't incorporated into the new sites.
- The staff responsible for the development and / or maintenance of the RITSA may have left the owning agency or may have other responsibilities, with no other staff assigned to provide access or information.
- Because of their age, lack of use and data retention schedules, RITSAs may have been deleted by agencies, even if they are the most current architectures for the region.

3.2.5 Summary of RITSA Compliance

Table 2 summarizes the California RITSAs' compliance with federal maintenance and use guidelines. This is based on the RITSAs that the Project Team was able to access and assess as part of this task. Since not all RITSAs were accessible in their entirety, some assessments are not complete. Each available RITSA was reviewed for the following:

- **Development Compliance** – The assessment reviewed the RITSAs for completeness and overall quality of its products in terms of the architecture components required by the FTA and FHWA. The assessment indicates whether the RITSAs are:

- Complete or mostly complete
- Partially complete
- Incomplete.

- **Use and Maintenance Compliance** – The assessment reviewed the RITSAs to determine whether they had use and maintenance and use plans that were used during the life of the plan. The assessment indicates whether the RITSAs:
  - Developed maintenance and use plans that were demonstrably used
  - Developed maintenance and use plans that were not demonstrably used
  - Did not develop maintenance or use plans.

  Note that demonstrable use and maintenance was assessed based on the availability of updated information after the RITSA was first developed.

- **Planning** – The assessment reviewed the RITSAs to determine if the documentation included mapping or reference to other regional plans, including identifying how a region's ITS addressed regional transportation needs or helped to achieve regional goals and objectives. The assessment indicated whether the RITSAs:
  - Document regional needs, goals and objectives and demonstrate how ITS projects are related to them
  - Recognize the linkage to other transportation plans but does not show specifically how ITS projects are related to them
  - Do not reference other regional transportation planning.

- **Accessibility** – The assessment reviewed the availability of the RITSA to stakeholders either via online or through a designated contact at the agency that owns the RITSA. The assessment also considered the availability of technical support to stakeholders in the form of an identified contact and instructions on how to request support. The assessment indicates whether the RITSAs are:
  - Accessible in their entirety online, with clear ownership and contact information
  - Partially accessible by being online in some form, with or without ownership and contact information
  - Unavailable online and no current contact information provided.

Table 2: California RITSA Compliance and Accessibility

RITSA Name	Compliance			Accessibility
	Development	Use and Maintenance	Planning	
Bay Area ITS Architecture (2011)	Complete or mostly complete	Developed plans that were demonstrably used	Regional goals and objectives are not identified.	Accessible online with current contact information.
Central Coast ITS Architecture	Santa Barbara portion only uploaded to System Builder	Architecture has not been maintained.	There is no mapping of architecture elements to planning processes accessible.	Accessible via System Builder but contact information not provided.
COATS	Complete or mostly complete	There is a maintenance plan but it has not been updated.	There is no mapping to goals and objectives.	Accessible online but contact information is not current.
Fresno County Regional ITS Architecture	Complete or mostly complete	Developed plans that were demonstrably used.	The Strategic Deployment maps ITS projects and strategies to needs and existing conditions.	Accessible online with current contact information.
Imperial Valley Subregional ITS Architecture	Complete or mostly complete	Architecture has not been maintained.	There is no mapping of architecture elements to planning processes accessible.	Accessible online but contact information is not available.
Inland Empire Subregional ITS Architecture	Complete or mostly complete	Architecture has not been maintained.	There is no mapping of architecture elements to planning processes accessible.	Accessible online but contact information is not available.

RITSA Name	Compliance			Accessibility
	Development	Use and Maintenance	Planning	
Los Angeles County Regional ITS Architecture	Complete or mostly complete	There is a plan and stakeholders meet, but the physical architecture has not been updated.	There is no mapping of architecture elements to planning processes accessible.	Accessible online but contact information is not available.
Modoc County Regional ITS Architecture	Complete or mostly complete	Architecture has not been maintained.	There is no mapping of architecture elements to planning processes accessible.	Accessible via System Builder but contact information is not available.
North Valley Regional ITS Architecture (Butte County)	Architecture was not available for assessment.			
Orange County Subregional ITS Architecture	Complete or mostly complete	Architecture has been maintained and was updated in 2013.	The Strategic Deployment maps ITS projects and strategies to needs and existing conditions.	Accessible online but no contact information is available.
Sacramento Region ITS Strategic Deployment Plan	Complete or mostly complete	Developed plans that were demonstrably used	There is no mapping of architecture elements to planning processes accessible.	Accessible online with current contact information
San Diego Region ITS Architecture	Complete or mostly complete	There is a plan, but the physical architecture does not appear to be regularly updated.	There is no mapping of architecture elements to planning processes accessible.	Contact information available but the architecture is not accessible online.

RITSA Name	Compliance			Accessibility
	Development	Use and Maintenance	Planning	
San Joaquin Valley ITS Strategic Deployment Plan	Complete or mostly complete	There is a plan, but the physical architecture does not appear to be regularly updated.	There is no mapping of architecture elements to planning processes accessible.	Accessible online with current contact information
Shasta County Regional ITS Architecture and Strategic Deployment Plan	Architecture was not available for assessment.			
Sierra Nevada ITS Strategic Deployment Plan	Architecture was not available for assessment.			
Caltrans Statewide ITS Architecture	Complete or mostly complete	There is a plan, however, the architecture is made up of many district architectures, many of which have not been maintained.	There is no mapping of architecture elements to planning processes accessible.	Accessible online with current contact information.
Ventura County ITS Architecture	Complete or mostly complete	There is a plan, but the physical architecture does not appear to be regularly updated.	There is no mapping of architecture elements to planning processes accessible.	Accessible online but contact information is not current.

3.3 Tools Used in RITSA Development

Accessibility and accuracy of a RITSA improves when its data is managed using a single tool. A single tool makes the architecture data easier to manage in a consistent manner through a single interface, and allows the output to be provided from a single tool to stakeholders in a cohesive and consistent manner.

An agency that develops and maintains an architecture entirely using Turbo Architecture will only need to access that one program to perform maintenance and updates. In addition, Turbo links the

components of a RITSA such that an update to an ITS element or ITS stakeholder in one place is propagated throughout the entire architecture.

An agency that uses several tools, resources and databases to develop and maintain an architecture typically has to utilize all of those tools to make an update. If the tools are not dynamically linked in some fashion (say, to a relational database), updates may essentially have to be done "manually", requiring concurrent updates to diagrams, databases, data flows, and word-processed documentation that may not be centrally managed from a single tool. Significant effort may be required to ensure consistency of architecture information as a result. For example, if the responsibility to maintain a Traffic Management Center transitions from one stakeholder to another, the agency that owns the architecture will have to update information stored in the various tools to ensure that change is properly reflected in, at least, the stakeholder definition, ITS elements, information flows, operational concept, ITS agreements. Then, the agency will have to ensure that all of the updated documentation is made accessible to stakeholders.

The tools described in Table 3 have been used to develop and document the components of California's RITSAs. The range of tools results in varying output formats, such as some data being stored in a database, while other data may be stored in word processing formats or in spreadsheets. Additionally, the tools do not ensure consistency in the manner or detail that define the RITSAs. Outputs in multiple formats make it more difficult for users to be able to identify and understand architecture information that may be relevant to their activities, and even more difficult to revise or update these architectures.

Most of the current architectures (i.e., those produced since the advent of 23 CFR 940) utilize Turbo Architecture as the basis for their documentation, although older versions of Turbo that were used are likely obsolete today (version 7.1, has been in use since 2015). The more current versions provide capabilities such as mapping architecture service packages to planning needs, goals and objectives.

Table 3: Architecture Development Tools

Tool Name	Description	Output	Strengths / Weaknesses
Turbo Architecture	Turbo Architecture is a software application that supports development of regional and project ITS architectures. Turbo uses the National ITS Architecture as its basis to help ensure consistency and compliance with it. Turbo has an interface that directs the user to select national ITS architecture elements to define regional ITS. It also allows for all architecture data to be stored in a single database and can output that information as text, web pages and graphic images.	• Physical architecture • All architecture components • Web pages • Architecture diagrams • Reports	**Strengths**: • Structured development processes support consistent, architecture-compliant development. • Changes made through the Turbo interface are reflected in all output across all formats. **Weaknesses**: • Built-in tools have limited flexibility in the appearance of the output. • Requires staff to receive specific training.
Word Processor	Many RITSA owners have developed architecture documentation in word processors. This tool is typically used to complement Turbo output, or to modify Turbo's output format. The tool allows for flexibility in the narrative format and incorporation of images. The output is text documents and has been used for project descriptions, mapping needs to ITS services and describing existing and needed agreements.	• Strategic Plans • Project descriptions • Some Architecture components • Planning information • Project agreements	**Strengths**: • Flexibility of the output to include narrative, tables and images. • Requires no special training. **Weaknesses**: • Not automatically updated when Turbo data is updated, resulting in potential discrepancies in a region's documentation. • Does not ensure compliance with ITS architecture requirements.

Tool Name	Description	Output	Strengths / Weaknesses
Spreadsheet	Some RITSA owners have developed high-level project descriptions in spreadsheets such as Excel. The descriptions can be extended to include project details outside the scope of an architecture, such as budgets, quantities and locational details. The spreadsheets can also be developed to be consistent in format and detail with other regional planning documents, such as Transportation Improvement Plans.	• Project definitions	**Strengths**: • Flexibility of the output to include narrative, tables and images. • Potential coordination with other regional planning project definitions. • Requires no special training. **Weaknesses**: • Not automatically updated when Turbo data is updated, resulting in potential discrepancies in a region's documentation. • Does not ensure compliance with ITS architecture requirements.
Proprietary Consultant Tools	A few of California's RITSAs have used proprietary tools developed by the consultants who supported the RITSA developments. The tools typically are used to address the noted inflexibility in Turbo Architecture's output. The proprietary tools interface with the Turbo Architecture database and are used to customize the output. They allow for tailored formatting of reports, web pages and graphic images that are more consistent with the owning agencies' other materials.	• Web pages • Architecture diagrams • Reports	**Strengths**: • Flexibility of the output to include improved formatting and consistency with other agency materials. • Support consistent, architecture-compliant development. **Weaknesses**: • Require consultant support and can result in not being updated once consultant is no longer under contract. • Require special training and access to tools.

4. Use and Maintenance Survey Process

In order to understand the relationship between the regions and their RITSAs, a survey was developed and provided to RITSA owners, as well as Caltrans. The survey provided information about how they currently use, interact with and maintain their architectures. In addition, the survey was intended to collect candid opinions of the ITS architecture process, and identify issues that limit the region's ability to use and maintain them.

4.1 Target Audience

The target audience for the Use and Maintenance Survey consisted of SWITSA and RITSA owners who are in the process of developing, have developed or are responsible for current regional architectures. The audience was asked to candidly reply to the questions in order for the Project Team to gather an accurate understanding of:

- Whether and how the SWITSA and RITSAs are used in compliance with CFR 940.
- Whether and how the SWITSA and RITSAs are adequately maintained.
- Whether the SWITSA and RITSA owners have the appropriate resources and training.

4.2 Survey Process

The Project Team identified ownership of California's most recent SWITSA and RITSAs. The contacts for each owning agency were invited to respond to an ITS Architecture Assessment Survey online. A copy of the survey is attached as **Appendix A**. Architecture owners were encouraged to have more than one staff member respond where appropriate, such as in the case that different staff is responsible for use and maintenance.

4.3 Survey Response

Of the twenty architecture owners invited, eight responded to the survey. The following subsections summarize the responses in the five categories of:

1. Architecture Basics
2. Architecture Ownership
3. Architecture Maintenance
4. Architecture Use
5. Architecture Compliance

4.3.1 Architecture Basics

Responding RITSA owners represented architectures that ranged from the oldest "active" RITSA (COATS) to the most recently completed (Fresno County) and one currently in development. The

group also reflected owners who are not planning to update their RITSAs, those currently in the process of updating, and those who plan to update in the near future.

Table 5: Architecture Basics

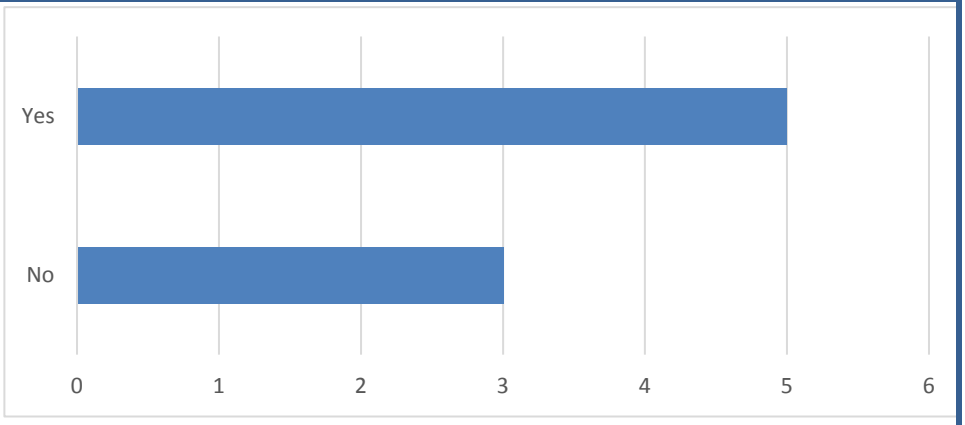
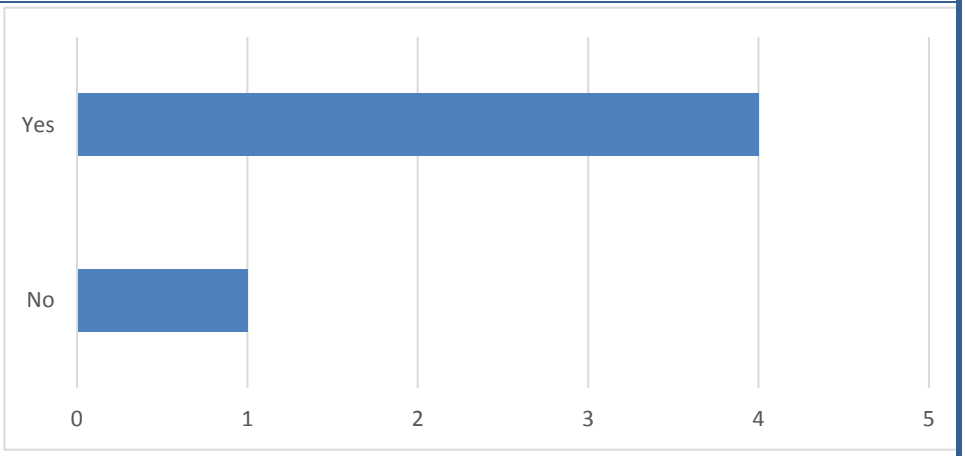
Names of Regional Architecture	Age of Architecture
1. Bay Area ITS Architecture	2011 / 2016
2. California Statewide ITS Architecture	2010
3. Caltrans District 2	2008
4. COATS	2000
5. Fresno County Regional ITS Architecture	2015
6. Los Angeles Arterial ITS Inventory and Architecture	2004
7. Orange County ITS Architecture	2013
8. Ventura County ITS Architecture	2004

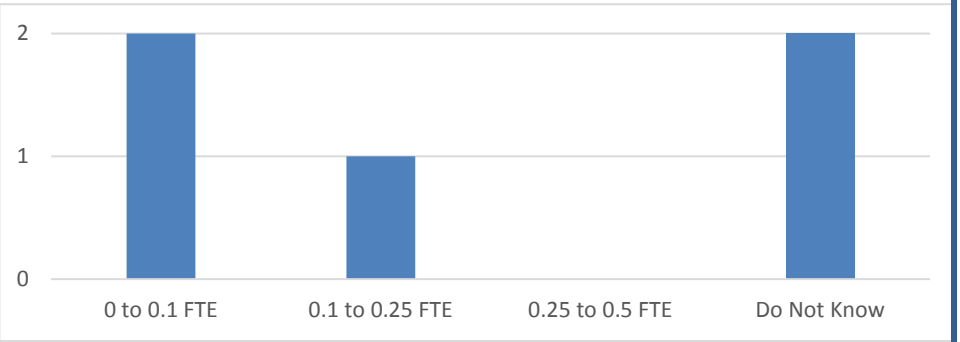
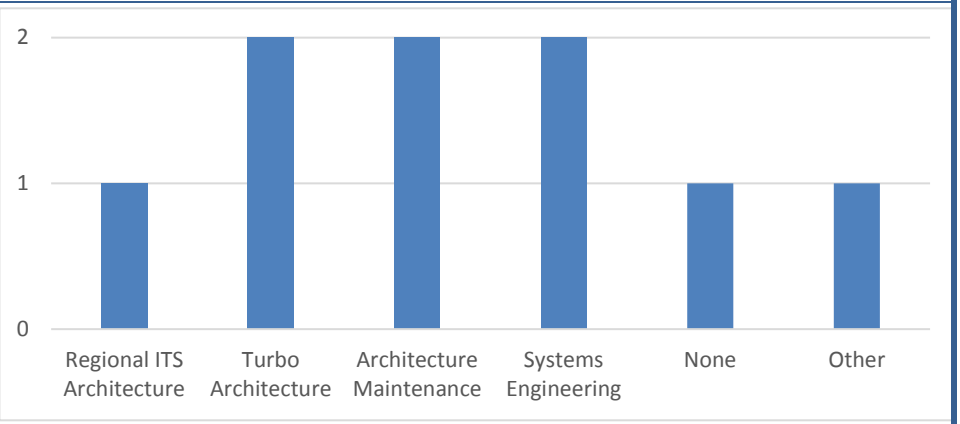
4.3.2 Architecture Ownership

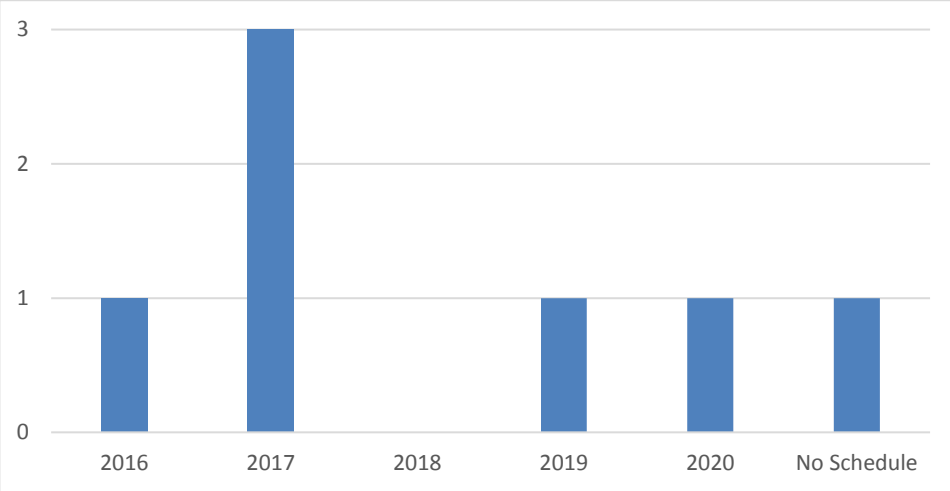
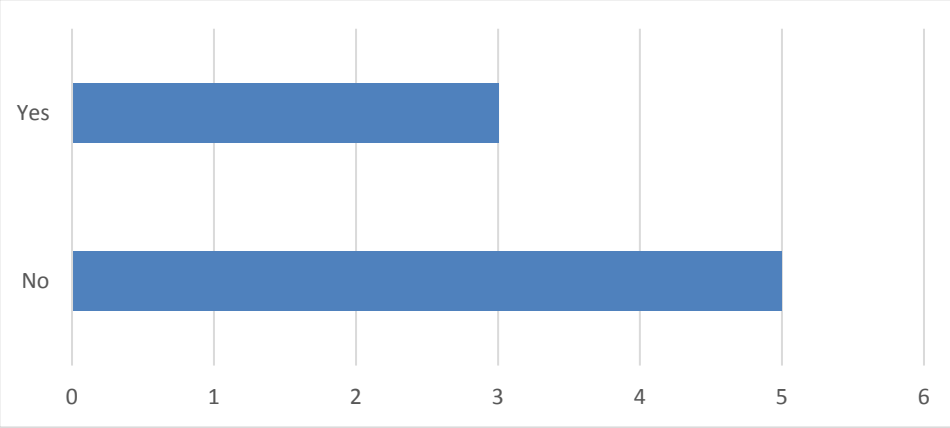
The survey asked respondents about the ownership of the RITSAs and the skills within—or contracted by—the owners to develop, maintain and provide support for the RITSA. Five of the responding agencies indicated they have dedicated staff, while three did not. A similar ratio was provided by respondents regarding the training of the staff.

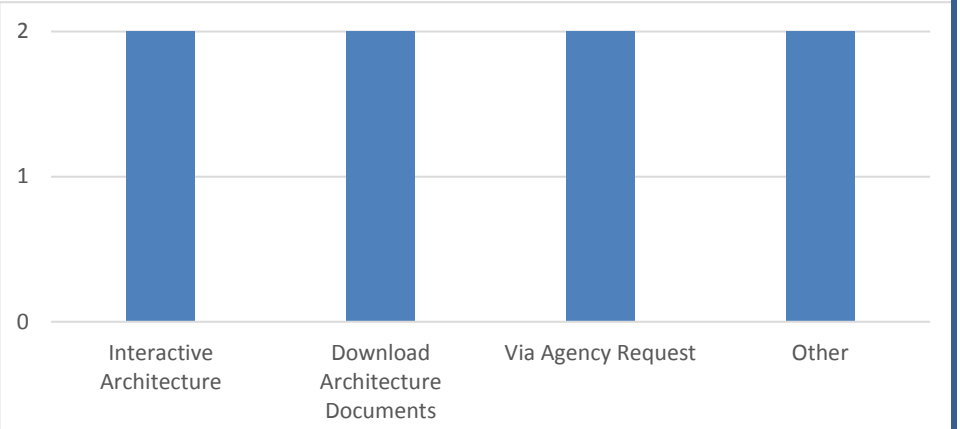
Note that the responses likely suggest a greater percentage of RITSAs being maintained than actually are; it is assumed that many of the RITSA owners who did not respond to the survey specifically because they do not have staff responsible for the RITSA use and maintenance.

Table 6: Architecture Ownership

OWNERSHIP AND TRAINING	
1. Does the owning agency have specific staff assigned to supporting the use and maintenance of the architecture?	 *The three owners who responded "No" all have RITSAs that are ten years old or older*
a. Was that staff involved in most recent update or development activity?	 *Of the five agencies who reported having staff dedicated to the architecture, 80% said that same staff was involved in the RITSA's development. The age of those RITSAs: three are six years or younger, one RITSA is 11 years old.*

OWNERSHIP AND TRAINING	
b. What level of staffing is dedicated to the Architecture activity?	 Of the RITSA owners with staff dedicated to the RITSAs, three indicated that architecture maintenance requires 20% or less of an FTE to manage, including maintenance, use and support. Two responses stated that the owner does not know how much time is required, suggesting the amount may be minimal and does not require tracking.
c. What Architecture training does staff have?	 Note that five respondents answered this question and that some indicated their staff had training in multiple areas. One respondent had no training and one other stated that staff received training but was unclear on what type of training it was.

OWNERSHIP AND TRAINING	
2. When will the Architecture be updated?	 Six respondents indicated that they plan to update their RITSAs within the next four years, while one respondent whose Architecture is more than ten years old stated they will update the RITSA but had not determined a schedule yet. The eighth respondent stated the owner has no plan do an update. That RITSA is more than ten years old. All seven agencies planning to do an update indicated they would use a consultant to perform the update.
3. Is the Architecture developed / updated in coordination with the Region's transportation planning process?	 The majority of respondents stated that they RITSA was not developed/updated in coordination with other regional planning processes. This suggests that even among active RITSA owners there may be an opportunity to improve understanding of the value of integrating ITS planning into other planning activities.

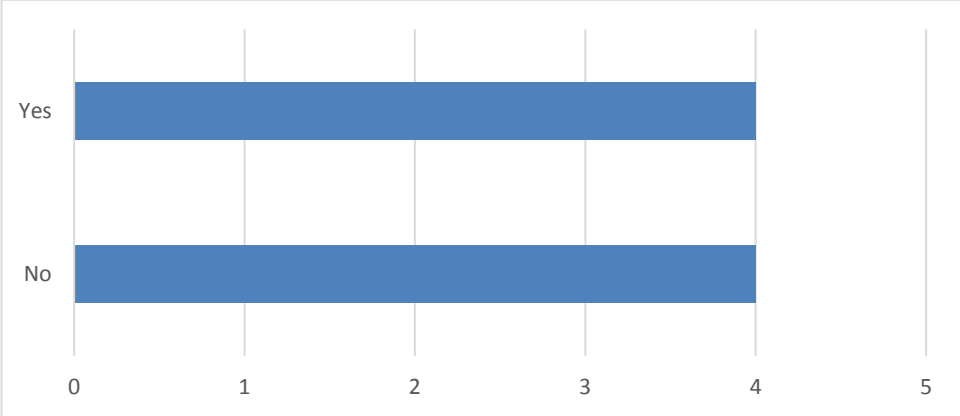
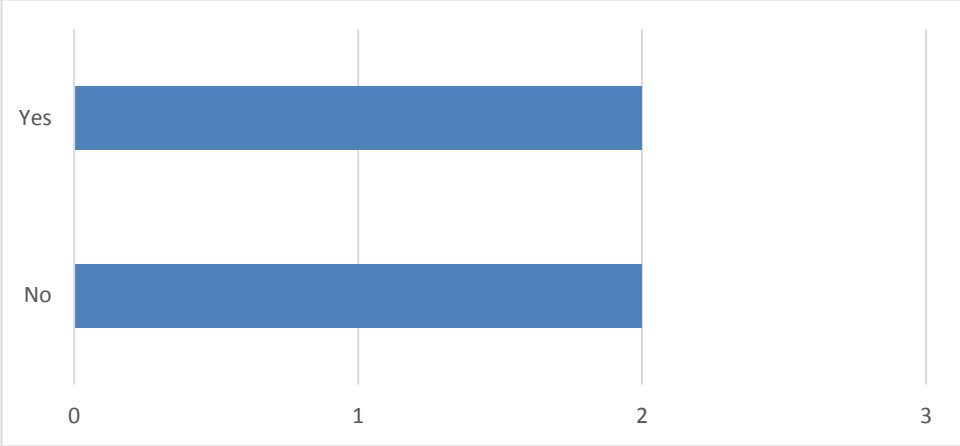
OWNERSHIP AND TRAINING	
4. How do stakeholders access the most recent Architecture?	 The architectures that are available as interactive web sites are among the most recently updated in California, a result of both the improved publishing tools in Turbo Architecture and the changing expectation of stakeholders in receiving information. In addition, one response of "Other" was explained that the architecture will be available through ITS-SB, as described in Section 4. Those RITSAs available by request only are among the oldest in the state. The second "Other" response stated that a "hard copy" was distributed to stakeholders when it was developed, but the agency has never had requests for additional copies. It is not available online.

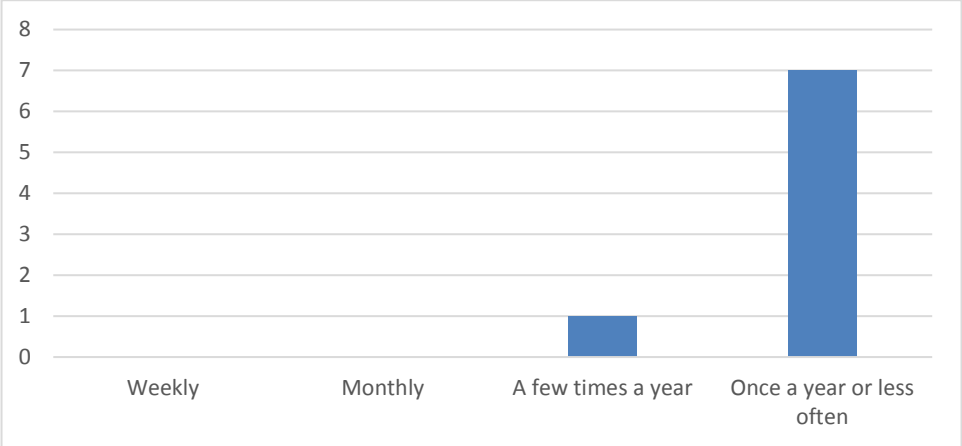
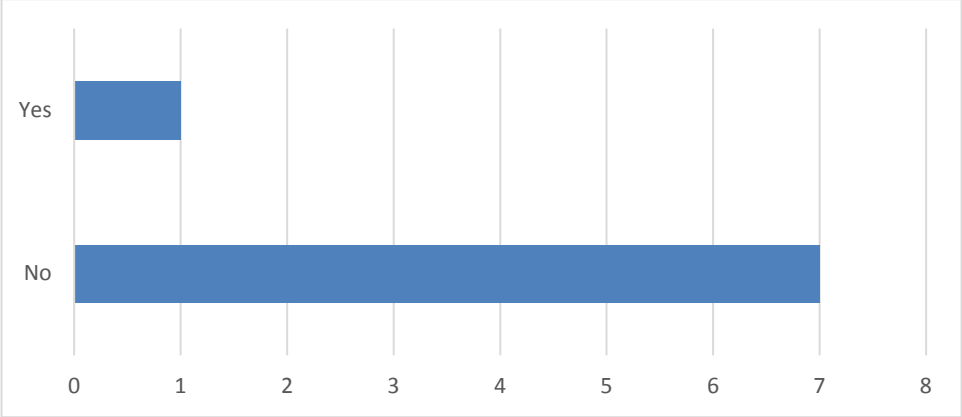
4.3.3 Architecture Maintenance

Consistent with the findings of the assessment conducted during this effort, the survey respondents stated that a majority of RITSAs received inconsistent or no maintenance. Also consistent with the assessment findings, the survey responses indicated newer RITSAs tend to be more actively maintained than older RITSAs.

Overall, survey responses indicate a lack of sufficient staff resources and training to maintain the RITSAs to the level required by FHWA rule and FTA policy. The lack of resources and training may indicate that RITSA owners either did not anticipate the level of effort required, or perceive maintenance to not be an important part of RITSA ownership.

Table 7: Architecture Maintenance

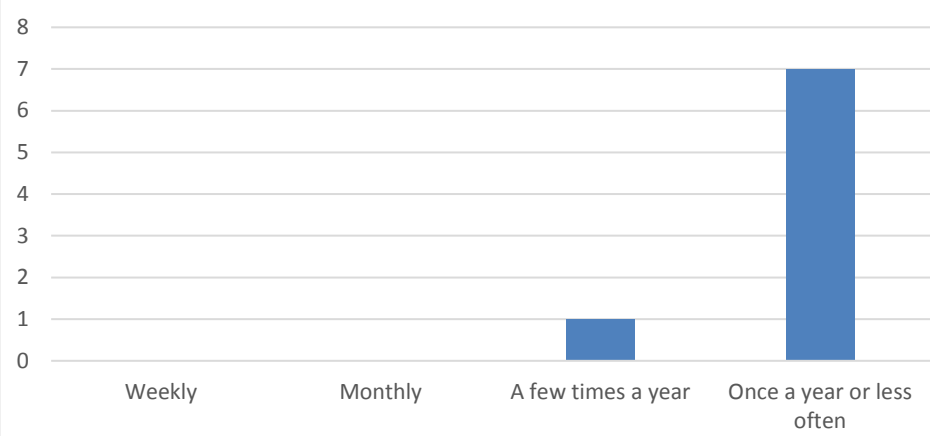
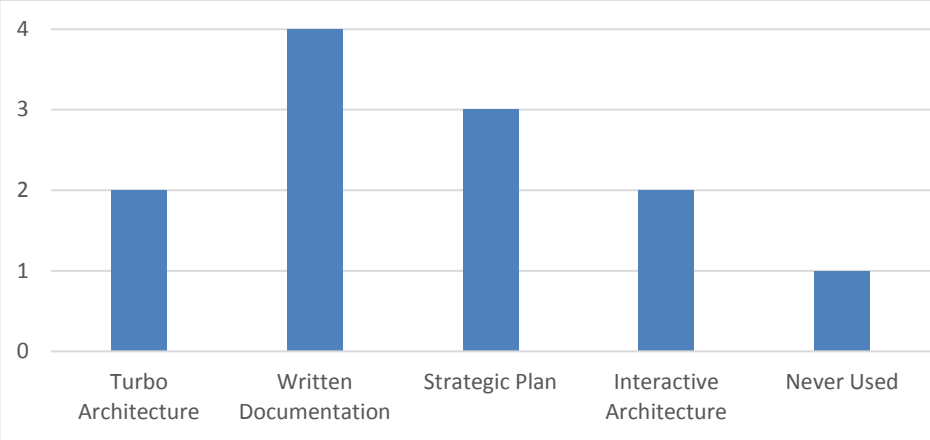
ARCHITECTURE MAINTENANCE	
5. Is there an Architecture Maintenance Plan?	
a. Is the Plan followed?	 Of the four RITSA owners who stated there was a Maintenance Plan, only two indicated that that Plan is followed. That means that only 75% of the survey respondents do not maintain their RITSAs according to a plan. Based on the assessment of California's RITSAs, it appears an even higher percentage of non-respondents' Architectures are not maintained.

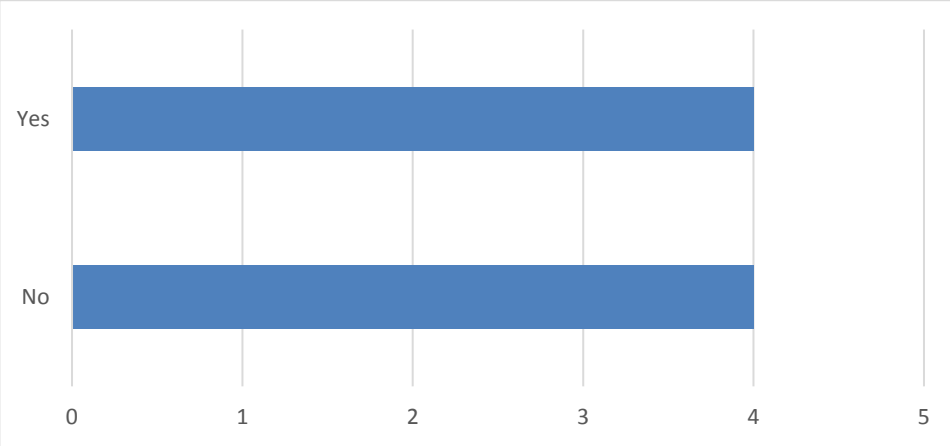
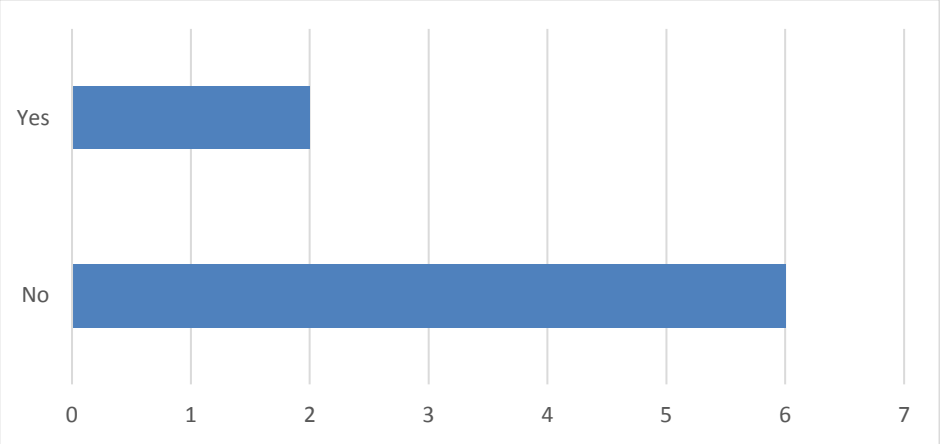
ARCHITECTURE MAINTENANCE	
6. How often is Architecture maintenance performed?	 Only one RITSA owner performed maintenance more than once a year while several of the respondents represent regions that are major metropolitan areas with significant past and ongoing ITS activity.
7. Has the staff responsible for maintenance participated in architecture skills training since the Architecture was developed?	 Only one RITSA owner has received additional architecture training since the RITSA was developed or updated. This is despite most of the RITSAs represented by the responses being more than six years old. The responses are consistent with the finding of the assessment that few of the RITSAs have been maintained. The one respondent who has had continuing architecture training indicated they have received training in Regional Architectures, Turbo Architecture, Architecture Maintenance and Systems Engineering, and, therefore, likely has a strong understanding of the value of using and maintaining a RITSA.

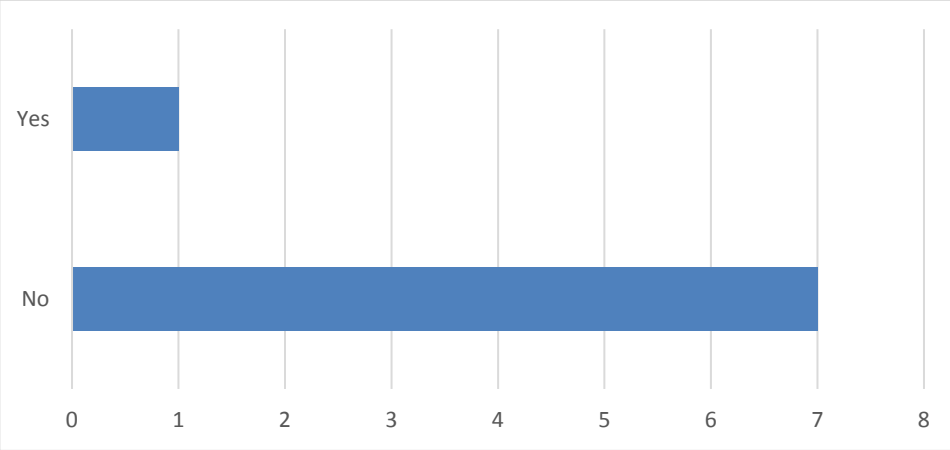
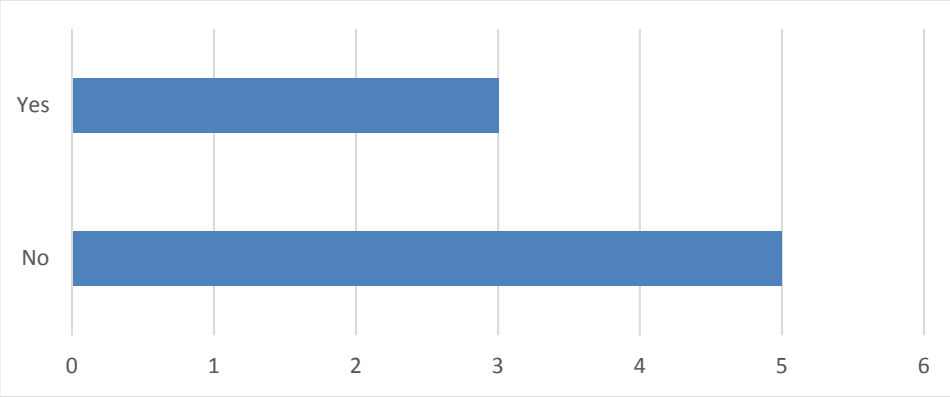
4.3.4 Architecture Use

In general, survey responses mirrored the results of the assessment of California's RITSAs. The majority of the RITSAs are either not used or used in a very limited capacity. In addition, there is little support provided in many regions. This leaves stakeholders, who often have little ITS architecture training, to try and understand how to plan, develop and deploy their projects in a manner consistent with the regional vision.

Table 8: Architecture Use

ARCHITECTURE USE	
8. How often does your agency reference the Architecture in the region's planning and project implementation processes?	 Only one respondent indicated that the RITSA was used as a reference more than once a year. Note that the one respondent who references the RITSA multiple times each year also indicated they updated multiple times each year and had the most extensive Architecture training.
9. When referencing the Architecture, do you view:	 One respondent responsible for a RITSA indicated that they had never used it. Other respondents indicated that they had used more than one source for referencing different components of RITSA information.

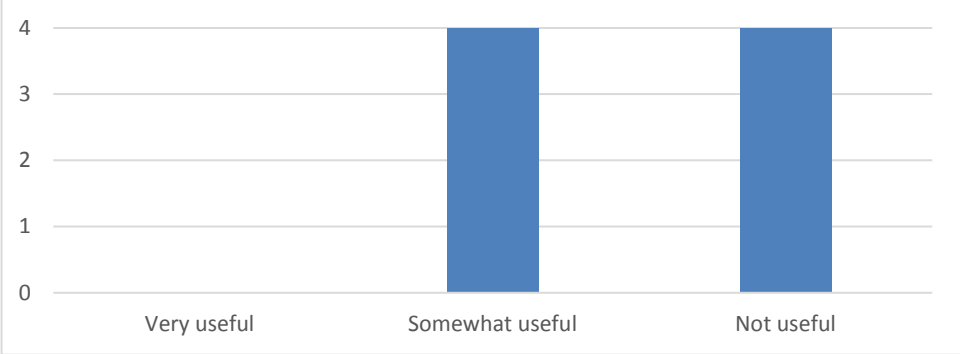
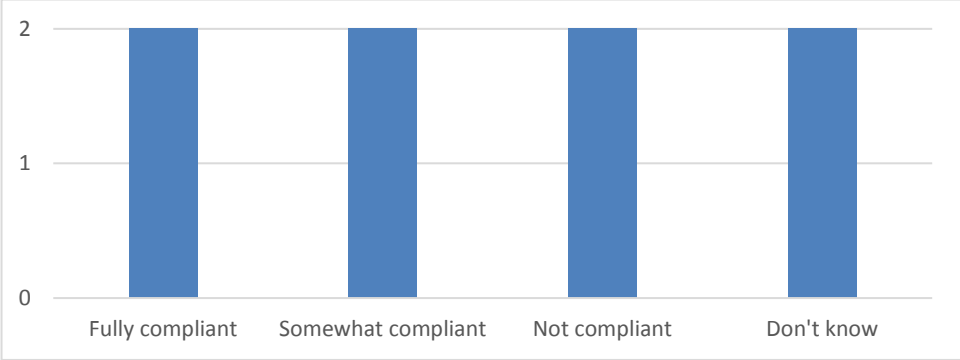
ARCHITECTURE USE	
10. Does your agency provide support to stakeholders when they request help understanding the architecture?	 Of the eight responses, 50% indicated that the agency did not provide support to stakeholders who may need to use the RITSA. As later survey responses reveal, this may be the result of limited staff resources and / or a lack of RITSA knowledge at the owning agency.
11. Does your agency have a process to verify that the region's ITS is planned and implemented consistent with the Architecture?	 Only two of the respondents have a process in place to ensure that regional ITS projects are consistent with the RITSA. Similar to an owning agency providing RITSA support, the lack of verification processes may be the result of limited staff resources and RITSA knowledge. Both of the respondents who have a RITSA consistency verification processes for ITS projects stated that regional ITS projects must adhere to a Systems Engineering process. One of the two also requires verified RITSA consistency in order to qualify for regional funds.

ARCHITECTURE USE	
12. Does the architecture owner have a formal process for providing technical Architecture support to stakeholders?	 Only one respondent has a formal process for providing technical support to the RITSAs stakeholders. This may make it difficult for the RITSA owner to track stakeholder requests and suggested maintenance actions, and limit a stakeholder's understanding of how to use the RITSA and interact with its owner.
13. Does the Architecture owner coordinate communication among ITS project stakeholders?	 The majority of respondents stated that they do not coordinate communications among stakeholders. Not facilitating this communication may limit the usability of a RITSA by limiting the opportunities to promote interoperability and ITS solutions that can be scaled to multiple stakeholders.

4.3.5 Architecture Compliance

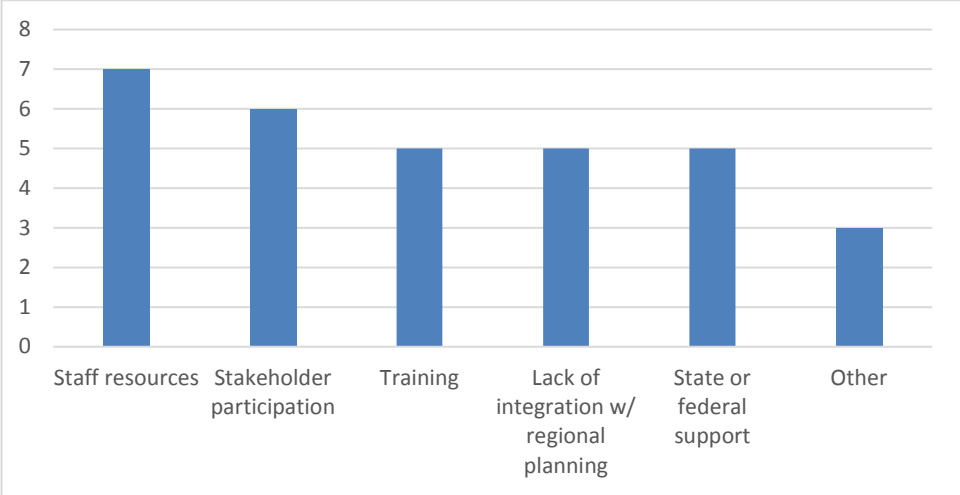
The survey responses largely indicated that the RITSAs owners struggle with maintenance and a very small minority are actually maintained as required. The respondents indicated that there are many reasons for the region's poor RITSA maintenance record that include limited staff resources, and architecture knowledge, as well as a belief among some respondents that RITSAs have limited value to them.

Table 9: Architecture Compliance

ARCHITECTURE COMPLIANCE	
14. How useful do you perceive the Architecture is in the regional planning of ITS projects?	 None of the respondents indicated that their RITSA was "very useful" in regional ITS project planning. Only 50% said it was "Somewhat useful." The responses may illustrate a core reason why resources are not allocated to manage many of California's RITSAs.
15. How compliant is your region with the federal ITS Architecture policy (CFR 940)	 Only half of the respondents believed their RITSAs were at least "somewhat compliant" with federal requirements. A quarter of the respondents are aware that their RITSAs are not compliant, while the remaining quarter are either do not know the federal requirements or their own RITSAs well enough to know if they are compliant.

ARCHITECTURE COMPLIANCE

16. What do you perceive to be the significant challenges in using the Architecture?



Respondents indicated several significant obstacles to using the architecture, with all choosing more than one challenge. Seven of the eight responses cited staff resources. The staff resources may be the result of a perception that the architecture is labor intensive, or it may be because architecture is not considered a high priority within the owning agencies. Staff resources may also impact the ability of an owning agency to receive proper training, or the ability to integrate the RITSA in other planning activities.

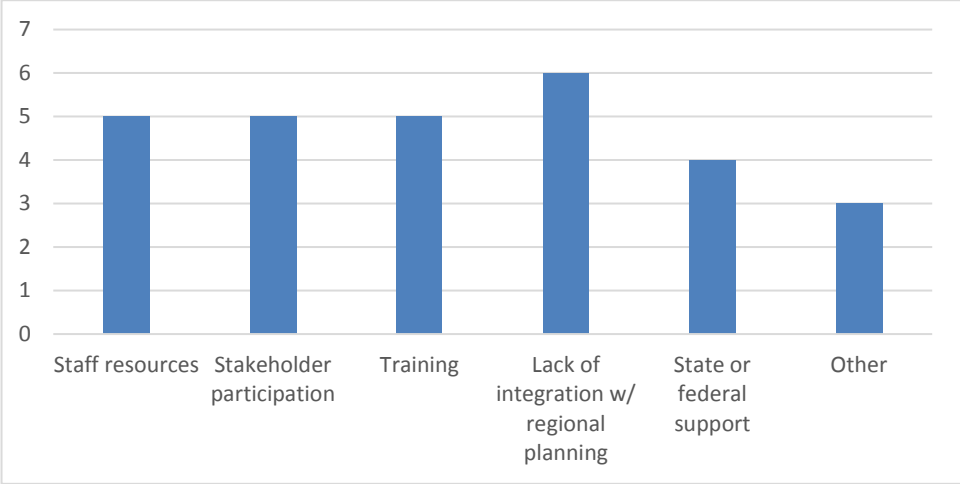
Similarly, state and federal support may be closely correlated to training as owning agencies may not feel that enough training is provided by the state or feds.

Respondents also provided explanations for the "Other" responses. Those comments were:

- RITSAs have an "inconsistent format and application" that limits its usability.
- Federal requirements that are the same for all districts may make sense in metropolitan areas, but not in rural area. A rural RITSA owner stated that they had made two documents: one for federal compliance, and a second that would be applicable to their activities.
- ITS architecture was obsolete by the time it was defined and has been unable to keep up with the pace of technology development or the institutional issues that impact planning, design and deployment.

ARCHITECTURE COMPLIANCE

17. What do you perceive to be the significant challenges in maintaining the Architecture?



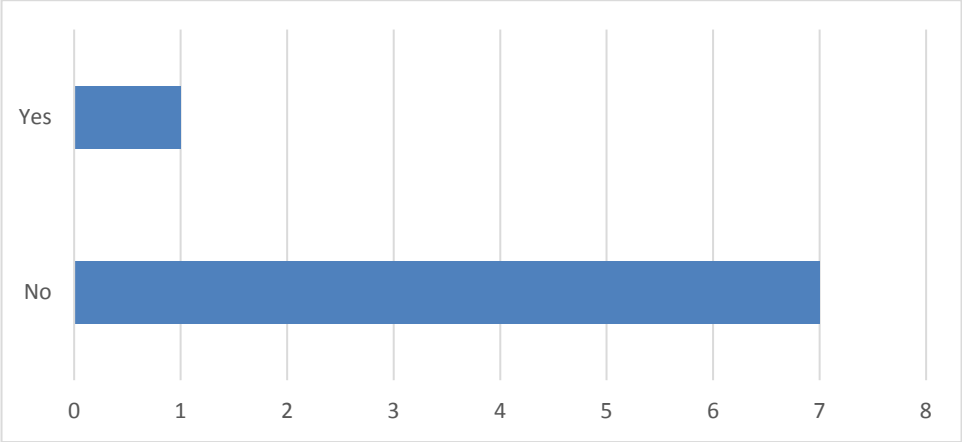
All eight respondents selected multiple challenges for maintaining their RITSAs. In general, respondents indicated much similarity in the challenges to maintaining their RITSAs as they had in using them. Respondents indicated that a lack of integration with regional transportation planning was the most common challenge in maintaining their RITSAs. However, staffing, involving stakeholder and training were also cited by the majority of RITSA owners. All three are necessary for proper maintenance. Without available and trained staff, even basic maintenance will not happen. Also, without proper training and knowledgeable staff, a RITSA owner may not recognize any value in maintaining a RITSA, or have the capability to perform updates.

Three respondents identified "Other" challenges. These are:

- RITSAs have an "inconsistent format and application" that limits its usability (as with using the architecture).
- Nobody at the owning agency understand the RITSA or believes it to be useful, so it does not get referenced or used.
- Technology is developed and delivered faster than can be represented by the RITSA.

ARCHITECTURE COMPLIANCE

18. Does your agency work with stakeholders to maintain awareness of the Architecture and its use?



Only one of the respondents has activities to maintain awareness of their RITSA and how it should be used. This response stated that the RITSA is highlighted in all regional transportation forums hosted by the RITSA owner. Another respondent indicated that while no RITSA outreach was happening currently, new outreach activities that would start soon.

The one affirmative response provides an example of the level of activity that may be required to keep stakeholders aware of a RITSA. It may not require new or additional outreach, but rather to incorporate information about the RITSA into existing stakeholder engagement that can be tailored to the specific audience.

5. Next Steps

The findings of the RITSA assessment, combined with the survey findings, has highlighted strengths and weaknesses in the use and maintenance of the RITSAs. Key findings include:

- California has RITSAs that cover every county in the State.
- Recent RITSA development has focused on improved accessibility and usability to enhance compliance with federal requirements.
- The majority of California's RITSAs are over ten years old and not maintained.
- Many agencies do not feel they have the training or resources to use and maintain their RITSAs, nor does it appear there is much incentive to do so.
- Some agencies question the value of RITSAs in planning.
- Most agencies do not consider SWITSA/RITSA to be a "highly useful" tool at this time.

These findings, and all others, will be used to guide the discussion and recommendations of this project to improve the development, use and maintenance of ITS Architectures. Future efforts will involve workshops and discussions with the RITSA owners with the purpose of expanding on their survey responses to identify the specific issues that limit the effectiveness of ITS architectures in the transportation planning process. Strategies will be developed to directly address the weaknesses identified through this assessment.

APPENDIX A

Regional ITS Architecture Use and Maintenance Survey

Ownership:

The following questions should be answered by the agency responsible for the Architecture.

Architecture Ownership	
1. What agency has ownership of the architecture?	
2. Was the architecture developed by the owning agency, a consultant or other?	
3. Has the owning agency assigned specific staff members to supporting the use and maintenance of the architecture?	
a. If yes to 3, was that staff involved in the architecture development process?	
b. If yes to 3, what architecture training has that staff had?	__ Regional ITS Architecture __ Turbo __ Architecture Maintenance __ Architecture Use __ Systems Engineering __ Other
4. Is there a plan to update the architecture? If yes, what year?	
a. If yes to 4, in what year is the update planned?	
b. If yes to 4, will the architecture update be done in-house, by a consultant or other?	
5. Is the most recent version of the architecture available to the public?	__ via an interactive public website __ via documents available online __ via request for information __ other

Maintenance:

The following questions should be answered by the agency responsible for the Architecture.

Architecture Maintenance	
1. Is there a Maintenance Plan?	
a. If yes to 1, is the plan followed?	
b. If yes to 1, is the staff identified in the Maintenance Plan the same staff that perform maintenance?	
2. How often is maintenance performed on the Architecture?	
3. When was the last time the people responsible for maintenance reviewed the Architecture?	
4. How often do stakeholders suggest changes to the Architecture?	__ weekly __ monthly __ a few times a year __ once a year or less often
5. How do stakeholders identify and request changes to the maintenance?	
6. Has the staff responsible for maintenance participate in architecture skills training since the Architecture was developed?	

Use

The following questions should be answered by the agency responsible for the Architecture.

Architecture Use	
1. How often does your agency reference the architecture in reviewing the region's projects?	
2. When referencing, do you view the Turbo?	
3. When referencing, do you review the written documentation (e.g. Strategic Plan, Architecture Report)?	
4. Does your agency provide support to stakeholders when they request help understanding the architecture? If yes, please explain.	
5. Does your agency have a process in place to verify that the region's ITS projects are properly represented in the Architecture?	
6. How do stakeholders access the architecture?	__ Online __ Contacting the agency __ Other
7. Is there a process in place for stakeholders to contact the architecture owner with questions about technical Architecture support?	
8. Is the architecture referenced by stakeholders or regional planners in the transportation planning process?	
9. Is compliance with the architecture required in order to receive funding?	
a. If yes to 9, please describe the process to verify project compliance?	
b. If yes to 9, does the architecture owner provide support to stakeholders in verifying? If yes, please describe.	
10. Does the architecture owner coordinate communication between stakeholders on planned ITS projects	