Anchorage Regional ITS Architecture Update: Use & Maintenance Guide

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Revision History

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1 Introduction

Many ITS architectures have been developed across the United States. In many cases, the architectures are not used often or by many people. It may be years before they are analyzed and updated. In order to make the Anchorage Regional ITS Architecture (ARIA) easier to use and maintain, the updated architecture was simplified and converted to use the Turbo Architecture database. This document provides users with a convenient and easy to understand guide on how to use and maintain the architecture. The guide takes into account the input gathered from stakeholders during interviews and workshops conducted throughout the project lifespan. The Anchorage Regional ITS Architecture Maintenance Plan was adopted in 2012 for the original ARIA and was based on the statewide architecture's Iways Architecture Maintenance Process Technical Memo. That original ARIA maintenance plan was used as a foundation to construct this document.

1.1 ARIA Update

The Anchorage Regional ITS Architecture Update report is a companion to this document. The update to the original 2004 ARIA was implemented due to advances in technology, changes in user needs, and the availability of the Turbo Architecture database tool. The update adheres to the Federal Highway Administration (FHWA) National ITS conformity rule (23 CRF Part 940) and the FTA National ITS Architecture Policy on Transit Projects. Rule 940 states that an ITS architecture is required for ITS projects that are considered significant for the region and eligible for Federal funding.

1.2 Turbo Architecture

Turbo Architecture™ is a software application that aids in the development of regional and project ITS architectures based on the National ITS Architecture. This program became available after the 2004 ARIA, and was used to document the ARIA update. This program is widely used throughout the US in the development and maintenance of regional ITS architectures, and supports better usability and accessibility to the ITS Architecture. The update to the Anchorage Regional ITS Architecture was implemented in Turbo Architecture™ (version 7.0). The software is free and available for download at

http://www.iteris.com/itsarch/html/turbo/turbomain.htm

Turbo Architecture™ supports the FHWA Rule 940 and the FTA National ITS Architecture Policy on Transit Projects; specifically, it provides:

- Support for defining and documenting Functional Requirements
- Support for documenting Operational Concepts (i.e. Roles and Responsibilities)
- Additional fields in Regional Description to fully define an architecture's scope
- Support for documenting any required or existing Agreements

- Support for identifying any ITS Standards available to support the implementation of the architecture

1.3 How to Use this Guide

This guide is organized into three main sections:

- Section 1 : Introduction
  - This section provides information on the ARIA update and how to use this guide.
- Section 2 : Uses of the ITS Architecture
  - This section describes the different ways the ITS Architecture can be used after it has been developed. For example, how the architecture can be used to support integration among regional projects or how ITS can be incorporated into regional projects.
- Section 3 : Maintenance of the ITS Architecture
  - This section outlines the recommended methods to maintain the ITS architecture to extend the life of its use.

In each of the major sections, the following questions are answered (in no particular order) in relation to the section in which it belongs to:

- Who?
- When?
- Why?
- What?
- How?

Further details are outlined below. An example of a question in the use section that could be answered is *if a planner or engineer is developing a transportation plan, how does he/she incorporate the ITS architecture into the project?* An example of a question that applies to the maintenance section is *who is responsible for changes to the architecture?* The following sections aim to answer these questions.

1.4 Who Should Use this Guide?

This guide should be used by the appropriate stakeholder members involved in planning for or implementing ITS projects in the Anchorage area. Appropriate stakeholders could include staff from a variety of Municipality of Anchorage (MOA) Departments and organizations (including Anchorage Metropolitan Area transportation Solutions (AMATS)), Alaska Department of Transportation & Public Facilities (DOT&PF) staff, and consultant members who are assigned to either update, change, or simply refer to the information found in the ITS architecture.

1.5 When to Use this Guide?

This guide should be used when there is a need to use the ARIA and/or to make changes to the ARIA. If the purpose is to use the ARIA, this guide should be used in at least four different contexts:

- Planning
- Program Development
- Project Development
- Project Design

In regional transportation planning processes, the ARIA can be a great resource to coordinate with. There are some overlapping steps between planning processes and ITS architectures. By using this guide to supplement transportation planning, redundant steps can be reduced and better efficiency achieved.

Before projects can be implemented, a program must be developed to determine requirements and feasibility. The ARIA outlines existing and proposed systems, including ITS activities, elements, projects, and stakeholders. By referencing the ARIA, program development becomes easier.

Project development follows the programming phases. Once the requirements for a project have been identified, the concepts of the project can be developed. Federally funded ITS projects must complete the Systems Engineering checklist and some of those checklist components can be obtained from the architecture. Some of these checklist components that are included in the ARIA are participating agencies, their roles and responsibilities, project requirements, and standards.

Finally, project design is another use for the ARIA. The ARIA contains design requirements such as concept of operations, interconnects, and flows. By examining how existing and proposed ITS services function and the types of data exchanged, project design steps can be minimized.

Additionally, there may be instances where required changes to the architecture are discovered when using the architecture. In such cases, maintenance of the ARIA should be performed as soon as possible to keep the architecture up-to-date. In these occurrences, this guide can also be helpful by referring to Section 3 Maintenance of the ITS Architecture.

1.6 Why Use this Guide?

This guide should be used because it provides a user-friendly way to make use of the ITS architecture after development. This guide outlines different scenarios when the ITS architecture would be relevant as well as how to make changes to the ITS architecture when necessary. The changes to the architecture could include minor changes or major updates.

2 Uses of the ITS Architecture

The recommended uses of the ITS Architecture are summarized in this section. The effectiveness of an ITS architecture can be gauged by how it is used. The ARIA can be a useful tool for planning and project implementation. It is especially effective at pinpointing opportunities and possibilities for making ITS integration cost effective.

2.1 Introduction to Uses

One of the objectives of the ARIA update is to integrate with regional planning processes. The main focus of this chapter is to outline how the ARIA can be used in coordination with planning processes within the Anchorage region. In addition, this chapter also highlights the other uses of the architecture, identifies potential users, when to use the ARIA, where to find it, and why someone would use the architecture.

2.1.1 General Planning Uses

Coordination and integration of planning processes with the ITS Architecture can provide many benefits. One major benefit is that the architecture can support and help define goals and objectives of planning processes such as the Congestion Management Process (CMP) and the Metropolitan Transportation Plan (MTP).

For general planning processes, the ARIA service areas can be used as a starting point for coordination using project categories of potential projects. By identifying what category the potential project belongs to, the user can identify the potential service areas that are associated with that project. This mapping of project categories, potential projects, and service areas is summarized in Table 1.

Table 1. Mapping of ITS/Operational Projects to Architecture Service Areas

Project Categories	Potential Projects	Service Area
Traveler Information Systems	• Detector systems • Probe data systems • Dynamic message sign • Highway advisory radio • 511, web site mobile services	• Archived Data Services • Network Surveillance (AKIA) • Arterial Management • Traveler Information • Roadway Maintenance and Construction • Transit Operations

Project Categories	Potential Projects	Service Area
Signal Improvements	• Intersection upgrades • Corridor upgrades • Retiming • Central control • Emergency preemption	• Archived Data Services • Arterial Management • Traveler Information
Transit Signal Priority	• Intersection priority • Corridor priority	• Arterial Management • Traveler Information • Transit Operations
Transit ITS Operations	• AVL deployment • Automated passenger count system • Fare collection upgrade • Bus safety and collision avoidance systems	• Transit Operations • Traveler Information • Archived Data Services
Carpooling and Vanpooling Systems	• Dynamic ride matching • HOV lanes	• Archived Data Services • Network Surveillance (AKIA) • Arterial Management • Traveler Information
Non Motorized ITS and Operations	• Safety warning systems • Bikeshare system	• Archived Data Services • Arterial Management
Freeway Management	• Detection and Surveillance System • Traffic Management Center • Ramp Metering • Active Traffic Management	• Archived Data Services • Network Surveillance (AKIA) • Traveler Information • Roadway Maintenance and Construction
Emergency Management, Incident Management	• Service patrol • Emergency signal preemption • Emergency center – transportation center links	• Traffic Incident Management (AKIA) • Regional Traffic Management (AKIA) • Arterial Management • Traveler Information • Roadway Maintenance and Construction • Transit Operations
Road Weather Management	• Road weather information systems • Mobile sensors • Winter maintenance decision support	• Archived Data Services • Road Weather Data Collection (AKIA) • Weather Information and Processing and Distribution (AKIA) • Arterial Management • Traveler Information • Roadway Maintenance and Construction • Transit Operations

Project Categories	Potential Projects	Service Area
Construction and Workzones	• Work zone monitoring systems • Active traffic management	• Archived Data Services • Arterial Management • Traveler Information • Roadway Maintenance and Construction

Based on this mapping, users can easily identify how certain ITS/Operational projects relates to the ITS architecture. This is a great starting point for integrating with planning processes as it identifies at a high level the portions of the architecture that may be relevant to the project. Additional information pertaining to the uses of the architecture is summarized in the following sections.

2.1.2 Where to Find the ITS Architecture?

The Anchorage Regional ITS Architecture update document can be found on the Anchorage ITS Department website at:

http://www.muni.org/Departments/OCPD/Planning/AMATS/Pages/ITS1.aspx

The Anchorage Regional ITS Architecture update is stored in a Turbo Architecture™ file. [Access to this file for download only is open to anyone who cares to download the file. (Changes can only be made by authorized stakeholder members involved in the update and maintenance process.)]

2.1.3 Who Should Use the ITS Architecture?

Members of the identified stakeholders involved in the planning and/or development of projects relating to ITS in the Anchorage region should use this architecture. These members are most likely staff members of transportation related public agencies in the Anchorage area.

As a result of the posting of the ITS architecture on the department website, this is also made available to the public, who could potentially view the document for information.

2.1.4 When to Use the ITS Architecture?

The updated ARIA should be used when ITS related projects are involved, whether the project is in the planning or implementing phases. This also applies to the development of long range transportation plans in Anchorage.

2.1.5 Why Use the ITS Architecture?

The ARIA provides stakeholders with the opportunity to further improve on the MOA's regional ITS functions and operations. The identification of possible ITS implementation can result in new ITS projects that are consistent with the regional plans. The architecture provides possibilities without forcing the stakeholders to make commitments regarding project implementation or technologies used.

2.1.6 What are the Uses of the ITS Architecture?

The uses of the ITS architecture includes, but is not limited to the following:

- Gathering general ITS architecture information
- Identifying regional ITS goals and objectives
- Identifying current and future stakeholders involved in ITS operations and maintenance
- Identifying roles and responsibilities of stakeholders
- Viewing standards applicable to the ITS architecture
- Viewing existing ITS agreements in the region
- Examining current and proposed ITS functions, connections, and data exchanges
- Integrating ITS into transportation plans, including the Metropolitan Transportation Plan (MTP) and Congestion Management Process (CMP)
- Integrating ITS into the with programming processes
- Developing ITS projects
- Designing ITS projects

2.2 How to Use the Architecture in the CMP and MTP Processes?

2.2.1 CMP Background

The development of a Congestion Management Process (CMP) is required according to Federal regulation 23 CFR 450.32. CMP involves the formulation of operational and travel demand management strategies to effectively manage transportation facilities. The process also provides information to decision makers on system performance and implemented strategy effectiveness. These strategies can be reflected in the Metropolitan Transportation Plan (MTP) and the Transportation Improvement Program (TIP). The steps associated with the CMP may vary across different regions, but are generally similar:

- Develop Regional Objectives
- Define the Network for the CMP
- Develop Multimodal Performance Measures
- Collect Data and Monitor System Performance
- Analyze Congestion Problems & Needs
- Identify and Assess Strategies

- Implement Strategies
- Evaluate Effectiveness

The Anchorage CMP update process occurred during the same general timeframe as the ARIA update. Hence, coordination of the ARIA update with the Anchorage Metropolitan Area Transportation Solution's (AMATS's) CMP update was performed to integrate the two processes.

2.2.2 MTP Background

The Metropolitan Transportation Plan (MTP) was originally developed as a part of a Federal transportation legislation called Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2005. The 2035 MTP for Anchorage was approved in 2012. The MTP aims to guide the development and the application of transportation improvement strategies that directly affects the transportation system long term. Specifically, the MTP transportation improvements look into more than 20 years into the future. The 2035 MTP for Anchorage can be found on the municipality planning department website:

http://www.muni.org/Departments/OCPD/Planning/AMATS/Pages/2035MTP.aspx

AMAT's MTP involves a wide range of stakeholders and is implemented following the framework outlined in Figure 1. Figure 1does not display the connections to the ARIA or the CMP, which are established in Section 2.2.3.

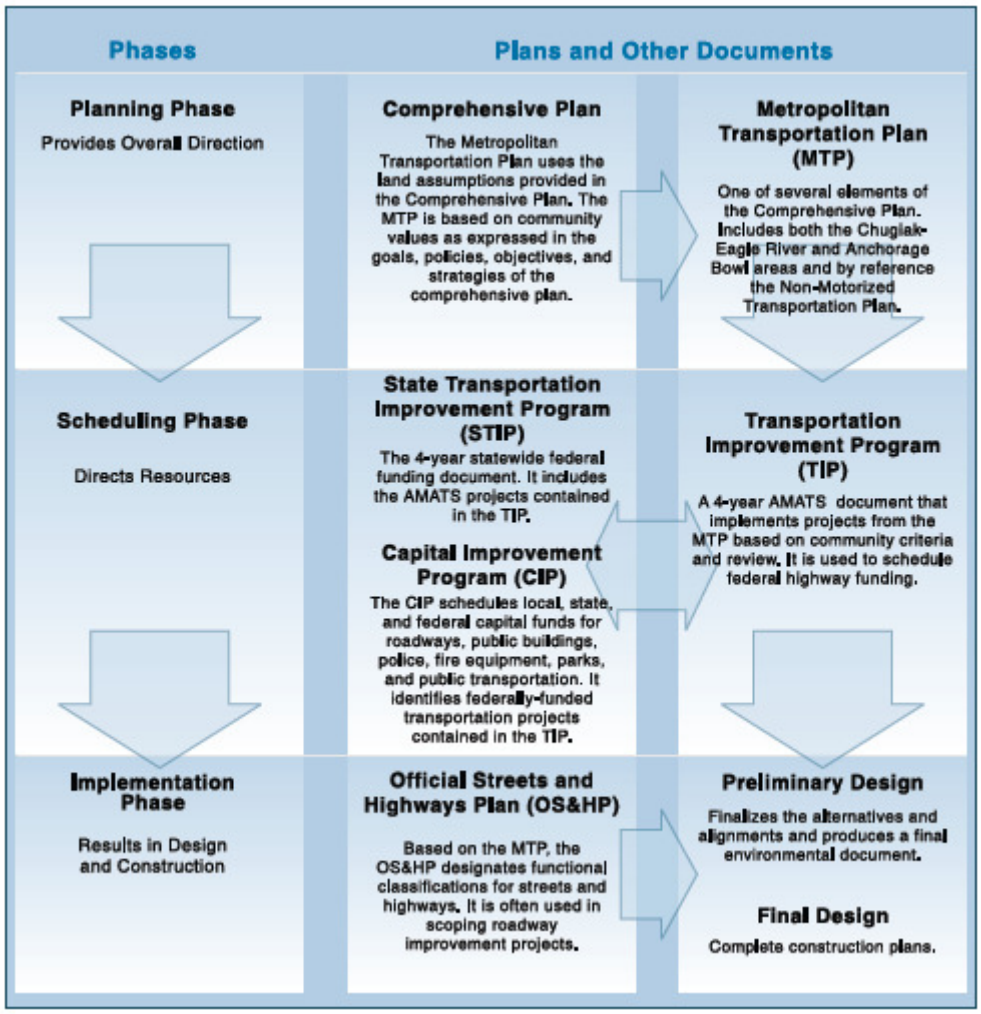

Figure 1. AMATS MTP Process

2.2.3 Integration with Planning Processes

The ITS architecture identifies operations and technology integration techniques, while the CMP identifies performance measures that may require technology utilization. The ITS strategies identified in the architecture should be included in the CMP because it complements the performance measures identified using technology. Since strategies developed in the CMP can be reflected in the MTP, integration of the ITS architecture and planning processes makes sense.

Both the CMP and the MTP follow a series of general planning steps. Each of these planning steps can be coordinated with the ITS Architecture in terms of extracting information and making changes as necessary. The planning steps, the method of coordination with the ITS Architecture, and the output from the coordination are all summarized in Table 2. The proposed touch points with the ITS Architecture are shown in bold.

Table 2. Planning & ITS Architecture Coordination

CMP or MTP Planning Step	Coordination with ITS Architecture	Output
1. Goals and Objectives	**1. Identify key ITS Architecture stakeholders associated with each goal area (safety, mobility, etc.)**	List of contact information for ITS stakeholders for each goal area
2. Identification of Needs and Deficiencies (using performance measures)	1. Categorize those needs and deficiencies which could be addressed all or in part with ITS solutions	List of needs and deficiencies that may have ITS solutions
3. Development of Alternatives	1. Use output list identified in step 2 to and identify potential ITS and operational solutions. **2. Review ITS architecture to determine whether proposed solutions are included** 3. For those solutions included identify key stakeholders	List of potential ITS solutions, whether or not they are currently in the architecture and key stakeholders (if included)
4. Refinement of Potential ITS Solutions	1. Define ITS alternatives, including geographic scope and technology 2. Determine whether project is stand-alone or should be incorporated into capital project 3. **Review ITS architecture for refinement – identify linkages, data flows and stakeholders** 4. Refine project definition as needed	List of refined ITS solutions to be evaluated
5. Evaluation of Alternatives	1. Conduct evaluation of ITS alternatives identified in step 4 Output.	Evaluation Report of Potential ITS Solutions identified in step 4.
6. Project Selection and Prioritization	1. Develop project ranking / selection criteria. 2. Rank ITS projects and develop prioritized list, applying ranking/selection criteria developed in step 1. 3. Reprioritize based on financial constraints **4. Identify needed changes and/or additions to ITS architecture based on selected project list**	Final list of prioritized ITS projects, based on fiscal constraints Update the ITS Architecture to reflect changes based on final list of prioritized ITS projects. For projects not in ITS define full architecture inputs, including stakeholders, service packages and data flows

For project ranking in the Anchorage TIP, see criterion 13 for ITS projects at the following website: http://www.muni.org/Departments/OCPD/Planning/AMATS/Documents/2015-2018%20TIP/TIP%2015-18%20Roadway%20Criteria%20PC%20Final%2020130627.pdf

In addition, institutional arrangements should be made to ensure that the proposed coordinating activities take place. These include:

- Establishment of clear ownership and responsibility for making changes to the ITS Architecture.
- Establishment of contact personnel for each key stakeholder organization.
    - Ensure that this position continues to be filled through personnel changes
- Identification of ITS owners and operators at the beginning of planning processes (e.g. CMP and MTP).
    - Maintain contact to ensure that the designated individual(s) are involved in the planning activities.
- Establishment of a shared system in which updated ITS Architecture documents are available.
- Inclusion of ITS Architecture coordination in the scope and work plans for the CMP and MTP with an adequate budget attached.
- Ensure availability of ITS and Operations tools and expertise in their use with TOPS-BC capability as a minimum.
- Establishment of a standard form that can be used to submit changes to the ITS Architecture owner, including:
    - Project description
    - Proposed technology
    - Geographic scope
    - Key stakeholders & their roles
    - Sources and receivers of system data
    - Linkages to other systems

It should be noted that all changes do not have to be made dynamically but can be a part of periodic updates.

2.2.4 Planning Processes Flow Charts

In addition to the planning and ITS architecture integration methods outlined in Section 2.2.3, FHWA also created flow charts to document the linkages between planning and ITS architectures. One of these flow charts displays the CMP process, which does not directly incorporate the ITS architecture process. This chart is presented in Figure 2, and although it doesn't show direct linkages to the ITS architecture process, the M&O process on the right hand side of the diagram can be considered to include it. The "Systematic process to develop and select M&O Strategies to meet objectives" step in Figure 2 - Figure 4 embodies what would be included in an ITS strategic plan or Operations/ITS plan.

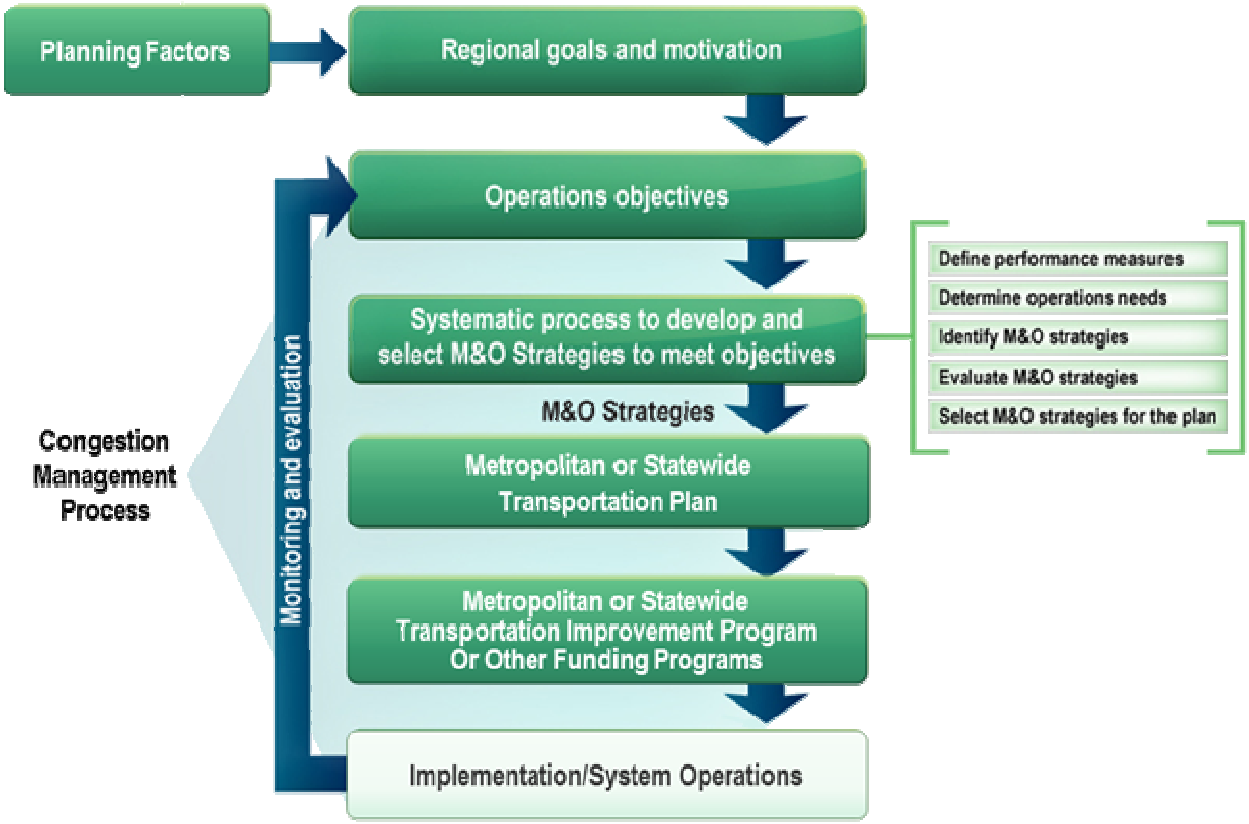

Figure 2. CMP Process (source: FHWA Planning for Operations)

Another one of these flow charts display the points of possible integration between the MTP process and the ITS architecture process. This chart is presented in Figure 3 with the MTP process on the left hand side, and the ITS architecture process on the right hand side.

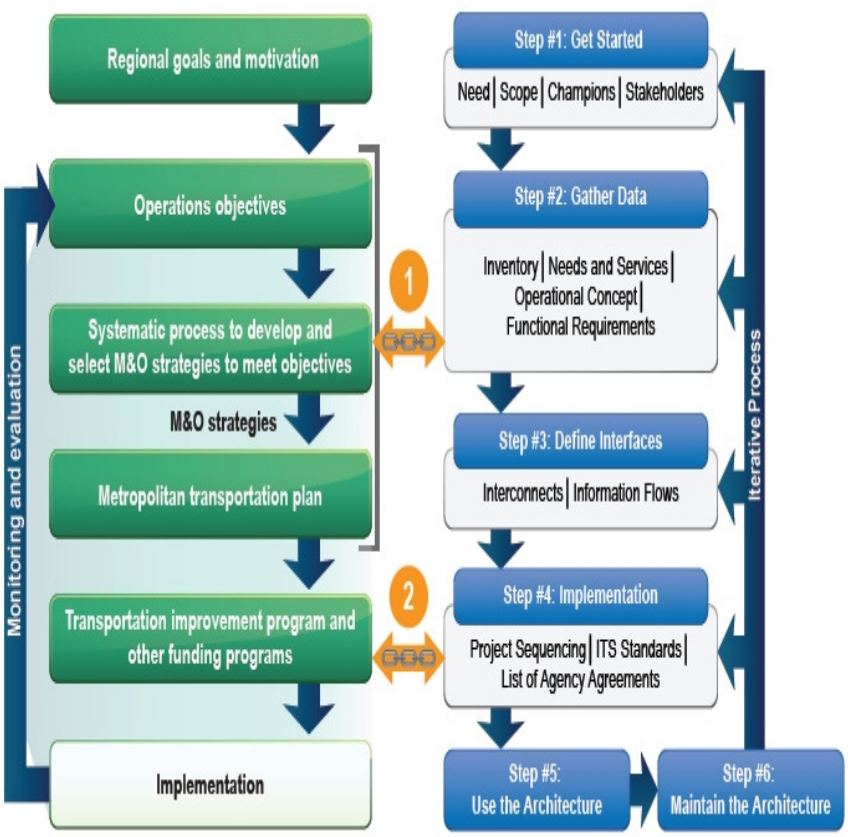

Figure 3. MTP and ITS Architecture Process (source: Planning for Operations Manual)

FHWA also created a flow chart to present how ITS architectures can link to both Operational Planning and Regional Planning efforts. This chart is displayed in Figure 4.

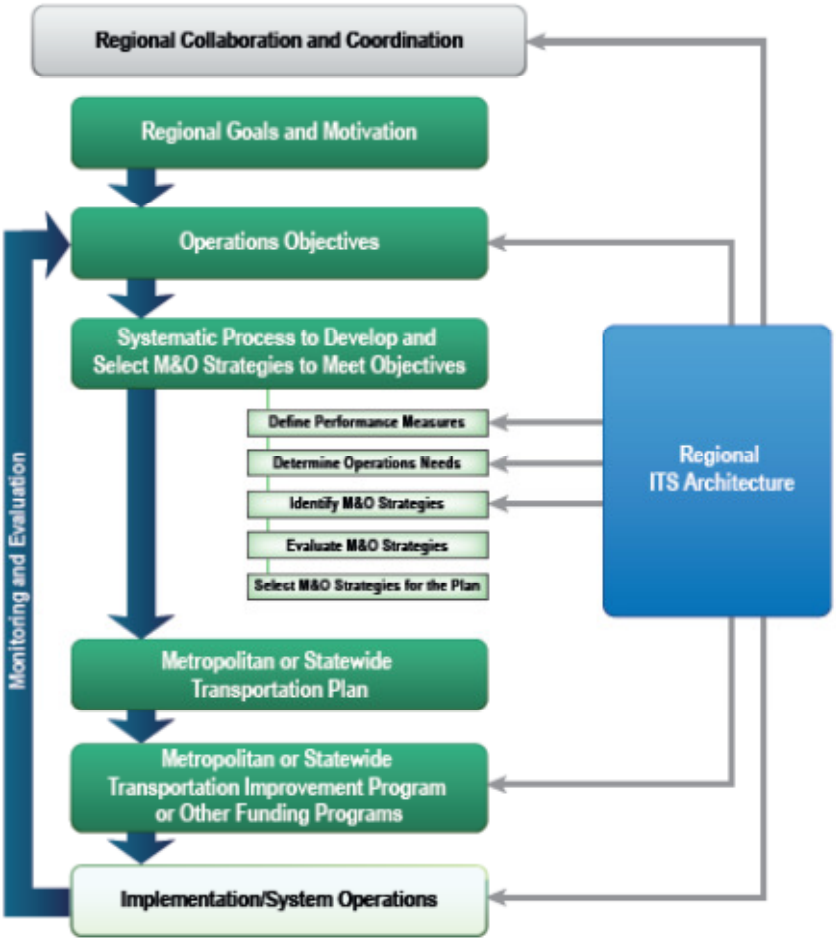

Figure 4. ITS Architecture in Planning for Operations (source: Turbo Architecture website)

2.3 How to Use the Architecture When Programming Projects?

2.3.1 Using the Architecture for Programming Projects

Before a project can be implemented, a plan of action must be completed to determine the feasibility of the project and identify what needs to be done. The ARIA is a great source to support the programming process of ITS projects.

Being in conformity with USDOT policies, regional ITS architectures contain information that is beneficial when programming projects. When programming projects that include ITS elements, it is important to identify the proposed ITS activities, elements, and projects in the ITS architecture. This will paint a clear picture of the status of ITS in the region.

The next step is to identify the stakeholders who may need to be involved as projects move forward. The ARIA has stakeholders identified for both existing and proposed systems for the Anchorage region. If a similar project has already been proposed, then potential stakeholders have already been identified. This helps to reduce repetitive steps in the process. If the project has not been proposed, the programmers can see how their project may fit into the overall system.

In addition, feedback can be provided to the architecture if new ITS elements or activities are not represented. This will help with the maintenance process of the architecture as well. An example of a potential project programming process is the implementation of CCTV traffic cameras for network observation. The process is similar to the planning approach where the user can identify the service area that relates to traffic cameras or camera images (in this case that would be the Traveler Information service area). Another way is to search for the term "camera" in the architecture document so see where it fits into the overall framework.

2.3.2 Institutional Requirements for Programming Projects

When using an ITS architecture to support program development, institutional requirements need to be fulfilled. One such requirement would be to identify an ITS "owner" for program development. This would be a staff person that program managers can consult with regarding the architecture. Furthermore, continuous architecture coordination needs to be performed during program development to ensure ITS projects, elements, and activities are in the architecture. Finally, knowledge of the existence of the architecture and the Use and Maintenance document is critical.

2.4 How to Use the Architecture in Project Development?

2.4.1 Using the Architecture for Project Development

An ITS architecture can continue to provide support in the project development phase. The ITS architecture can be used to identify proposed projects and/or project elements in the region. If a project or project elements have already been proposed, the ITS architecture can provide project developers with a head start in the process. The ITS architecture also provides information to aid in the completion of the Systems Engineering Checklist, which is required for ITS projects that use Federal funds. Information on what Systems Engineering Checklist components can be found in the ARIA are summarized in Table 3. Finally, by using the ARIA in this phase, the user can provide feedback to the architecture if new ITS elements or activities are not properly represented in the ARIA so that changes can be made.

Table 3. Systems Engineering Components in the ARIA

Systems Engineering Component	Does ARIA Provide It? If So, Where?
Portions of the Regional ITS or Statewide Iways Architecture being implemented.	Yes, for regional concepts. Service Areas, Chapter 4 and Appendix C.
Participating agencies roles and responsibilities.	Yes. Stakeholders identified for Service Areas, Chapter 4 and Appendix C.
Requirements definitions.	Yes, if no Concept of Operations exists. Requirements by Service Area, Appendix C.
Analysis of alternative system configurations and technology options to meet requirements.	No.
Procurement option(s).	No.
Applicable ITS standards that are being implemented and testing procedures that will be used upon project implementation.	Yes. Appendix E.
Procedures and resources necessary for operations and management of the system.	No.

2.4.2 Institutional Requirements for Project Development

Similar with the process for using the architecture with program development, institutional requirements need to be met. The ITS "owner" for project development should be identified. This is a staff person that project managers can consult with regarding the architecture and how to use it. This is especially important for the Systems Engineering Checklist. Architecture coordination during project development also needs to be performed to ensure that ITS projects and/or project elements are in the architecture. Finally, knowledge of the existence of the architecture and this document is critical.

2.5 How to Use the Architecture for Design?

2.5.1 Using the Architecture

The ARIA can also be useful during the project design phases. If no Concept of Operations exists for the project, the requirements for project design can be identified within the ARIA. The ARIA includes an Operational Concept chapter in which service areas with differing purposes are presented. These service areas are supported by functional requirements tables that can assist a project designer in identifying the requirements needed for a project. Additionally, interconnects and flows identified in the ARIA can narrow down what needs to be included in the system design. Standards are also included the ARIA, which can be used to help identify standards for project specification. Similar to the previous project phases, discovery of missing or outdated items in the architecture would be useful for updating and changing the architecture.

An example of a project design phase that is supported by the ARIA could be the deployment of new detectors in the Anchorage region. The project designer would start by identifying the service area in which the project design most closely relates (in this case that would be the Arterial Management service area). Another way to do this is to simply search the document for project keywords such as "detect." This will result in instances of "detector" or "detection" in the ARIA. Appendix C Functional Requirements for the service area can also be used to find instances of the search word for requirements pertaining to the design. Appendix E for that service area provides the standards, which can be used to narrow down the search of relevant standards for project design.

2.5.2 Institutional Requirements

As with the program and project development phases, institutional requirements need to be met for the project design phase as well. The ITS "owner" for the design process also needs to be identified. This is the staff person that project designers can consult in regards to the architecture and how to use it. As with the other phases, architecture coordination and knowledge of the existence of the architecture and the Use and Maintenance document is critical. Architecture coordination during the design phase can help to identify requirements and standards. In addition, a policy or accepted practices in regards to the standards need to be created. This includes a way to determine which standards to use, identifying local standards, and how to access them. Finally, institutional knowledge of the project's existing Concepts of Operations is critical.

3 Maintenance of the ITS Architecture

The FHWA Rule 940 states that agencies and stakeholders that are involved in the development of the regional ITS architecture must develop procedures and responsibilities for maintaining the architecture as needs change with time across the region. The maintenance of an ITS architecture is a critical component and was therefore mandated by FHWA.

This section presents the maintenance approach for the Anchorage Regional ITS Architecture. This plan identifies how the regional architecture update will be kept current based on stakeholder input and Federal policies. Integration with transportation planning processes can result in new priorities and strategies as time advances. Technology also has a tendency to change and evolve with time at rapid rates. Maintenance of the ARIA is imperative for enhancing the usefulness of the architecture in the future.

The maintenance section was created based on the original maintenance plan developed for the original ARIA. The plan was adopted in 2012 and this section adjusts the plan as necessary to make it more compatible with the ARIA update.

3.1 Who Should Maintain the ITS Architecture?

AMATS was the primary party responsible for maintaining the original ARIA. There is no reason to shift this responsibility to a different entity. However, AMATS should have the ability to share some of this responsibility on a project-by-project basis. Different projects may result in necessary changes in roles and responsibilities of involved stakeholders. In such cases, it is recommended that AMATS gathers input from stakeholder participants to make changes to the architecture. Since the input may come from different sources, it may be difficult for an individual to effectively make updates. In this case, AMATS should assemble a panel of representatives from each applicable agency to help implement updates and changes. This is essentially a multi-agency maintenance committee where tasks can be divided and a common method for updates can be agreed upon for the duration of the project. This also allows for agencies to become more involved in the update process and everyone will be on the same page when changes need to be implemented. AMATS may also elect to hire a consultant to maintain the architecture.

When selecting individual(s) to be responsible for updating the architecture (whether it is an AMATS individual, a multi-agency committee, or consultants), it is important that at least one person is well-versed with the Turbo Architecture software. Maintenance of the architecture implies maintenance of both of the architecture products: the report document and the Turbo Architecture database file.

Maintenance of the report document itself does not require a high level of expertise compared to the Turbo Architecture file. Changes made to the report document are dependent on the changes made to the database file, therefore selecting an individual responsible for working with the file is critical. If finding individuals experienced in the Turbo Architecture software becomes an issue, training is available for free online by visiting the National ITS Architecture website:

http://www.iteris.com/itsarch/html/training/training.htm

Following the directions on the National ITS Architecture website will direct the user to the National Highway Institute (NHI) website where the user has to sign up for the Turbo Architecture training. It may be beneficial for multiple individuals to partake in the online training for Turbo Architecture so that more people are capable of handling the file for maintenance or using it for other means.

3.2 When Should Maintenance of the ITS Architecture Occur?

It is recommended that major changes within the region be reflected in the ARIA as soon as possible. By implementing major changes in a timely manner, it keeps the architecture up-to-date for potential future projects. Major changes could include changes to the regional user needs or ITS system functions that results in the architecture purposes to no longer be accurate. A major change could also be the addition of a major new element or system to a service area. For example, a major change could be the implementation of a new technology, such as connected vehicles. The architecture should be updated to reflect that change within a few months, and not 4-5 years later.

In the instance of a minor change, such as a new type of information flow between existing elements, an update to the architecture is not as pressing. In such cases, an update to the architecture should be implemented when time is convenient for the maintainer(s). If there are multiple minor changes that could be approaching in the near future, it may be beneficial to wait to apply those updates to the architecture all at once.

In order to keep the maintenance process efficient, it is recommended that a list of changes that need to be added to the architecture be managed so that they are not forgotten. (See Section 3.5.1) However, consideration should be given for the time and resources required to maintain such a list. Consideration for the resources required to update the architecture should also be given as it can be a time consuming task. Planning in advance will allow for funds and time to be properly allocated so that updates can be completed in an efficient manner.

If no major ITS changes have occurred within the region for an extended period of time, a workshop should take place to gather stakeholder input on regional changes. At this workshop, relevant stakeholders can discuss any changes that have occurred since the last update. If no significant changes can be identified, potential future changes can be discussed. The results of the workshop will determine whether an update to the architecture is needed. These workshops should occur, at a minimum, once every five years if no changes have been identified within that time. Otherwise, the update process should be a change responsive process and not an interval one.

In addition, the development stages of the MTP involve coordination and review of the architecture. In such a case, users may be prompted of changes that should be made to the architecture during the review. This provides an opportunity to identify the necessary steps to maintain the architecture.

3.3 Why Should Maintenance of the ITS Architecture Occur?

There are many reasons to revise or update the ARIA. The degree of the change to be made depends on what those reasons are. Minor reasons may result in only a few chapters to be changed in the document. Understanding the reasons to update the architecture will make the update process easier. Some potential reasons that are based on changes in the region and are outlined below:

- Changes in Regional Needs
  - As transportation problems are solved and new ones arise, needs could change.
  - New stakeholders could result in changes in needs.
- Changes in Institutional Framework
  - Prior stakeholders may no longer be relevant as projects end and agencies split/merge.
  - New stakeholders may become regionally relevant with new needs and ITS.
- Changes in Project Definition
  - Proposed ITS projects may be modified (elements, connections, flows, functionality, or implementation), therefore the architecture needs to be modified accordingly.
- Changes in Project Acceptance and Status
  - Addition, modification, or elimination of projects could result in necessary changes to the architecture.
  - Changes in project status are to be reflected in the architecture (e.g. planned, existing, etc.).
- Changes in Project Priority
  - Project implementation delays may occur due to funding complications or institutional matters, which may affect implementation of other projects. An architecture update may be needed.
  - Project implementation may be advanced due to increased need, which may affect other projects' implementation. An architecture update may be needed..
- Changes in the National ITS Architecture Framework
  - Changes to the National ITS Architecture and the Turbo Architecture software may result in changes to user services, subsystems, and flows. The architecture may need to be updated accordingly.
- Changes to FHWA Rule 940 and other Federal Statues
  - FHWA Rule 940 has specific requirements for the development of a regional ITS architecture. Some of these requirements include identifying stakeholders, roles and responsibilities, agreements and standards. Although these requirements are not likely to be taken down any time soon, but there is always the possibility of modifications in the future. Changes in Federal policies such as FHWA Rule 940 need to be reflected in the architecture.

3.4 What is Maintained in the ITS Architecture?

The ITS Architecture consists of two main products: the ARIA documentation and the Turbo Architecture database file. The FHWA Rule 940 and FTA National ITS Architecture Policy on Transit Projects identifies components required in ITS architecture development. These components are listed below, along with where to find them within the architecture products.

- Description of the region
  - Document
    - *Section 1.1.1 Description of the Region*
  - Turbo Architecture File
    - A description of the region was not inputted into the Turbo Architecture file. However, the user may choose to do so in the *Start* tab if desired.
- List of stakeholders
  - Document
    - *Section 3.2 Stakeholder Outreach*
  - Turbo Architecture File
    - *Stakeholders* tab of the respective service area
- Operational concept
  - Document
    - *Chapter 4 Operational Concept*
  - Turbo Architecture File
    - Each service area is displayed as separate "Project architectures" that can be selected in the *Start* tab. The best way to examine the operational concept is to output a flow diagram for each service area. Do not mistake the *Ops Concept* tab in Turbo for operation concept in the document. The *Ops Concept* tab is actually for inputting stakeholder roles and responsibilities.
- Agency agreements
  - Document
    - *Chapter 7 Agreements*
  - Turbo Architecture File
    - Agreements were not inputted into the Turbo Architecture file. However, there is an *Agreements* tab where agreements can be inputted if desired.
- Functional requirements
  - Document
    - *Appendix C: Functional Requirements*
  - Turbo Architecture File
    - *Requirements* tab of the respective service area
- Existing and planned interconnects/flows
  - Document
    - *Appendix D: Architecture (Data) Flows & Flow Diagrams*. *Chapter 4 Operational Concepts* also displays some flows in the diagrams. *Chapter 5 Interfaces and Information Exchanges* displays the interconnect diagram.
  - Turbo Architecture File
    - *Interfaces* tab
- Applicable ITS standards

- Document
  - *Chapter 6 Standards* and *Appendix E: Standards*
- Turbo Architecture File
  - *Standards* tab of the respective service area

- Project sequencing
  - Document
    - There was no project sequencing in this project.
  - Turbo Architecture File
    - N/A

Aside from the FHWA requirements for ITS architecture development, maintenance of the architecture products should cover all of the product components. The components of the Turbo Architecture file are summarized in Section 3.4.1.The components (chapters and sections) of the ARIA document are summarized in Section 3.4.2. The chapters and sections in the document should be checked first, and the database file components should be checked after.

3.4.1 Turbo Database Structure & Components

The Turbo Architecture file contains the physical ITS architecture for the Anchorage region. Changes made in this file need to be completed carefully so that future changes can be completed with relative ease. Use of the software also allows for an easy comparison of the regional architecture to the Statewide and National ITS Architecture. Any future updates to the National ITS Architecture should result in an update the Turbo Architecture software to reflect those changes.

In the construction of the ARIA update, the same sequence outlined by the FHWA for developing a regional ITS architecture was followed. That process can be reviewed by examining the FHWA Regional ITS Architecture Guidance Document's flow chart at:

http://ops.fhwa.dot.gov/publications/regitsarchguide/2procoverview.htm

In the Turbo Architecture software, there are 10 tabs in which data can be inputted to build a regional architecture. These 10 tabs are displayed at the top of the program interface as shown in Figure 5.

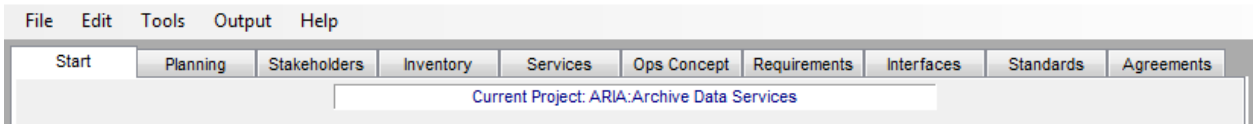

Figure 5. Turbo Architecture Tabs

A short description of each tab in Turbo Architecture is presented:

- Start
  - This tab is where architectures can be managed within a single file. The user can create a regional architecture and multiple project architectures.
- Planning
  - The planning tab is where the transportation planning process objectives and strategies can be linked to the ITS architecture components. **This tab was not used in the ARIA.**
- Stakeholders
  - This is the tab where stakeholders are inputted into the architecture. Users can group similar stakeholders performing similar functions into a stakeholder group.
- Inventory
  - This is where the user can input the ITS elements into the architecture
- Services
  - This tab allows for the user to associate elements inputted in the Inventory tab to National ITS Architecture defined service packages. **This tab was not used in the ARIA**
- Ops Concept
  - The Operational Concepts tab allows for the user to specific the roles and responsibilities of the stakeholders in the architecture. Users can create project areas that narrow down the responsibilities to specific service packages.
- Requirements
  - This tab is where the user can specify the functional requirements of each architecture element.
- Interfaces
  - This tab is where the architecture interconnects and flows are built from the inputted data in the previous tabs.
- Standards
  - This tab contains a list of standards that apply to the selected flows in the interfaces tab. This list of standards is automatically populated based on the interface tab.
- Agreements
  - Users can input agreements amongst different stakeholder agencies in this tab. **This tab was not used in the ARIA.**

In summary, the maintainers of the Turbo Architecture file only need to check seven out of the 10 tabs available in the software. They do not need to worry about updating the Planning, Services, and Agreements tabs as they were not used and therefore contain no information to be updated.

The existing National ITS Architecture service packages were not able to be used for the ARIA update. Tailored flows were needed for the ARIA in order to reflect the needs of stakeholders in the Region. Customizing service packages with user defined flows to be logically included within service packages was impossible due to the lack of this capability in Turbo Architecture

version 7.0. A workaround was used to address this issue. Customized individual service areas were created as single project architectures instead. By creating each service area as individual project architectures, Turbo Architecture was able to display the tailored flows in project architecture flow diagrams.

In addition, the services tab was not used because the benefits of using service packages did not outweigh the work required for the implementation and maintenance of service packages in the ARIA. Creating service areas that consist of flows from varying service packages without using service packages themselves reduces extra steps and simplifies the architecture. By removing this extra layer of complexity, the ARIA becomes easier to use and maintain.

There are five service areas created as project architectures within the Turbo database. These four service areas are labeled as:

- ARIA: Archive Data Services
- ARIA: Arterial Management
- ARIA: Roadway Maintenance and Construction
- ARIA: Transit Operations
- ARIA: Traveler Information

These five service areas are treated as project architectures and can be accessed in the *Start* tab as shown in Figure 6.

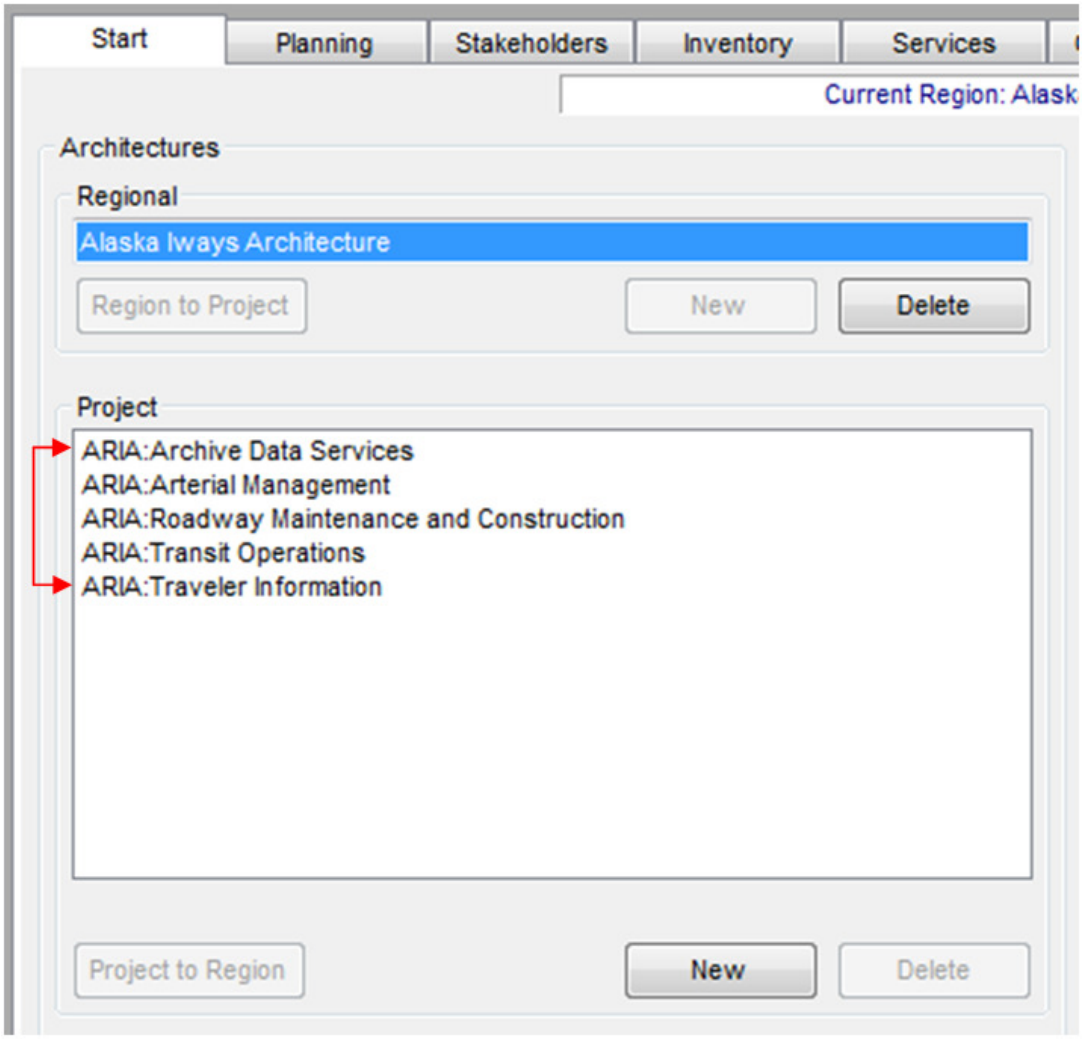

Figure 6. ARIA Service Areas in Turbo Architecture

It is recommended that the review of the architecture products should be completed in sequential component order starting with the Turbo Architecture file. When checking for changes to be made in the Turbo Architecture database, the maintainer should start with the *Start* tab, and end with the *Agreements* tab (assuming anything is input into the *Agreements* tab). Certain tabs build on each other, therefore it is important to follow this order.

After the Turbo file has been updated, the document should be next in line. The update process for the document follows the same idea as the Turbo database. The maintainer should start with Chapter 1 and end with Appendix E, just as outlined in Section 3.4.2. Similar to the Turbo file, each chapter builds upon one another in the report; therefore it is important to perform updates in this order. Essentially, the documents start with high level concepts and moves to more specific details further into the report.

3.4.2 Document Structure & Components

The ARIA update document is broken up into seven major chapters and five appendices that outline the revamped architecture. These seven major chapters are as follows:

- Chapter 1: Introduction
  - This chapter provides an overview of the update process, including the contents of the report, the description of the region, timeframe, and purposes and objectives.
- Chapter 2: Background
  - This chapter summarizes the past events and projects that lead up to the implementation of the ARIA update.
- Chapter 3: Processes and Outcomes
  - This chapter mainly focuses on the key stakeholders involved in the ARIA update process.
- Chapter 4: Operational Concept
  - This chapter presents the service areas that were tailored from the National ITS Architecture to support the stakeholder needs and regional goals. This includes the architecture flow diagrams and the stakeholder roles and responsibilities in each service area.
- Chapter 5: Interfaces and Information Exchanges
  - This chapter displays an overview of the interconnects and flows used in the ARIA.
- Chapter 6: Standards
  - This chapter discusses the standards that may be applicable to the flows identified in the ITS architecture.
- Chapter 7: Agreements
  - This chapter outlines any existing and future agreements within the region that may be required to implement the architecture service areas.

The architecture document also contains appendices that should be checked:

- Appendix A: Glossary of Terms
  - This appendix provides a list of definitions for words used in the document as well as key words relating to the National ITS Architecture.
- Appendix B: Architecture Flow Definitions
  - This appendix differentiates user-defined flows and default National ITS Architecture flows used in the ARIA. It also provides a description of what the flow entails.
- Appendix C: Functional Requirements
  - This appendix provides the requirements of individual elements within each service area as well as the high-level status of each.
- Appendix D: Architecture Flows
  - This appendix presents the every flow documented in each service area. To aid in the interpretation of the flows, service flow diagrams are provided as well.
- Appendix E: Standards
  - This appendix displays the standards applicable to each service area.

3.5 How to Maintain the Architecture?

The maintainer(s) of the ARIA should have a few minimum required responsibilities. These responsibilities include:

- Informing agencies and departments of meetings and workshops with the purpose of measuring current ITS activities that may have an impact on the maintenance of the architecture.
- Archiving files and documents (electronic or hardcopy) and sending them out to agencies as needed.
- Performing architecture updates as changes are approved.
- Maintaining a list of changes to that need to be made to the architecture.
- Maintaining a change log of the architecture throughout the maintenance process.
- Archiving comments in regards to the architecture and implementing them as necessary.
- Responding to stakeholders if asked how changes were made.

In order to successfully perform these responsibilities, the maintainer(s) should understand the following:

- How to manage changes to the architecture
- How to maintain the Turbo Architecture file
- How to maintain the report document

Recommended methods on the maintenance of the ARIA are summarized in the following sections.

3.5.1 How to Manage Changes

Before any changes are to be made to the architecture products, the changes should be approved by the appropriate authority figure. In this case, that should be AMATS. By developing a change management process, the maintenance approach becomes more standardized and less confusing. Tracking changes made to the architecture and archiving maintenance products becomes easier as well. The maintenance plan for the original ARIA presented a sample change request form that could be used. This form has been slightly modified for this update. The modified sample change request form can be seen in Table 4. These forms should be sent to AMATS at the following address for approval before a change is implemented:

Municipality of Anchorage
Transportation Planning Section, Community Development Department
4700 Elmore Road
PO Box 196650
Anchorage, AK 95519-6650
E-mail: amatsinfo@muni.org

Table 4. ARIA Change Request Form

Architecture Change Information		
Project Name:		**Date:**
Type of Change:	□ New Element □ Proposed (funding not secured) □ Planned (funding secured) □ Under Construction (element currently being deployed) □ Existing □ Deleted Element □ Modified Element □ Changed User Need □ Changed Element Status □ Changed National ITS Architecture □ Changed ITS Standards □ Other	
Project Description & Proposed Technology		
Geographic Scope		
Description of Requested Change:		
Change Rationale:		
Agencies & Roles:	**Agency:**	**Roles:**
Sources & Receivers of System Data:		

Linkages to Other Systems:			
Additional Notes:			
Submitter Information			
Name & Title:			
Agency:			
Address:			
Phone Number:		**Email:**	

3.5.2 How to Maintain the Turbo Architecture Database

As mentioned, the changes made to the architecture should occur in the Turbo Architecture database prior to the architecture document. In order to make changes to the Turbo Architecture file, several guidelines should be followed to prevent confusion and support future maintenance work. These guidelines are summarized in the Turbo Architecture Usage Guidelines below.

Turbo Architecture Usage Guidelines

Create copies of the file

The more complex the architecture, the more difficult it is to track changes made in the Turbo file. Often times, major changes made can result in undesired consequences that can be difficult to undo. By creating copies of the file throughout the maintenance process before major changes, the user will have "restore points" in which he/she can turn back to in the event of a major mishap in the process. This is especially useful for new users of Turbo Architecture.

Track changes made to the file

Creating copies of the file helps to mitigate unintentional changes to the file. Tracking changes made to the file will help the user backtrack on minor mistakes. It also creates a timeline of changes made so if something goes wrong, it will be easier to pinpoint where and when the error occurred.

Follow naming conventions of elements, stakeholders, & tailored flows

By establishing a naming convention, the user can prevent duplicate entries and unintentionally parsed data. These are common issues when there are multiple users editing a single file. This is why a naming convention was created for stakeholders, elements, and tailored flows. The naming convention of each is summarized in Table 5.

Table 5. Stakeholder, Element, & Tailored Flow Naming Conventions

	Stakeholder Naming Convention	Element Naming Convention	Tailored Flow Naming Convention
Format	Agency/ Division	Class/ Element	.flow name.
Example	MOA/ Street Maintenance	Center/ MOA Maintenance Dispatch Office	.roadway information (plow status).
Agencies or Classes Used	• ADOTPF • Combined • MOA • NOAA • Private Sector Agency • Public • Public or Private Sector Agency	• Center • Field • Vehicle • Travelers	N/A

Following a naming convention also makes flow diagrams easier to follow and understand. It is important that maintainers are on the same page with naming convention to avoid confusion. Figure 7 displays an example of an element extracted from Turbo Architecture's flow diagrams that follows the naming convention for stakeholders and elements.

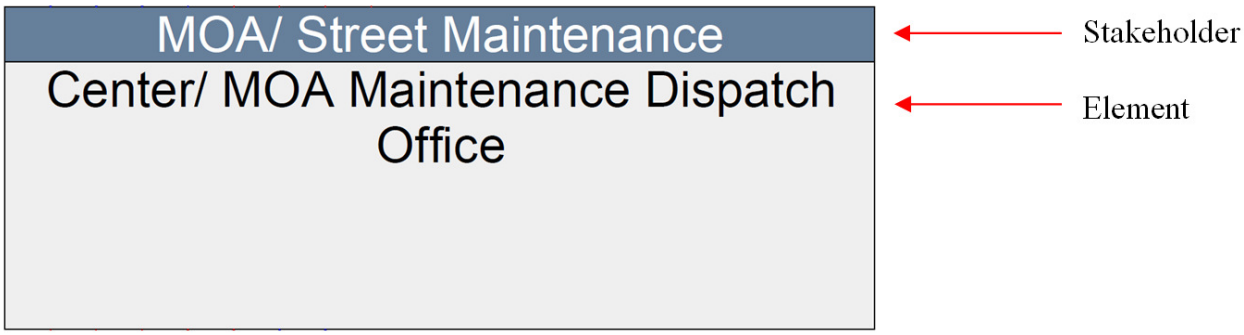

Figure 7. Turbo Architecture Element

In terms of flow naming convention, the periods before and after flow names were used as a subtle way to differentiate user-defined flows from the default National ITS Architecture flows. It also makes it easier to locate user-defined flows in the *Interface* tab of the Turbo Architecture file. For example, when flows are sorted, the user defined flows will appear at the top of the list as shown in Figure 8.

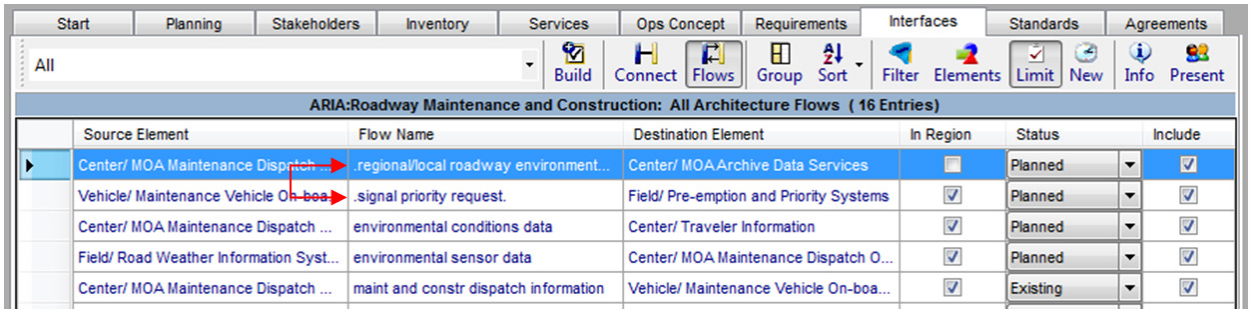

Figure 8. Sorted User-Defined Flows

Gain User Expertise

As mentioned previously, the maintenance of the Turbo Architecture file requires a higher level of expertise compared to maintenance of the document. It is recommended that the maintainer is familiar with the software or has received the proper training to make changes. This guide does not provide step-by-step instructions on how to perform tasks in Turbo Architecture. For high level of detail instructions, training for the Turbo Architecture software is available. Training for the Turbo Architecture software is free online via a sign-up process. For more information on how to receive online training, please refer to the following link:

http://www.iteris.com/itsarch/html/training/turbowebbasedtraining.htm

In addition, the user should be familiar with the overall scope of the architecture. The more the user understands the goals and purposes of the components of the architecture, the easier it is to make changes. Understanding why a change is made will clear up confusion and limit potential mistakes when editing the file.

Updates to Service Areas

As mentioned, service areas were created as individual project architectures for the ARIA update to create data flow diagrams that were better suited for the stakeholder needs. As of version 7.0 of the Turbo Architecture software, this is a workaround for a lack of the software's capability to create flow diagrams that display tailored service packages. In addition, creating these service areas as separate project architectures will make them more accessible and easier to understand. Updates to the ARIA are to be completed via the individual project architectures. Since these project architectures use elements and stakeholders from the overall "regional architecture," changes made to these components in one project architecture will be automatically reflected in the rest of the projects.

To update a service area, the maintainer should use the same approach to update an overall regional architecture. The user selects the service area project architecture from the *Start* tab and check for changes to be made in the other tabs. Once a service area has been selected from the *Start* tab, every tab that follows it applies to that service area. For example, the stakeholders tab will only display stakeholders directly involved in that service area. Updating the architecture will involve making changes to each service area as necessary.

Adding Service Areas

As mentioned, service areas were used instead of the National ITS Architecture service packages to tailor the architecture to the situation in Anchorage. Essentially, these service areas are made up of components of service packages without directly using the service packages themselves. These service areas were created from scratch by adding individual elements and flows. Guidance from the National ITS Architecture website was useful in the creation of service areas from scratch without adding service packages and modifying them. Users can gain access to information on the National ITS Architecture service packages by referring to the following link:

http://www.iteris.com/itsarch/html/mp/mpindex.htm

To create a service area as a project architecture, the user would do so in the *Start* tab by selecting "New" as shown in Figure 9.

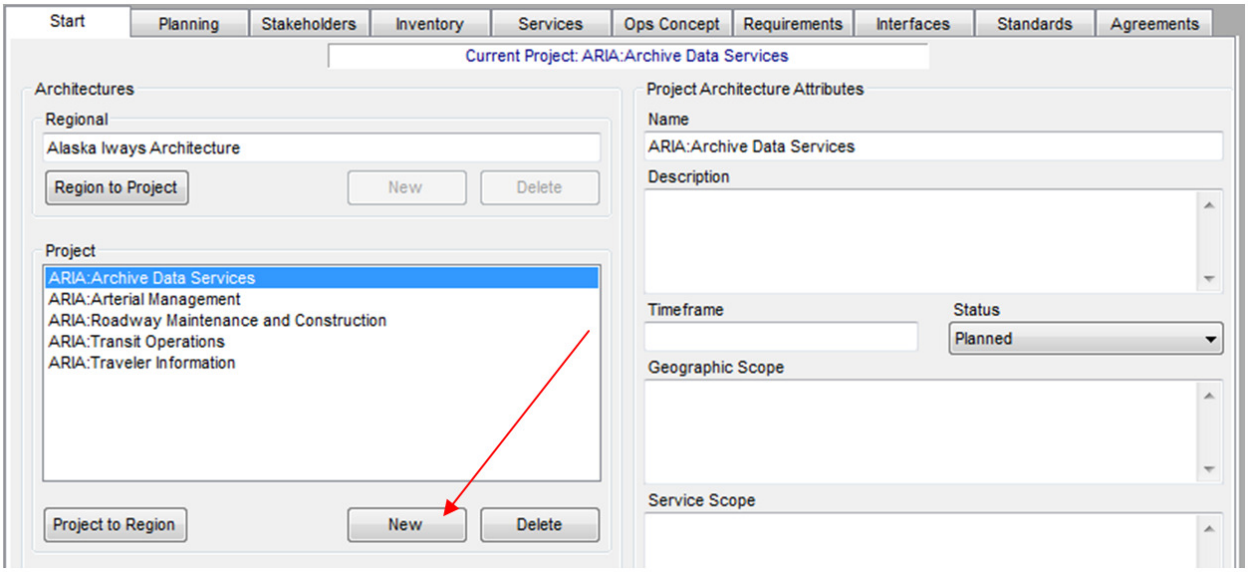

Figure 9. Creating a New Service Area

Accessing/Creating Flow Diagrams

The main way to analyze service areas is to create Turbo Architecture flow diagrams. Creating flow diagrams requires that all the tabs prior to the *Standards* tab be completed. Specifically, the *Stakeholders*, *Inventory*, and *Interfaces* tabs are required. Once these tabs are ready, flow diagrams can be completed in Turbo Architecture by selecting *Diagrams* in the *Output* menu at the top of the program.

Extracting Tables

Tables can also be outputted from the Turbo Architecture software based on the data inputted. To output a table, the user would have to select *Tables* from the *Output* menu. Tables that can be created are listed below with tables included in the architecture in bold:

- Architecture Summary
- Change Log
- Planning
- Stakeholders
- Inventory
- Services
- **Operational Concept**
    - Roles and Responsibilities Tables in Chapter 4
- **Requirements**
    - Functional Requirements Tables in Appendix C
- Interconnects
- **Interfaces**
    - Architecture Flow Tables in Appendix D
- Flow Definitions
- **Standards**
    - Standards Tables in Appendix E
- Standard Group Definitions
- Agreements
- Status Values
- Subsystems and Terminators

Individuals that need help performing tasks such as creating tables at higher levels of detail need to take the free online turbo as specified in Section 3.1 of this document.

3.5.3 How to Maintain the Architecture Document

Once the required changes have been completed in the Turbo Architecture software, the changes need to be implemented in the document as well. The seven chapters of the ARIA update document should be reviewed in sequential order to identify where the changes implemented in the Turbo Architecture apply. Once those changes have been made, the changes can be made with relative ease in the appendices of the report. The tables created in the appendices are direct outputs of the Turbo Architecture software. Since the changes should have already been implemented in Turbo by this point, outputting the tables would be the final steps in terms of the Turbo software and document modification.

3.5.4 Notifying the Stakeholders

It is recommended that the maintainer(s) identify key stakeholders that would benefit from notifications of changes to the architecture. This also includes identifying the type of notification the stakeholders would be receiving (e.g. phone call, email, web conference, etc.). After taking these initial steps, notification of the appropriate stakeholders should occur when changes are made to architecture products. By notifying stakeholders, entities responsible for transportation activities in the region can adjust plans and operations based on those changes.

3.5.5 Archive Files

It is recommended that the maintainer(s) archive all files that were created during the maintenance process. A change management process was developed to guide in the architecture update process. Usage of a change request form such as the sample form presented in Table 4 can make the archiving process easier.

It is also recommended that hardcopy files be converted to electronic files such as PDF and stored on a cloud service such as Dropbox or Google Drive. Storing the files on an agency network drive would be sufficient if it is desired to keep the files internal. Hardcopy files are easier to lose and more difficult to share with others. Electronic files stored in the cloud makes it more accessible to the individuals who have been given access to the archive. It also reduces the risks of losing files due to hardware failure or network compromises. Even if a computer is wiped, the files will still be saved in the cloud. An additional copy of the files should also be kept in a separate location in case something does happen to the original files such as accidental deletion. By having these files readily accessible, future updates and changes would be more easily implemented.