# Regional Architecture Development for Intelligent Transportation

# Help Manual
Version 9.1.175

**Prepared by the**

*National ITS Architecture Team*

**Prepared for:**

*Intelligent Transportation Systems Joint Program Office (ITS JPO)*

*US Department of Transportation*

*Washington, DC  20590*

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# RAD-IT Help

Version 9.1.175 – 3/9/2023

This information in the online help format or as a document provides help on the use of the **Regional Architecture Development for Intelligent Transportation (RAD-IT)** software. RAD-IT is designed to integrate custom inputs with the database tools of the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) so that users can develop custom regional ITS architectures in support of planning for ITS deployment.

## Support Services

Our customer support team is standing by to offer friendly, responsive technical support to RAD-IT users. You can contact customer support via phone or email. To receive the best support, please have the following information ready before contacting us:

- The version of RAD-IT that you are using (and whether it's 32-bit or 64-bit),
    - Look at the splash screen when RAD-IT opens or open the File menu bar item and select 'About' near the bottom of the navigation pane.
- The version and name of your operating system,

    - On the Windows desktop click the Start button ( ), select Computer, then select System Properties on the navigation ribbon near the top of the screen to see your system version and name information.
- A brief description of your problem or issue.

Telephone (U.S.): (800) 260-1001
Email: radit@iteris.com

## End User License Agreement?

The RAD-IT software is provided by USDOT without fee and in an "as is" condition. There is no End User License Agreement (EULA) or Terms of Service associated with the RAD-IT software available on the ARC-IT website. Anyone interested in developing or maintaining a regional or project architecture is allowed and encouraged to download the software and use it.

If you have further questions, please contact Cliff Heise at cdh@iteris.com or 703.623.6709. He is the Program Manager for the National ITS Architecture Program.

## What's New

With this release there are several new features as well as several problems fixed:

- New Spell Check capability – gives the user the ability to manage a dictionary of what uniquely spelled words to include and which to ignore. Works across all data entry fields.
- New capability on the Agreements tab to generate Joint agreements and map them to the elements that are jointly operated, owned, etc., by different stakeholders.  It also generates Joint agreements when the stakeholder involved is actually a Stakeholder Group.

- New option on the Output Diagrams menu to Batch generate a diagram for each project architecture in your file.
- Communications solutions will be retained when a user creates a user defined flow that is meant to replace an ARC-IT information flow.
- Changes made to the Agreements AutoSelect function to support removing any agreements that are no longer needed based on the information flows defined in the current architecture. This also included several other usability enhancements, e.g., update the preview grid so that one can see the lengthy titles and descriptions of the agreements to be deleted.
- Stakeholders are now automatically included in a Project when they are created at the same time a new element is created for that project.
- The Batch Diagram output window in RAD-IT now indicates the number of diagrams that will be generated as a way to help with large architectures. If there are going to be too many diagrams, you may want to de-select some elements.
- No longer get an error generating a Subsystem Diagram if your architecture included user defined subsystems.
- A new output table lets you see a summary of statistics about your regional and project architectures. Look for the Architecture Summary Details table.
- Use a Remote Access Device (new physical object in ARC-IT) to show when secure remote communications are being used by center and support system operators to access their center/support systems.
- RAD-IT can now check to see if an update is available when the tool starts up or on demand.
- The columns on the Interfaces and Solutions tab can now be sorted more consistently. Clicking the top of a column will sort the table by that column and proceed to sort the others to the right of that column.
- Diagrams can now include the coloring based on the class of the physical objects, similar to the colors used on the http://www.arc-it.net/ website, e.g. Blue for Vehicles, Orange for Field, etc.
- Agreements can now be imported between RAD-IT and SET-IT.
- There is a new Search button on the Needs tab to let you search for Needs to be included in your region/project.
- The Autoselect button on the Services tab now includes options to maintain consistency with either the Planning tab or the Needs tab.

As with each version you can open and migrate or convert architectures that were created in a previous version of Turbo or RAD-IT. The "Conversion" process as it is called will go through and update your architecture so that it works with the current features of RAD-IT. RAD-IT will produce a set of reports during conversion to tell you of objects that have been deprecated and replaced in the new version – usually due to an update to the ARC-IT reference databases. This report can be viewed / saved as a document or spreadsheet for analysis later on.


## Bugs Fixed

This version corrects a number of defects in the previous versions including:
- Error when generating the Flow Definitions output table no longer occurs.
- Fixed the issue seen in larger architectures with long lists of project architectures or inventory elements where as soon as you clicked apply the screen would jump back up to the top of the list. This saves some time when you just wanted to go to the next item in the list.
- Fixed an issue in which user defined flows were being left out of some output tables.

- Conversion not retaining connections between agreements and information flows shown on the Agreements tab.
- Error generating a Subsystem diagram if your architecture had any user defined subsystems.
- Communications tab not selecting the correct communications solution or, in some cases, no solutions were being assigned, e.g., when a data distribution system (DDS) was being used as an intermediary or when the SU03 Data Distribution service package was included.
    - This also fixes an issue where older files used DDS for flows that are no longer eligible for data distribution based on the ARC-IT rules. Review the Flow Conversion Details report to see how this affected your converted file.
- Performance issue when working on the Interfaces tab for a project architecture. For large complex project architectures it was taking 90 minutes to click to include or unincluded a flow.
    **NOTE:** It is still best to simplify the architecture as much as possible before getting to the Interfaces tab following the Tips and Guidelines for how to map elements to physical objects and include the appropriate elements in service package instances for your project. Then on the Interfaces tab a Moderate build setting will include the best set of flows to consider. After the Build it should be simpler to edit the flows to include for your project.
- Several fixes were made to the queries used during conversion to improve the accuracy of the converted architecture and prevent crashes seen during conversion of some older architectures.

Be sure to upgrade for the latest features and better, more resilient performance.


**TIP:** With database oriented tools like RAD-IT it is often best to run and save locally and then create backup files (zip) that can be saved/archived off to a network or cloud server for safe-keeping.



**NOTE:** The development of RAD-IT is continuing with new features being added frequently. When available you will want to download and install the new version in order to get the most up-to-date features. Be sure you exit RAD-IT and save your files before trying to uninstall RAD-IT and install the update.

**NOTE:** RAD-IT can only support 1 copy of RAD-IT on a machine at a time so if the installation script detects a version of RAD-IT on your machine it will uninstall it before installing the new version. You will then be able to use the Convert feature to convert your older projects to match the schema and features of this new version.


# Known Issues

There are a few issues based on different configurations or errors that happen on a sporadic basis that you may encounter.

o Users of the 64-bit version of RAD-IT have noticed that Autoselect Agreements (one per stakeholder pair) can cause RAD-IT to crash in certain situations. The work-around is to make sure you have saved before using the Agreements tab and, try the operation again. If this persists try finding a machine with the 32-bit version of RAD-IT.

o Users may get an error generating outputs to Word or Excel that refers to 'Interop' in the error message. If this happens the solution is to close RAD-IT, go to the Control Panel and look for your Microsoft Office, click "Modify" and select a "Quick Repair". Restart RAD-IT and it should generate outputs again.

o If you are using a cloud-based or network based storage system like OneDrive or Drop Box that try to synchronize your local files over a network then you may get a message that you have a "Locked File Selected" and "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file." If this happens, you can still close RAD-IT and your information is still stored. To avoid this message, go into the settings for the file sharing program, e.g. Drop Box, and pause synchronization until you are done generating the tables, documents, diagrams, or web pages.

o Icons and buttons may disappear if there are a lot of programs running at the time or if RAD-IT is working with a very large architecture and system resources start to get constrained. This has been observed on the Add Interfaces window when the Yes button did not appear. Exit, (save your work), and restart RAD-IT and try again. This issue may also be related to Display Settings which can affect some windows if a setting other than 100% scaling is used on Windows computers.

o Also related to very large architectures, some users reported issues with the Interfaces tab after converting very large architectures, well over 100,000 flows. As they were Un-Including flows they didn't want on the tab after several clicks they would click Apply and get a "Concurrency violation" error. In these cases, doing a Conservative build to remove flows not included greatly reduced the size of the file/architectures and the errors didn't recur.

o Some users reported a situation where RAD-IT would stop whenever they tried to Save a file and a screen would appear saying "RAD-IT Stopped Working". As of May 1, 2018 this has been determined to be an issue with the Microsoft Access Database utilities that RAD-IT makes use of during saves. The fix is to do the following steps outside of RAD-IT:
  o Open a Microsoft Access database: Either start Access and then select a database or just double-click on a database file.
  o From the File menu, select the Compact & Repair Database function.
  o Close Access
  o Restart RAD-IT

o Occasionally, users with Microsoft 365 get errors trying to do an Output. The error might say something like "Unable to cast COM object of type 'Microsoft.Office.Interop…'"
Use the following steps to run a "Quick Repair" of Office and try again:
  o Close RAD-IT
  o Go back to the Control Panel
  o Look for Microsoft Office 365 or "365 Apps for Enterprise"
  o Click "Modify" or "Change"
  o Choose the "Quick Repair" option and click "Repair"
  o Afterward, restart RAD-IT; open the project again and try the output table again.

- Currently RAD-IT will not work if the executable files reside on a network drive. You may receive different error messages in these situations. You should be able to run if your executable is local and your saved data file is on a network though some users have reported that Cloud Services like Azure require an answer from the user before saving or opening RAD-IT files on that service.

# What is RAD-IT?

Formerly known as Turbo Architecture, The Regional Architecture Development Tool for Intelligent Transportation, or RAD-IT, is a high level, interactive software program that aids transportation planners and system integrators, both in the public and private sectors, in the development of a Regional and/or Project ITS Architecture. RAD-IT is a planning and integration aid designed to facilitate usage of the National ITS Architecture, now known as the Architecture for Cooperative and Intelligent Transportation or "ARC-IT". The application will utilize user inputs and information from the ARC-IT databases to provide users with tabular and graphical outputs comprising a high level representation of their Regional or Project Architecture. In order to more easily use the tool, it is highly recommended that the user of the RAD-IT application be familiar with ARC-IT. (This tool is not an introduction to or training aid for ARC-IT. Look to the ARC-IT website for training on the architecture.)

RAD-IT and its companion tool, the Systems Engineering Tool for Intelligent Transportation (SET-IT) are all based on the same ARC-IT databases. RAD-IT's focus is on the development and maintenance of regional ITS architectures to support planning for ITS in a region and other long-range, region-wide activities. SET-IT's focus is at the single project level – once a project is being scoped SET-IT can use the same ARC-IT reference architecture to define and build a customized project architecture. Now, both tools support the import of data from one tool to another. See the section on Importing a SET-IT Project.

## In General Terms

RAD-IT:
- Guides users through the design of a Regional or Project Architecture, identifying and extracting the required portions of ARC-IT.
- Assists in local mapping and tailoring to a region's needs.
- Helps the user with potential conflict resolution between Regional and Project Architectures.
- Provides a "jumpstart" toward architecture development and consistency with the National Architecture.
- Is a standalone application.

RAD-IT *is not* a complete end-to-end solution to fully develop ITS architectures. User and stakeholder interaction, gathering local needs and systems, a "Concept of Operations" agreed to by consensus, and extension of the resulting architectures will be required beyond the data, diagrams, and output tables that the tool provides, in order to meet the needs of the local transportation community. The local region may require queries of the data or outputs that are not part of RAD-IT. The Federal Highway Administration (FHWA) Code of Federal Regulations (CFR) 940 and the Federal Transit Administration (FTA) policy on Regional ITS Architectures and Standards requires various other documents and data. RAD-IT aids the user in gathering much of this additional information.

Feedback and consensus is required between the **stakeholders** during the creation of a Regional or Project ITS Architecture. *The architecture is NOT complete simply by following the RAD-IT tabs,*

*building the architecture, and printing the results.* A great deal of **customization** may be required, including iteration of the steps in RAD-IT, selecting additional service packages, etc., in order for the interconnections and information flows between elements to be complete and correct. Stakeholders should be involved initially to attain consensus on the services (centers, data, equipment, and interfaces) that a project or region require. They should become involved in the process again as the Project or Regional Architecture is customized.

# What Can RAD-IT Do for You?

This section discusses some basic topics about RAD-IT – users, their expectations, terminology, system overview, and a review of what makes a regional architecture.

## Who are the Potential Users of RAD-IT?

Many types of agencies and personnel may find the RAD-IT tool useful. The following is an example of potential users of the tool:

1. Local and state transportation agencies such as:
   a. Traffic Management Centers
   b. Transit Management Centers
   c. Emergency Management services deploying ITS in a region
2. Metropolitan Planning Organizations -- transportation planners
3. ITS Architecture Deployment Workshop attendees
4. Consultants developing Regional and Project ITS Architectures

## User Expectations

The RAD-IT application can be used to generate Regional and Project Architectures. Elements may exist within each region that have already been deployed or are planned for the future, or an entire project may be labeled as planned for the future. The output tables and diagrams produced by the tool are able to distinguish between existing and planned architecture elements within a region or project. Within a single database file generated by the tool, there may be at most one Regional Architecture and/or zero to many Project Architectures.

Architectures generated using the current release of the tool and ARC-IT databases are planned to be upward compatible with future releases of these databases and software. You need to be able to create an architecture today that represents the current transportation plan for a region, perhaps including certain elements that are known to be planned for the future (not budgeted or entirely defined today). You must then be able to return to this architecture in a year or two and move those planned elements to "existing", flesh them out, and also create new (existing or planned) projects that will be added to the architecture for the region. The Regional and Project ITS Architectures are "living documents" for how communication is handled between various agencies and groups in the region. The database structure that has been implemented for the RAD-IT application makes this possible.

# Definitions and Terminology

### Architecture, Uncustomized

An uncustomized architecture is one which has been built via the "Build" button on the "Interfaces" tab in the RAD-IT tool, but no changes to element or information flow selections have been made, i.e., no tailoring of the architecture has been done yet on the "Interfaces" tab.

### Architecture, Customized

A customized architecture is one in which element and information flow associations have been modified on the "Interfaces" tab in the RAD-IT tool. The flow status may be changed or the project association for a flow or interconnect may be deselected (i.e., in order not to display this flow or interconnect on the diagrams).

### Center

Center elements are the primary Administration or Management "Element" in the region/project. This may often be a physical building (such as the Marinara County Freeway Management Center).

### Element

This is the basic building block of a local regional or project ITS architecture. It is the name used by the stakeholders to describe an instance of one or more ITS physical objects. An element is defined by the name that is given to an instance of an ITS physical object (e.g., Caltrans/California Highway Patrol District 12 Traffic Management Center). An element is also assigned to a stakeholder. In addition to Transportation Elements like TMCs, RAD-IT supports Communications Elements (e.g., communications gateways and hubs).

### File

The definition of an architecture is saved in a file. A file is also referred to as:
- A database file
- RAD-IT database file
- RAD-IT file

Within a single RAD-IT "file" (or database), you may define zero or one Regional Architecture and/or zero to many Project Architectures.

### Interfaces, Interconnect

Communications paths that carry information between physical objects (subsystems and terminators) of ARC-IT and between elements of a Regional or Project ITS Architecture. Interconnects are directionless and contain one or more information flows.

### Interfaces, Information Flows

Information flows define direction-specific information flow between ARC-IT physical objects and between elements of a Regional or Project ITS Architecture - such as "road network conditions" from a traffic management center to an emergency center. Forms the basis for the standardization of ITS interfaces.

### Physical Object

A physical object represents a system or device defined in the ARC-IT physical view, or a user defined (locally defined) object. In RAD-IT, each element is associated with a physical object. Physical objects are grouped into five classes: Center, Field, Personal Support, and Vehicle. Examples include the Traffic Management Center (TMC), the Vehicle Onboard Equipment (VOBE), and the ITS Roadway Equipment, corresponding to traffic operations centers, automobiles, and legacy ITS field equipment.

### Project

A project is a set of ITS deployment activities grouped together (usually within a single procurement) for planning, deployment, and/or operational purposes. A project has defined boundaries within the context of a region.

### Project Architecture

This term defines the elements and information exchanges of a single ITS project.

### Region

A region is a geographical area spanning one or more jurisdictions. A region is a local decision. It is not necessarily bounded politically. It could be a state or multiple states, a metropolitan area or multiple metropolitan areas, one MPO or multiple MPO's, a corridor (e.g., I-95 corridor), counties, rural towns or areas.

### Regional Architecture

A regional architecture can be thought of as a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects. It defines the elements and information exchanges of the many ITS projects existing or planned within a region. It should be a comprehensive organization of the region's ITS.

### Stakeholder

A stakeholder defines an organization or an institutional enterprise that owns, operates, or interfaces with the ITS elements in a region.

### Subsystem

There are 48 subsystems – physical objects with defined functionality – that make up ARC-IT's physical view and encompass all the functionality of ITS and are grouped into five classes: Centers, Field, Personal, Support, and Vehicles. There is an additional subsystem, ITS Object, that is defined to represent core capabilities that may be common to any class of object. Examples of subsystems include the Traffic Management Center (TMC), the Vehicle Onboard Equipment (OBE), and the ITS Roadway Equipment, corresponding to traffic operations centers, equipped automobiles, and roadside signal controllers.

### System

A system is a collection of hardware, software, data, processes, and people that work together to achieve a common goal (definition from the NHI System Engineering Course). NOTE that "system" is a relative term since many different types of systems fit this definition. To a sign manufacturer, a dynamic message sign is a "system". To a state DOT, the same sign is only a component of a larger Freeway Management

System. In ARC-IT, a Freeway Management System is a part of the overall surface transportation system for the region.

## *Terminator*

Terminators are physical objects that define the boundary of an architecture. In ARC-IT terminators represent the people and systems that interface to ITS. The interfaces between terminators and the subsystems and processes within ARC-IT are defined, but no functionality is allocated to terminators.

> NOTE: Sometimes terminators are removed from ARC-IT. If you had an older architecture that included elements mapped to those physical objects they will be classified as "discontinued" by the conversion process.

To continue the terminology discussion, a user begins by creating a database **file** to contain **architectures**. An architecture is composed of **elements** (centers, systems, vehicles, personnel, and roadside equipment, etc.) and information **flows** that connect the elements together. The elements are associated with **physical objects** (ARC-IT's subsystems and terminators, and user defined physical objects), **projects** (the current project or other projects in the region), and **service packages**.

# System Overview

## *RAD-IT Features*

RAD-IT is a Microsoft Windows based software product that uses the ARC-IT databases to aid in the development of a Regional and/or Project ITS Architecture. RAD-IT can convert existing RAD-IT databases of Regional and Project Architectures so they are consistent with the latest version of ARC-IT.

The computer system requirements to use RAD-IT are fairly straightforward:
- PC-Compatible
- Operating Systems: Windows 8.1 and Windows 10
- 200MB Free on Hard Drive
- Minimum 1280X1064 Monitor Resolution

As with any software product these minimal specifications may work but you'll want more memory and processing speed to develop and maintain large, complex architectures.

**64-bit or 32-bit**: RAD-IT offers a 32-bit version and a 64-bit version. It depends on what type of Microsoft Office suite you have installed. If you have a 64-bit version of Office or Microsoft 365 then you need to download and use the 64-bit version of RAD-IT.

**Language:** RAD-IT has been modified to work in other countries that have different language settings. This should allow RAD-IT to be more language resilient but has not been exhaustively tested or verified.

**Save over a Network drive**: You can now save a RAD-IT file and open it over a network drive, including windows servers, network filesharing platforms like Drop Box and OneDrive. We still encourage users to use a local drive for better performance. You can zip and save your work to a network drive for later use and version control.

The tool can be used to create a Regional Architecture, create a Project Architecture, modify a Regional Architecture, modify a Project Architecture, or update one based upon the other. The basic uses of the tool are to:

1. Create a new Regional Architecture.
2. Create a Project Architecture when no Regional Architecture exists.
3. Create a Project Architecture when a Regional Architecture does exist.
4. Update an existing Regional Architecture with a Project Architecture definition.
5. Import a project to SET-IT.

*User Scenarios*

Using the four basic capabilities of the tool, there are several additional scenarios that the tool will support. Included below are some of these (this list is by no means all-inclusive):

1. Create a Regional Architecture composed of many projects, some that exist in the plan for the current year, and some which may occur in the near or distant future for the region.
2. Import a project from SET-IT.
3. Bring multiple disjoint project definitions together in order to define a Regional Architecture.
4. Create a multi-phase project, where part of a project is being developed currently, but other phases may occur in subsequent years.
5. Create a two-tier or three-tier architecture. For example, several Regional Architectures are combined into a corridor or statewide architecture.
6. Determine the ITS standards that may correspond to portions of a Project.

## What is a Regional Architecture?

Regional Architectures may be built as a standalone architecture, or can be built around Project Architectures. As the name implies, a Regional Architecture is a description of a region that may be used for planning ITS projects and facilitating integration. It lists the functions, interconnections, services, stakeholders, how they communicate, and how they are all connected. Many diagrams and tables can be generated for later use by RAD-IT for the Regional and Project Architectures.

If transportation services are represented by service packages and functions in ARC-IT and the Regional Architecture, then the functions plus interfaces indicate how the services are implemented. When a Service Package or ARC-IT physical object (subsystem or terminator) is associated with an inventory element or center in RAD-IT, many information flows are selected by the system and provide connections to and from the element in the Regional or Project Architecture. These indicate the interconnections for this element to the rest of the architecture.

Regional ITS Architectures are becoming the link between planning and ITS standards, enabling project implementations to consider the standards based on the Regional ITS Architectures.

## Approaches to Creating a Regional Architecture

### *Architecture Definition Approaches*

There are two main approaches that may be used to define architectures using RAD-IT: *Top-down*, where a Regional Architecture is developed and used as the basis for defining Project Architectures or *Bottom-up*, where a set of Project Architectures is defined and then merged together into a Regional Architecture. There is a third approach where a Regional Architecture is built as a complete standalone entity. It does not include any Project Architectures.

RAD-IT supports all of these approaches. In support of the *top-down* approach, a user may develop a Regional Architecture, then use portions of this architecture to define a single or multiple Project Architectures. The tool also supports the *bottom-up* approach by providing the capability to update a previously defined Regional Architecture with a Project Architecture. If no Regional Architecture exists, then this update capability can be used to create one from the projects defined in the database.

Within a single RAD-IT "file", the user may define at most one Regional Architecture and/or zero to many Project Architectures. Within a single database file, each Project Architecture corresponds to a single, unique project. The user may also create separate files to represent different regions, or different collections of projects (or phases of a project) within a single region.

### *Architecture Creation*

The basic steps involved in creating a Regional or Project Architecture are:

1. Gather the Initial Data
2. Input Data (Inventory)
3. Build an Uncustomized Architecture
4. Customize the Architecture
5. Generate Outputs

# Getting Started

This section describes the data you need to collect before starting to develop a regional architecture and some tips for success.

## Gathering the Data You Need

The following steps will help you to gather the data required to begin design of a Regional or Project Architecture:

1. Interact with the stakeholders. Learn their issues and needs.
2. Review the Transportation Improvement Programs (TIP), Statewide TIP (STIP), State Implementation Plan (SIP), Capital Improvement Programs, Long Range Plans, Congestion Management Plans, the Commercial Vehicle Safety Plan (CVSP) for project scope and timing, and other plans and studies to identify regional transportation priorities and implementation time frames.

3. Review the Regional ITS Architecture Definition pages of the ARC-IT website which describes a process for creating Regional ITS Architectures with supporting examples for each architecture product and discusses mainstreaming ITS into the planning and project development processes.

In general, to effectively use RAD-IT, you will need a fairly complete understanding of the stakeholders, centers, elements, and services that are involved in the architecture you wish to develop.

## Suggestions for Success

The following suggestions may help you get the most from designing an architecture:

1. Gather the data for creation of your architecture(s).
2. Install the RAD-IT software.
3. Save intermediate backup versions of your architecture in files with different names, in case you need to return to them. RAD-IT includes a "Save As" feature that may be used to create checkpoints of an architecture in development.
4. Keep all paperwork together for each Regional or Project Architecture.
5. Organize the activity and personnel in a way that makes sense for your region. If you have multiple people involved in developing Project Architectures (which you later plan on merging into a single Regional Architecture), then it is best to develop a common set of terms for the element and stakeholder names. This will greatly facilitate the merge part of the process. (For example, do you call an element "City Transportation Management Center" or "City TMC" -- the tool will interpret these as two different elements when you perform the operation to merge the projects into the Regional Architecture.)  The timing of the updates should be reviewed, and a process put in place.
6. Keep communications open with the stakeholders. Review the architecture with them periodically during the development and at the end of the development cycle. Keep them involved.

The following walks through a set of steps that illustrates simple usage of the tool. After installing the tool, the user starts the tool by double clicking on the "**RAD-IT**" icon on your Desktop, double clicking on the RAD-IT executable file in the directory where it was placed, or by selecting **Start-> Programs-> ITS Architecture -> RAD-IT** to run the tool.

To create a new RAD-IT database file or open an existing file before opening an architecture, from the menubar pulldown, select "**File => New**" to create a database file, or "**File => Open**" to open an existing file. The first time into a new release of RAD-IT, the default directory is "**My Documents**". If opening an existing database file, this directory must be changed to the directory that holds your architecture(s).

The next thing the user needs to do is to create or open an architecture in this file. To create a new Regional ITS Architecture, select the "**New**" button in the "**Regional**" area on the Start tab. In the same manner, to create a new project ITS architecture, select the "**New**" button in the "**Project**" area on the Start tab. To open an existing architecture, select a name from the existing Regional ITS Architecture or the list of Project ITS Architectures on this window.

## RAD-IT File Extension

RAD-IT is a stand-alone application. It does not require any other applications, or databases in order to be used. RAD-IT generates Microsoft Access-compatible databases, but it is not necessary to have the Microsoft Access software resident on the machine in order to run RAD-IT. Nor does RAD-IT require

any ARC-IT databases from ARC-IT web site. After bringing up the application, the "File => About RAD-IT" option on the main menubar displays the version number for the RAD-IT application, and for all portions of the ARC-IT that are used with that version of RAD-IT.

RAD-IT includes support for the file extension, "radit" or ".tbo", for legacy Turbo architectures. RAD-IT also accepts the ".accdb" extension when opening or converting older Turbo files. The "radit" or ".tbo" file may also be double clicked from a Windows Explorer window and the RAD-IT application is launched.

> **WARNING:** Although the ".radit" or ".tbo" extension does not completely prevent a user from opening a RAD-IT database using MS Access, *which non-expert Access developers should never do*, it is less likely that the user will want to do this and damage his RAD-IT file.

> **TIP:** Alternatively, the RAD-IT development team recommends only using the .radit database file in Access as a way to review or create custom outputs. Always create a copy of the database first and work with the copy in Access.

> **NOTE:** If a user tries to open an older turbo file created prior to 2000 when the older.mdb extensions were used they will get an error saying, "Failed to open workspace." This is a pre-2000 mdb format file that is no longer supported by Microsoft. You may also get an error if you try to open a database created before 2010. This is also due to databases that are no longer supported by Microsoft.

> In either case you will have to convert it to a newer format before you can open it with RAD-IT. Contact the help desk for more information.

**To work around this issue, use a 2010 or earlier version of Access to open and save the older database as an .accdb file:**
1. For 'really old' files (Access 97):
   a. Open the old database in Access 2003.
   b. On the Tools menu, click Database Utilities, click Convert Database, and then click to Access 2002-2003 file format.
   c. Enter a name for the database, and then click Save.
   d. Exit Access 2003.
   e. Open the database in Access 2013 or later version of Access.
   f. On the File tab, click Save As, select Access Database (*.accdb), and then click Save As.
   g. In the Save As dialog box, click Save.
2. For files from 2002 or 2003:
   a. Open the old database in Access 2010.
   b. As it opens you will see a "Database Enhancement" window telling you that it was created in an older format and you need to convert it to 'enable recent enhancements'.
   c. Say "Yes".
   d. It may say an error was encountered and direct you to see a new table it created called "Conversion Errors". There should be a single row in that table that says "The current file format no longer supports user-level security. The conversion or compaction process has removed any user-level permissions." This is OK.
   e. On the File tab, click Save As, select Access Database (*.accdb), and then click Save As.
   f. In the Save As dialog box, click Save.

g. You can now also copy that to rename it with a *.radit file extension so you can double-click it to start RAD-IT.

When you use the tool to create an architecture, there will be a single RAD-IT database file created by the tool. This database will contain data tables, relationships, and elements for a single Regional Architecture and multiple Project Architectures. If a second Regional Architecture is to be defined, this must be done in another RAD-IT database file.

## Read Me

A README file comes with each version of RAD-IT and is available from several places:
- As a text box within the About screen that is part of the Project menu
- As a text file that can be opened independently of running RAD-IT. Click the Windows Start button and scroll down to "I" for ITS Architecture and select the RAD-IT Read Me file.



- From the ARC-IT website - https://www.arc-it.net/tools/raditreadme.txt
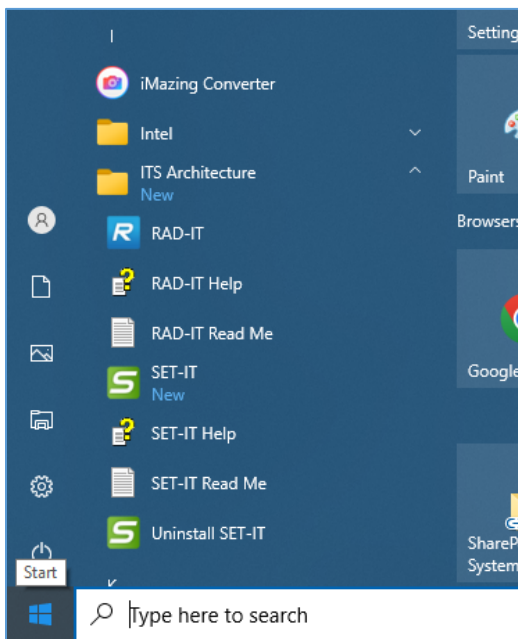
# Managing Database Files

This section provides some technical information about the files and file structures used by RAD-IT and how to work with older files.

## Creating a New RAD-IT Database File

To create a new database file in which new architecture definitions will be stored:

1. On the menubar, select:  File => New

2. If you already have an architecture database file open and have made changes, you will be asked if you would like to save the changes.

3.  A new blank architecture file will then open. The title bar of the main RAD-IT window will indicate that the file is "new".

## Opening an Existing RAD-IT Database File

To open an existing RAD-IT database file:

1.  On the menubar, select:  File => Open

2.  If you already have an architecture database file open and have made changes, you will be asked if you would like to save the changes.

3.  You will then be asked to select the name of an existing RAD-IT database file you wish to open.
    a.  If the database file selected was created using the current version of RAD-IT, then the database will open.
    b.  If the database file selected was created in an earlier version of RAD-IT, then you will be asked to convert the database or to open it without conversion.

RAD-IT locks the files (sets them to Read-Only) so you can't have a conflict where one application writes data that the other application is also editing. If you try open a file that is already open you will get a warning message that the file is in use by another program and to close the other program and try again.

## Opening a Prior Release RAD-IT Database File

You may open an architecture database file created in an earlier version. When doing this, the software automatically detects that the architecture was created in a prior release. You will be asked if you would like to open or convert the database to the current version of RAD-IT.
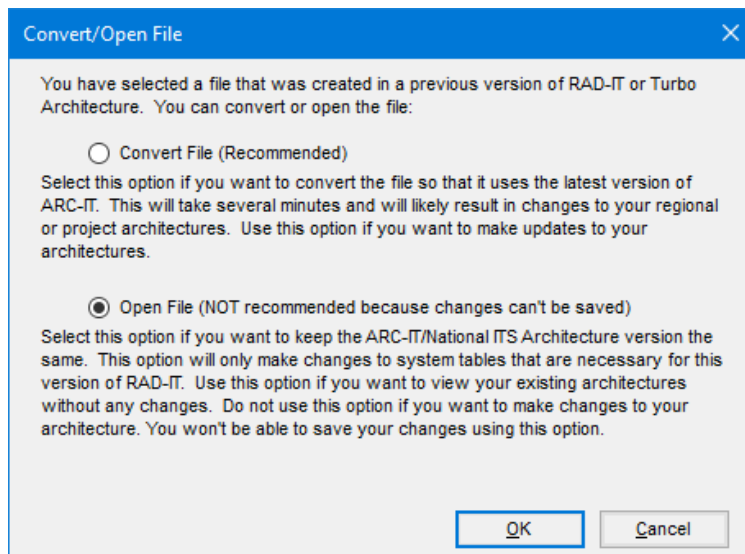


If you choose to simply *open* the database without conversion many of the current capabilities, including new services, interconnects and information flows will not be available. The Communications tab will

also be blank since no solutions will have been selected yet. This Open option will also provide a read-only version. See "*General Information Concerning the Conversion Process*" for some reasons why you may not want to convert the database though for the most part you will want to use the Convert File option. Open File is only useful for browsing an older file but not to work on it.  Note that even Open will change the file. It has to do this in order to put the database tables into the right schema in order to be read by the current version of RAD-IT.

The "Conversion" process migrates existing Regional or Project Architectures and database files created with prior releases of RAD-IT up to the current release of the software. Selecting to convert begins the automated conversion process. A series of screens is displayed checking off the steps of the process, and asking certain questions about how the process should proceed.

## Saving a RAD-IT Database File

1. To save an open file, on the menubar, select:  File => Save. This will overwrite the previous version of the database in the same directory where it was opened.

2. If "what-if" scenarios are being tested and several versions (checkpoints) of a database and its architectures are to be saved (for "what-if" testing or archival purposes), on the menubar, select: File => Save As…

A window will appear asking you to select a name of the new RAD-IT database file. You may select an existing file and will be warned that the file will be overwritten.

**NOTE:** If you are using a cloud-based or network based storage system like OneDrive or Drop Box that try to synchronize your local files over a network then you may get a message that you have a "Locked File Selected" and "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file." If this happens, you can still close RAD-IT and your information is still stored. To avoid this message, go into the settings for the file sharing program, e.g. Drop Box, and pause synchronization until you are done working with RAD-IT.

## Exiting from a RAD-IT Database File

1. To exit from the RAD-IT tool, select:  File => Exit or click the X in the upper right corner of the RAD-IT window.

2. If changes made to Regional or Project Architectures in the database file have been saved this command will simply exit from the tool.

3. If changes have not been saved a window will appear asking if you wish to save the changes.

## AutoBackup

Another project management feature is called AutoBackup. You can enable this to periodically make a backup of your project's files. This has the effect of making a copy of your project's files that you may need if there is a problem and you need to start over from a certain point. For example, if you mistakenly

made the wrong changes to a project and had already done a Save. This will let you go back to your last backup and restart your work.

The settings to manage how often, how much, and where the backups are stored are also found on the Project / Options menu – look for the AutoBackup tab.
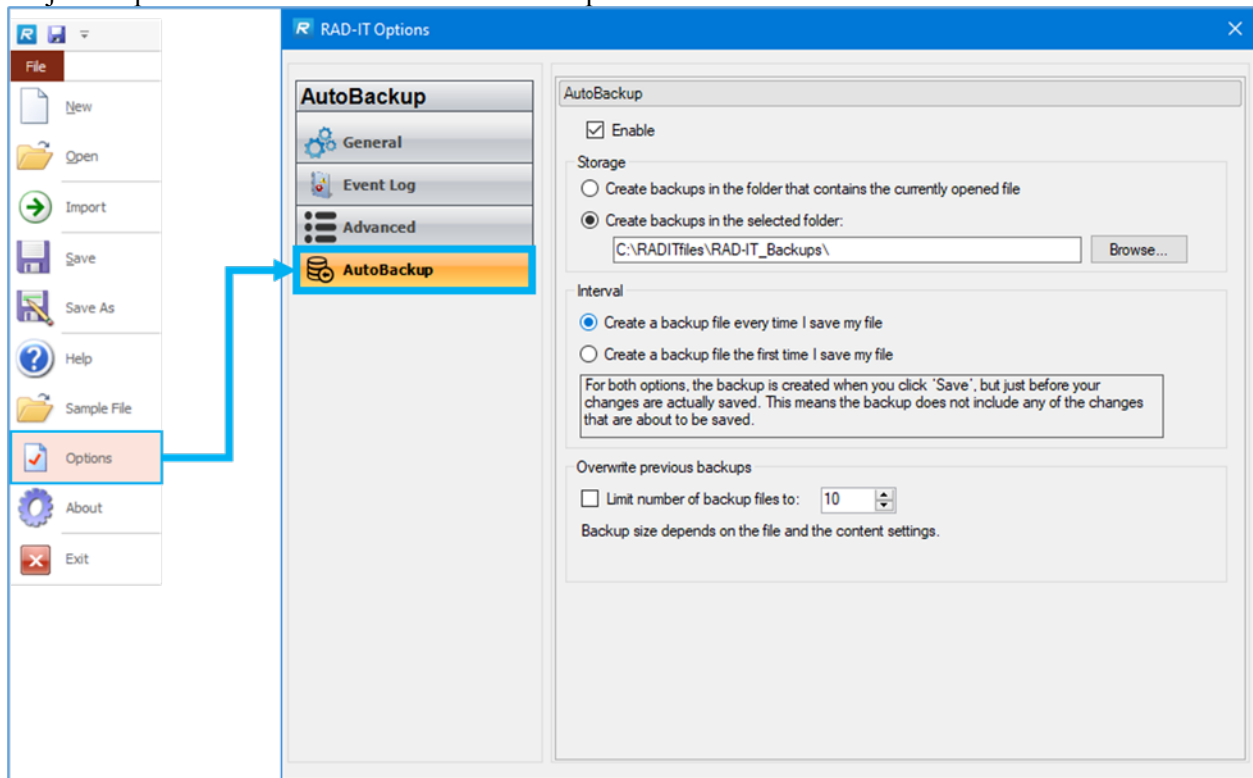


The settings let you assign a specific folder to keep all of your backups in or it will put them in your architecture's current folder. When the backup routine runs it creates a compressed or zipped file and adds a date/time stamp to the filename and uses a unique file extension, ".raditbkp". This file type can be opened by any file compression software.

You can change the interval, or how often backup will run; every time you do a Save or when opening the file.

AutoBackup will backup the database and the log file associated with your RAD-IT architecture.

TIP: one useful purpose of this backup file may be to have a ready copy of your data to send to a coworker or to the RAD-IT Help Desk in case you have a problem. If they can see your database alongside the log file they may be able to recreate your issue quicker and find a resolution.

As the note says on the screen – the backup is created as soon as you click the 'Save' button but just *before* the changes are actually saved to the database. This means the backup does not include the latest changes that are about to be saved.  The idea is to make a snapshot of your project just before you hit save at whatever stage you were at.  This may come in handy in the error/problem scenario.

The settings for AutoBackup also let you set how many backups to keep. Over time the files can really add up so you may want to limit the number of backups it keeps.

## File Sizes & the Temp Files

### *Save Your Work Often*

Data is only saved when you choose the "Save" or "Save As…" options (or when you exit the file and save). All work you do between saves is put into a temporary file. As you work this temporary file grows in size. If you wait too long to exit and save, this file can grow so large you may not be able to save it.

In order to actually shrink the size of the temporary file while working with large architectures, you must **save** periodically or exit RAD-IT. Applying changes isn't enough as that places new work in the original user file in compressed format, but the temporary file remains at the same size and keeps growing. To shrink the temporary file, the database file must be saved.

You may notice an error message popup warning you that you are about to exceed Microsoft's file size limit and to save/close your file.
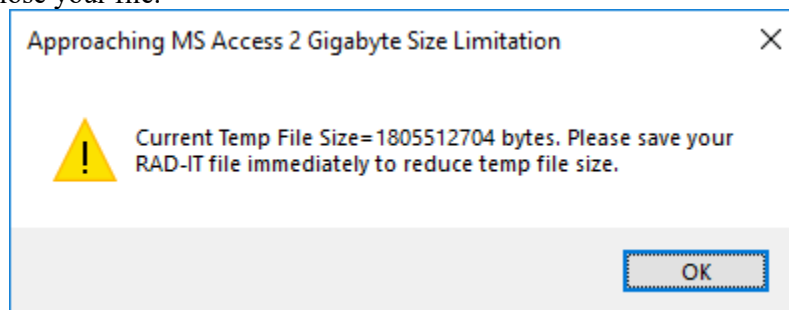


### *RAD-IT Crashed and I Forgot to Save!*

If the tool should fail with unsaved data, you may be able to partially recover. Look for the temporary file in the Windows "temp" directory (e.g., C:\Users\<logon id>\AppData\Local\Temp). Rename this file to end in ".radit" and then try opening it with RAD-IT. See the release notes for more hints on how to correct this problem if it happens.

A utility in the RAD-IT Options Menu item provides a way to find and recover these temporary files. Click on File and Options. From there click Advanced.
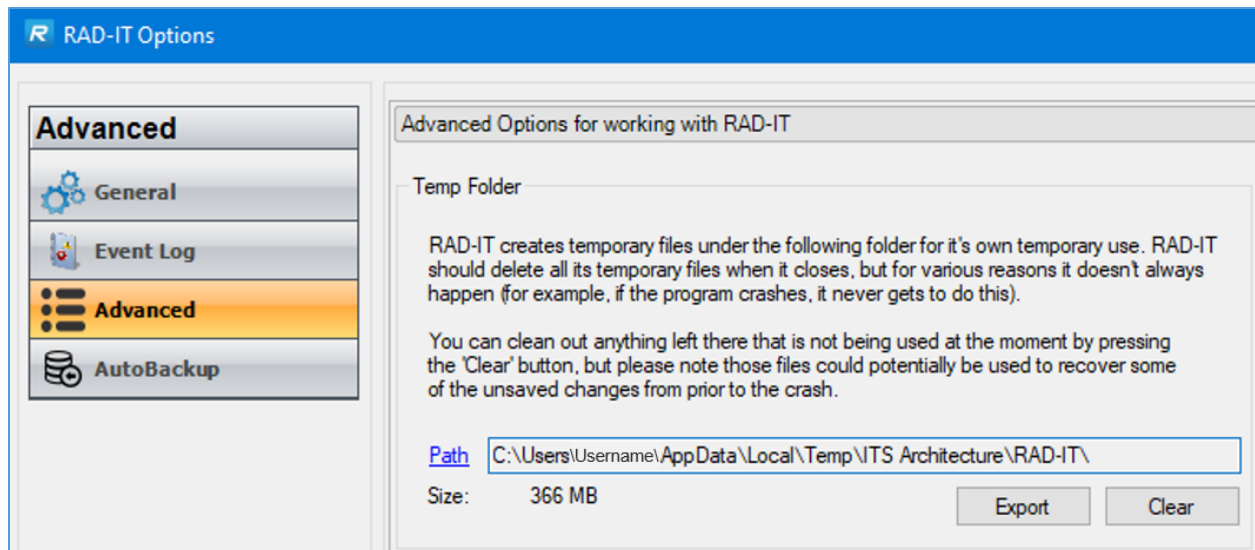
If you need to find a temporary file in order to restore it click "Path" and it will open the system file folder that contains the temporary files.
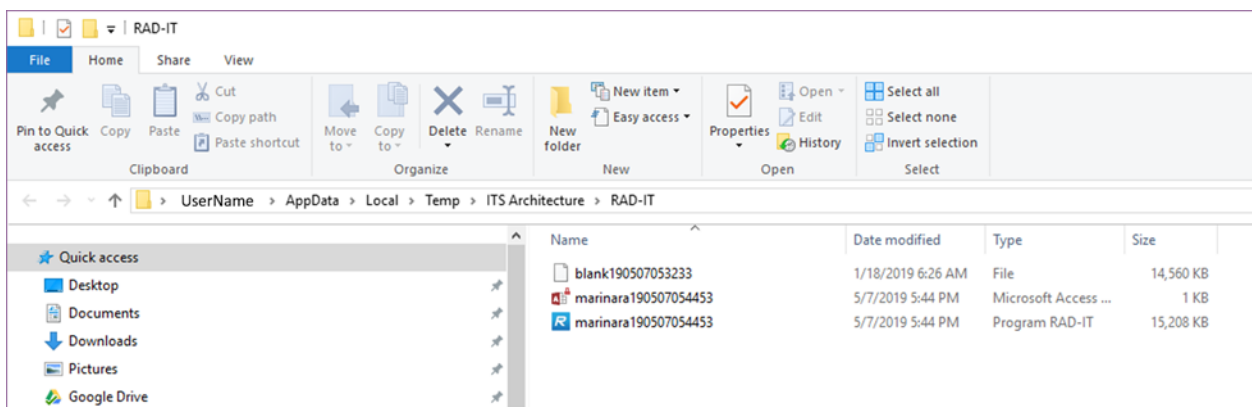


From this folder you can copy the temporary copy of the .radit file and re-open it in RAD-IT. You may not be able to recover all of your data but in most cases most of your data will be preserved here.

## Other uses of the Temp Folder window

**Clear** – One quick way to reduce the size of the temporary files is to click the "Clear" button. That will instantly erase any but the file currently being used by RAD-IT.

**Export** – Sometimes you may encounter a situation in which you need the help of the RAD-IT support team to fix your file or to find out what is wrong with RAD-IT. For some situations they may ask you to send them your temp files so they can help isolate the problem and debug any errors in the data or software. In this situation, click Export to create a zip file of the temporary RAD-IT files that you can email to the team.

# Open a Sample File

Use the Sample File as a way to learn how to use RAD-IT's features and to see a sample that includes a basic set of objects and interfaces that are likely to be common in many ITS architectures.
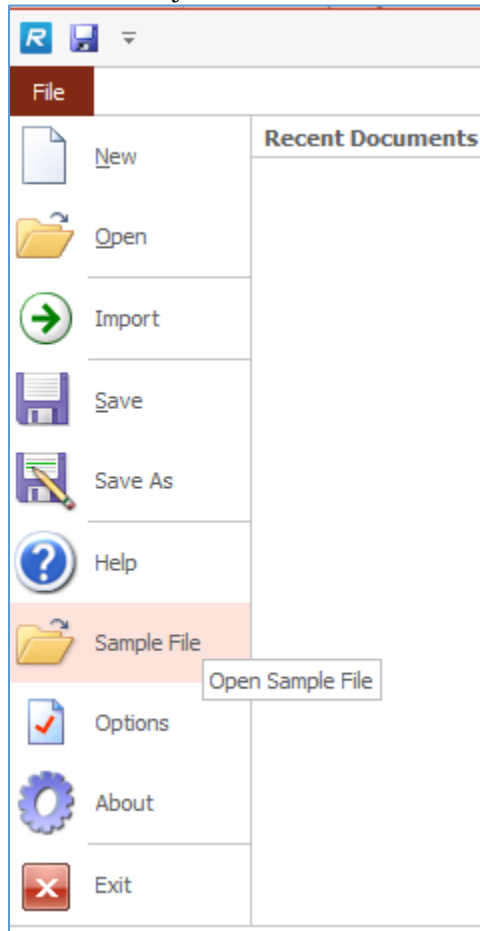


## Opening and Saving the Sample File

Clicking on the Sample File option from the File menu, brings opens the sample database called Marinara.radit. All the tabs will have information populated for a region and 4 projects.

You can save your own copy of this file for later by clicking Save. Since the copy of the sample file was stored in a read-only area you will see a window that is like the Save As window and allows you to save this sample as your own project into your own file folder. Use this window to choose the file folder and the name for the file.

Now you can edit the file, add to it, change the names to match your own, or just review or print out portions of the sample file to better understand how RAD-IT works and how to build a regional ITS architecture.

## More on the Sample File

The sample's file name is "Marinara" and once it is open the longer name for the region appears as the "Marinara County" regional ITS architecture.

This sample architecture originated as an exercise in the National ITS Architecture Public Sector Training Course. It illustrates many of the RAD-IT features. It can be used to highlight features of the tool as well as part of ARC-IT that merges traditional ITS concepts with connected vehicle technologies and supporting services. To this end, several minor extensions have been made to the basic Marinara County scenario so that features like user defined Physical Objects, Flows, and connected vehicle service packages can also be illustrated.

Use this sample as a starting point for your own regional or project architecture or simply to refer to how these support concepts are shown. Each tab is populated to show how they can be used.

Marinara includes the following features:
  - ➢ Connected Vehicle as well as traditional ITS services
  - ➢ Use of Element Instances in the project architectures
  - ➢ Use of Communications elements – Data Distribution and Wide Area Information Dissemination
  - ➢ Support services such as Security Credential Management, ITS Communications Support, and System Monitoring
  - ➢ User Defined Physical Objects and User Defined Flows

The current version of RAD-IT now includes all of the service packages, physical objects, and information flows as part of ARC-IT which is the new name for the National ITS Architecture. ARC-IT v8 and higher includes merged content from both version 7.1 of the National ITS Architecture and the Connected Vehicle Reference Implementation Architecture (CVRIA) so they can be included in your own project just like other ITS or connected vehicle applications defined in the Architecture.

# RAD-IT Options

RAD-IT has an Options menu that is accessible from the File menu. At the top left of the RAD-IT menubar, click "File" and go down to Options.
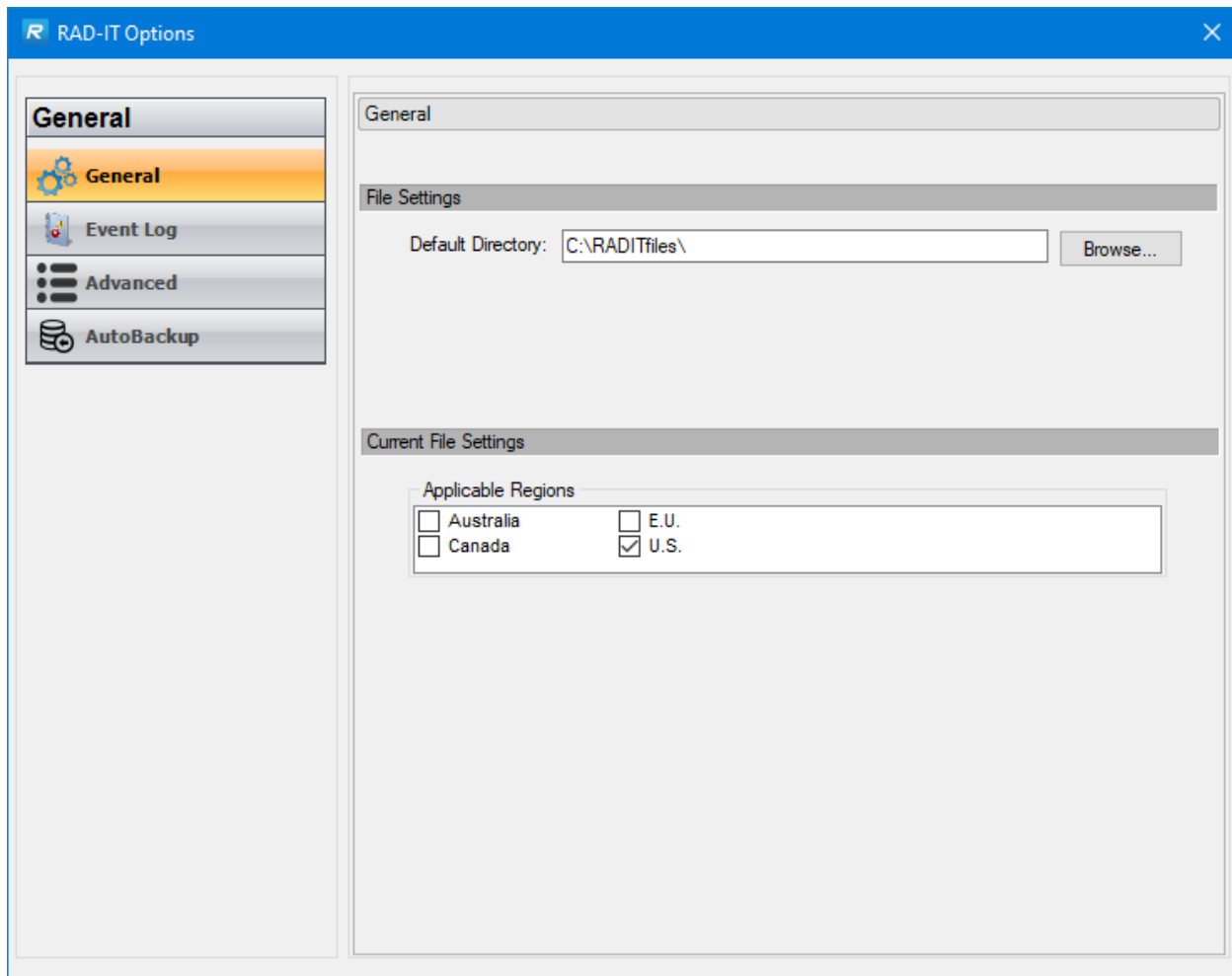
The Options menu has 4 categories: General, Event Log, Advanced, and AutoBackup.

*General Options*

The General category lets the RAD-IT user set the default directory for new architectures. Use the Browse button to navigate your file system and select the directory or folder that will be used as the default starting point when you Create, Open, or "Save As" a region or project file.

Current File Settings: used to set the Applicable Regions for the information to be included in your project. Choose from Australia, Canada, the European Union (E.U.) or the United States (U.S.) to determine what objects, flows, services, communications solutions, etc., are made available to choose from as you build your region/project.

For example,
- Select US and EU as input sources on the Settings screen
- On the Service Packages tab RAD-IT displays services that come from EU or US only. So an Australian-unique service, for example would not make the list (you may notice a gap or 2 in the list of service packages)
- Select the service packages to include and RAD-IT will only show the physical objects, functional objects, flows for those services that are relevant to the US or EU.

These settings are also used as you create user defined flows, physical objects, and functional objects. As you create those components they will be stored in the database as having those applicable regions. Later, if you change the settings to display components from another region those components will not be shown.

## Event Log Options

This screen includes options to turn on/off an event log utility that can be used for debugging errors caused by RAD-IT or issues in a projects database or diagrams. There are 2 sections:

- **Enable Logging** is a checkbox to first turn on the logging capability. Then there are check boxes for the type of error sources to trace: database, diagram, exceptions, form details, shape properties, other. There are pull-downs for each of Information or Verbose.
  TIP: It is a very good idea to check this box. If you run into problems or you have a strange error message pop-up, the RAD-IT development team will be able to diagnose your problem more quickly if you have this enabled.
  NOTE: The Trace Sources settings can only be changed if you are running as an Administrator on your computer. Many users can do this when they start RAD-IT from the program menu or the desktop. Right-click on the RAD-IT icon and select "Run as Administrator…"

- **Log File** – allows you to browse and set the location for the log file to be stored. It will be created in the form of a normal text file. The default path is the same file path of the current project. You can also set the maximum size of the file. When it reaches the maximum it will create a copy and start another file. If it reaches the maximum again then the first file will be copied over. File information tells you when the log file was created, modified, or last accessed.

  NOTE: There is another log file used to capture 'Start-Up' events that happen when a program is started but before a project has been opened or started. This Start-Up Log File is stored on your PC under C:\Users\<username>\AppData\Roaming\Iteris, Inc\RAD-IT\. A subfolder is created for each new version of RAD-IT and the file is called "RAD-IT.log".

  TIP: An easy way to find the Start-Up log is to start RAD-IT and select Project/Options before you open a project. Go to the Event Log tab of the Options window and click "Log Path" and it will open that directory in a Windows Explorer window.

## Advanced Options

This screen includes options to set the Temporary folder. This lets you see the path to the files that contain copies of the temporary databases and log files in case you have a crash or other bug. You can

click Export to move the files for offline analysis or you can Clear the files to make room on your hard drive.
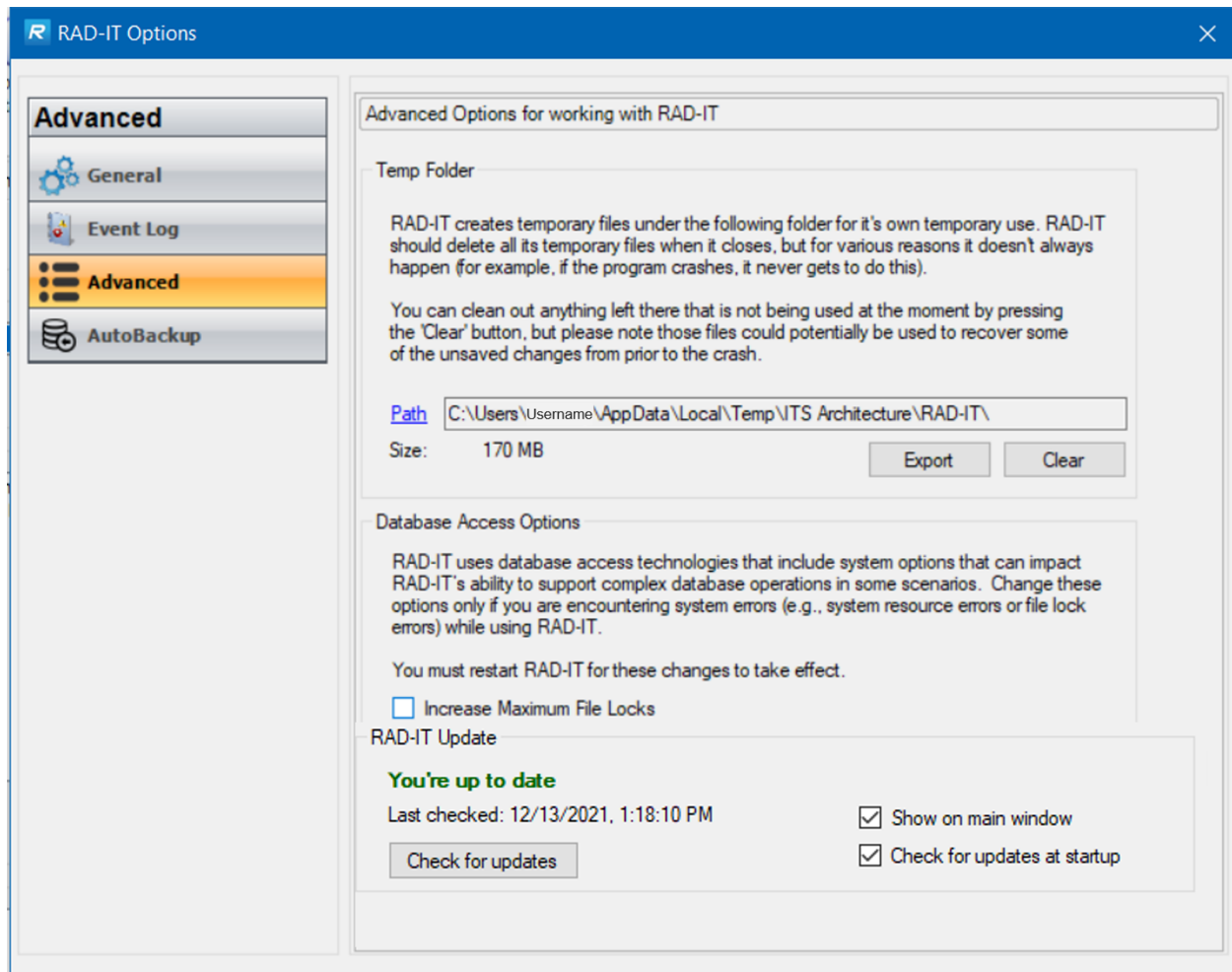


Under Database Access Options, you can change the maximum number of File Locks used by the Database Access Operations. Change this only if you are having issues with system resource errors.

The RAD-IT Update options allow you to manually check the National ITS Architecture website, www.arc-it.net to see if there are updates available for RAD-IT. The checkboxes here give you to option to show messages at the bottom right corner of the main RAD-IT window or to Check for updates during start-up.


*AutoBackup Options*

Another project management feature is called AutoBackup. You can enable this to periodically make a backup of your architecture. This has the effect of making a copy of your file that you may need if there is a problem and you need to start over from a certain point. For example, if you mistakenly made the wrong changes to a project and had already done a Save. This will let you go back to your last backup and restart your work.

The settings to manage how often, how much, and where the backups are stored are found on the File / Options menu on the AutoBackup tab.
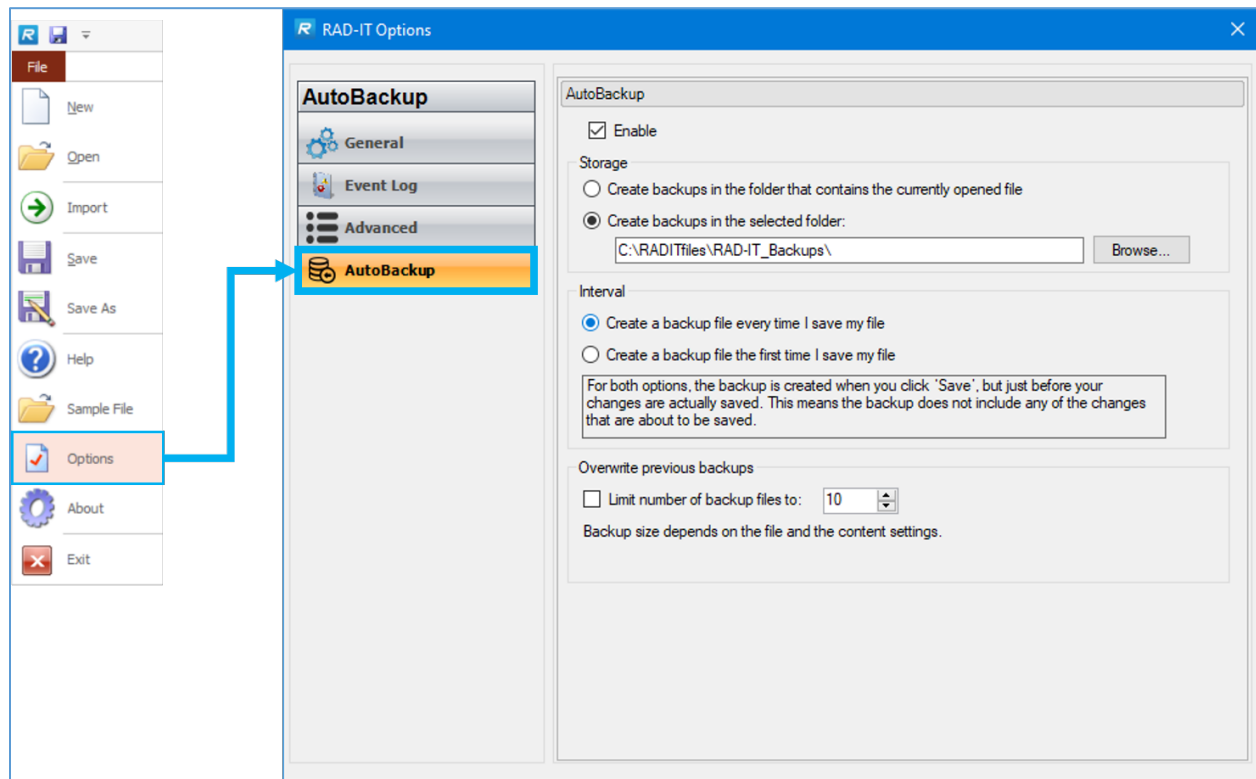


# Accessibility Features of RAD-IT

This section describes some features of RAD-IT that make it easier to use by all users.

## General Information about RAD-IT

In RAD-IT, Accessibility features are supported for compatibility with Section 508 of the Rehabilitation Act of 1973, the Standards for Electronic and Information Technology section. These features include the following:

1. Keyboard Shortcuts for all menu, toolbar, and form commands.
2. Accessibility Information in this Help resource (all figures include alternative text).

## Keyboard Shortcuts

There are several ways in which to access RAD-IT options and pulldown menus for accessibility without using a mouse. Many options include a "CTRL + <letter>" shortcut to perform a RAD-IT option. These are listed on the pulldown menus. For example, "CTRL+S" to save a file, appears next to the "File => Save" option on the pulldown menu. The "ESC" key acts as a cancel button.

Another shortcut method that may also be used in, is by using the "ALT" key. After pressing the "ALT" key, the menubar appears with the first character (in some cases it is another character) of each pulldown menu underlined. You may then type the underlined character for the menu and option that you are

looking for, such as, "ALT" key, "F" for the "File" pulldown, then "O" to open an existing architecture. Case is not important and the "ALT" key does not have to be held down while pressing these other keys.

You may also press the "ALT" key and the underlined letter (press at the same time) for each of the tabs across the top of the RAD-IT main menu, or press "ALT > s" ("Start" tab) then the right and left arrows to move between the tabs. For example, "ALT > i" will display the "Inventory" tab. Then it is a matter of pressing the right, left, up, and down arrows, as well as the tab right and left ("Shift > Tab") keys to move between the list of Inventory items and the options and tabs on the right of this screen.

On several tabs throughout RAD-IT, clicking the Right Mouse button will expand a list of objects. For instance, on the Inventory tab, right-click over the list of Physical Objects and the list will expand. It will also show the description field for the object you highlight. To go back to the original size list just do another Right-Click. This works on several places including the Stakeholders list for groups of stakeholders, projects on the Inventory and Services tab, and agreements on the Agreements tab.

The "Interfaces" tab works a little differently. The tab and arrow keys will move down the list of information flows and to the options at the bottom of the window, but they do not move to the options at the top of the window ("Connects", "Flows", etc.). This is a known problem with the third party tool that is used to generate this screen. Hence, all of RAD-IT and the documentation is compliant with Section 508 except for the toolbar on the "Interfaces" tab.

## Toggle between Open Applications without Using a Mouse

When using an application such as RAD-IT, you may toggle between open applications in Windows that appear across the task bar (generally at the bottom of the screen) without using a mouse. There are two ways to navigate between open applications:

1. Use the "ALT > TAB" keys:
    a. Enter any window, tab, or option in RAD-IT. If you have selected a menubar option and see the pulldown menu, you must select an option on this menu. The pulldown menu itself will not remain visible when the "ALT > TAB" keys are pressed.
    b. Press the "ALT > TAB" keys at the same time.
    c. A small navigation window pops up. This window includes an icon representative for each open application.
    d. While holding the "ALT" key down, use the right "Tab" and "Shift > Tab" keys to move between the open applications. One of these applications is an icon for RAD-IT. If selected, RAD-IT remains active. If another application is selected, such as a Windows Explorer window, this screen pops in front of the RAD-IT window.
2. Use the "ALT > ESC" keys:
    a. Enter RAD-IT.
    b. Press the "ALT > ESC" keys at the same time.
    c. While holding down the "ALT" key, keep pressing the "ESC" key. This will toggle between the open applications without reliance on the "ALT > TAB" navigation window.
    d. The main difference is that with "ALT > ESC", the application windows must actually be active (click on each window to maximize it). If "ALT > ESC" is attempted when an application window is minimized, it will not come up.

## Display Settings

**NOTE:** sometimes you may notice differences in the way the text on some buttons looks or labels for different columns. This may be caused by a Display Setting that some Windows users do called Font Scaling. RAD-IT attempts to scale the appearance of text as well as other Windows programs but when users select 125% scale or greater then they may occasionally see some differences, e.g. some button labels may be truncated or letters will run together. If this happens try adjusting the Display Settings to 100%.

# Converting from Prior Releases

RAD-IT Version 9.0 was developed specifically to support version 9.0 of the National ITS Architecture, now referred to as ARC-IT. An important facet of this support is the "Conversion" tool that allows users to quickly and easily upgrade their existing architectures to use the latest version of ARC-IT. This utility does much of the "heavy lifting" that is required to convert a regional or project ITS architecture so that it is uses Version 9.0 of ARC-IT.

## General Information Concerning the Conversion Process

The following are several items of general interest concerning the "Conversion" process.

1. Some of the features of the latest version of the RAD-IT software are not available to previous version databases unless the database has been converted.
2. If a customer site has not yet upgraded the RAD-IT tool from previous versions, RAD-IT will automatically upgrade an older version database to make it compatible with the latest version. You will notice an additional dialog box that will be displayed showing that the earlier version "database compatibility upgrade" is in progress.
3. All user-defined extensions will be carried forward into the current version of RAD-IT. In special circumstances, where a user defined Physical Object or flow happens to exactly match a new ARC-IT physical object (subsystem, terminator) or information flow, the user-defined extension will automatically be converted to the equivalent ARC-IT Physical Object or flow. These are duly noted in the conversion output tables. In every case, the interfaces defined will be carried forward into the new database.
4. During the conversion from a prior release RAD-IT database file, all system tables and configuration information are maintained. The conversion software copies all user data from source to destination and also copies any old system data that is referenced in your architecture.
5. Sometimes one information flow is replaced with another automatically during the conversion.
6. RAD-IT can open and use architectures that are based on current and previous versions of ARC-IT. It will detect when a previous version architecture is opened and ask if you would like to convert the architecture. If you choose to open the architecture and not convert it, RAD-IT will work with the older architecture in a Read-Only format – not recommended for any editing of the architecture.. You may return to the older version architecture at any time. RAD-IT automatically preserves the original file.

   > **NOTE:** Opening an older pre-2000 mdb format file may yield an error because it is no longer supported by Microsoft. You will have to convert it to a newer format before you can open it with RAD-IT. Contact the help desk for more information.

7. If upgrading the tool to the latest version of RAD-IT, then the question arises of whether to migrate architectures developed with prior releases.

a. It is recommended if you are actively working on a particular architecture coordinate the decision to upgrade to avoid incompatibility issues. The upgrade should be done at the same time for all architectures and database files within the project, and should be timed so as not to interfere with the development schedule.

b. If the new features of ARC-IT are not necessary for the current project, perhaps the upgrade can wait until after the project is completed. However, if the new architecture features are required in the architectures under development, the upgrade should be coordinated sooner rather than later.

c. If you are in the middle of developing a Regional Architecture, the decision to upgrade depends on the situation. Here are a few pointers. RAD-IT provides a conversion feature that makes the conversion to support the latest ARC-IT version quick and easy - a basic conversion can be done in a few minutes, even for a large architecture. What must be considered is where you are in the process, how the conversion will impact work products that have already been delivered, and how the conversion will impact stakeholder reviews and consensus work that has already been performed.

d. If the Regional Architecture has not yet been developed to the point that interfaces have been reviewed with stakeholders, then it is probably best to upgrade RAD-IT and convert to the latest version of ARC-IT so the stakeholders invest their time in reviewing the latest interface options. If the stakeholders have already invested time in reviewing interfaces, and the architecture is close to "final" publication, then it is probably best to wait and address conversion as part of future architecture maintenance activities.

8. As for the new version of the ARC-IT, the "What's New" section of the http://www.arc-it.net/ is the best source of information. This web site provides a list of the changes and a list of all physical objects, service packages, and information flows that were impacted. RAD-IT also provides special conversion tables that identify all impacts to subsystems, terminators, service packages, needs, functions, information flows, and standards mapping. As part of the conversion process, other tables are available that list the differences between the older RAD-IT and the converted architecture.

9. Agreements from older Turbo files will be copied into the new RAD-IT database but the Type field will not be converted. In Turbo the type field was a text field but with RAD-IT it became a pull-down to select from a pre-defined set of Agreement Types. If a Turbo user had agreements listed then they will need to manually go through and pick the most appropriate type manually.

10. In ARC-IT version 9.0 the Parking Management System physical object was split into 2 objects – a field-class Parking Area Equipment object and a center-class Parking Management Center. During Conversion if there was a Parking Management System element it will be mapped to both the new physical objects. Afterward, you may decide that you need another element or that your element is more related to one versus the other object and so you can adjust your mappings after conversion.

## The Conversion Process from a Previous Version of RAD-IT

The following details the conversion process of a prior release architecture file to the current version of the software:

1. Begin the conversion process by selecting "File => Open" for a database file from a previous release of RAD-IT.

2. Select the file and click "Open" to open the file and begin the conversion process, or "Cancel" to cancel the conversion.
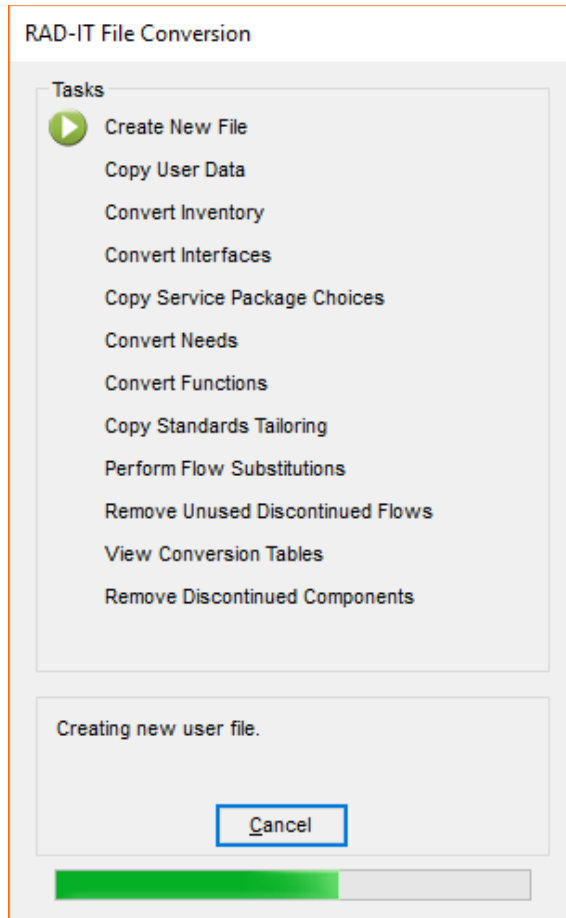
3. The RAD-IT software will detect that the selected file is from a prior release of RAD-IT and that conversion is an option. The next window will ask if you would simply like to open this file and view it as is, maintaining all previous version elements, physical objects, and information flows, or if you would like to convert the file so that it uses the latest version of ARC-IT. "Convert" is selected by default.
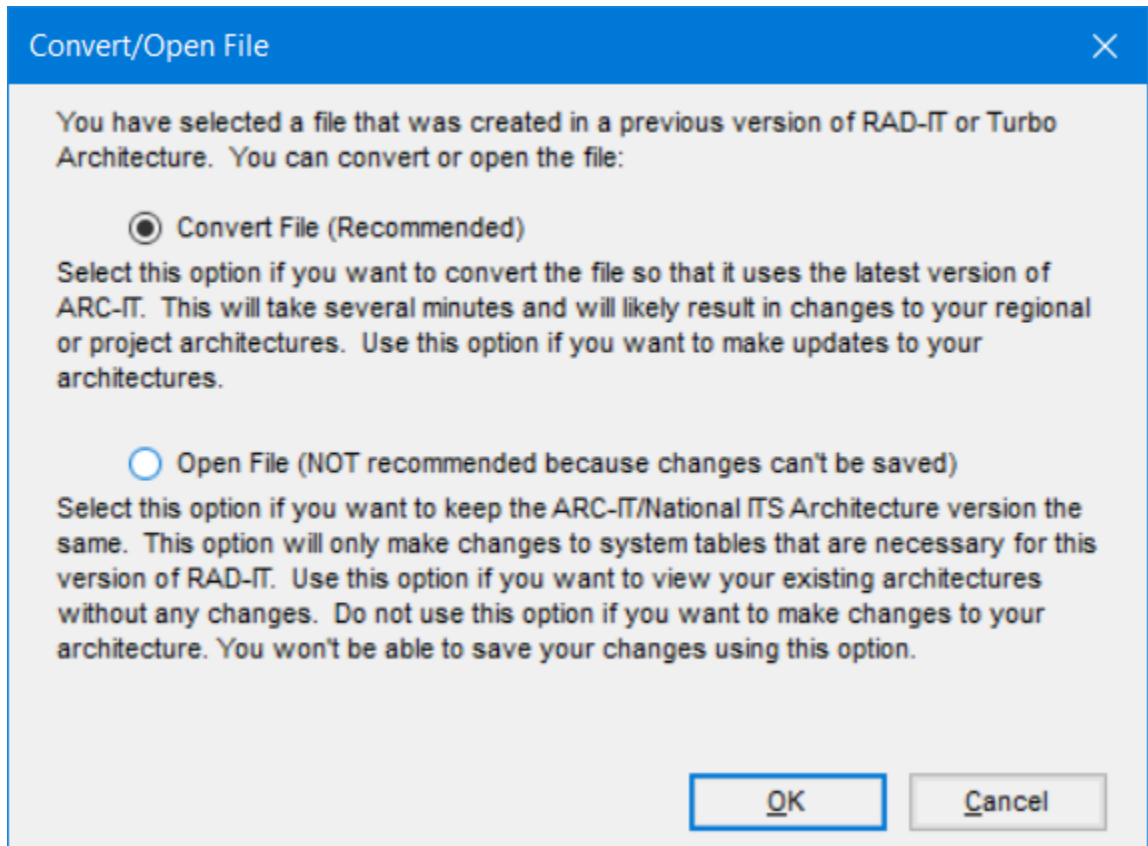


a. Select "Open File" and "OK" to simply open the file using RAD-IT without converting just to see what the older architecture looked like and perhaps answer a question that a user might have about the older architecture. It will still need to make some changes to the database in order for RAD-IT to work and be able to 'see' the older architecture. You may see warning messages during the Open process about fields not included. After opening the older file you will see a red box at the top of the screen saying "OPEN ONLY MODE" and the Save buttons have been disabled.

   CAUTION: "Open File" is not recommended for use of RAD-IT because changes cannot be saved. If you want to make any changes to anything in the older architecture, use the Convert option and then you can save the changes.

b. If you wish to convert the file, select "Convert File" and "OK" to begin the conversion.

**RAD-IT File Conversion**

Tasks

▶ Create New File
  Copy User Data
  Convert Inventory
  Convert Interfaces
  Copy Service Package Choices
  Convert Needs
  Convert Functions
  Copy Standards Tailoring
  Perform Flow Substitutions
  Remove Unused Discontinued Flows
  View Conversion Tables
  Remove Discontinued Components

Creating new user file.

Cancel

4. The next window asks you to select a destination file. The existing file is NOT replaced. It still exists in the original format at the end of the conversion process. Click "Save" to begin the conversion process, or "Cancel" to exit from the process. The software will warn you if an existing file name is selected.

5. The conversion will have to run to completion although you will be allowed to cancel out at different points during the process. You will be kept apprised of the progress and will be given the option to display, export, and print conversion tables during the conversion. The next screen reports the conversion progress. As each step in the conversion task list is completed, it is checked off and the pointer moves to the next step.

6. At the "View Tables" Step, you may display tables about the conversion, detailing both the differences in the two files, as well as the differences between the ARC-IT Versions. You may review the changes that have been made during the conversion and save a record of these changes for future reference. This is the only opportunity to view the conversion tables. If these tables are needed later, do not delete the original file. You may need to run the conversion again in order to see the tables a second time. The tables may also be printed or saved. As with the standard RAD-IT tables, the conversion tables can be customized to include or order by different fields and allows you to save the file or open it in Word or Excel.

NOTE: Physical Objects and flows that have been "discontinued" in the current version will appear with an asterisk (*) after the flow name in the output tables.

NOTE: In versions 8.0 through 8.3, environmental type terminators such as traffic, vehicle physical characteristics, or pavement conditions were no longer represented in ARC-IT. If you had an older architecture that included elements mapped to those physical objects they will be classified as "discontinued" by the conversion process. Some of them have been reintroduced in version 9.0 so you can re-map them to the new environmental physical objects on the Inventory tab after conversion. Say, No, when it asks if you want to remove discontinued objects at the end of conversion. Otherwise, it is always best to say Yes to remove the discontinued objects from your architecture.

NOTE: Service Package instances may be renamed if they still had the default name created by previous versions of Turbo, e.g. "ATMS01 Network Surveillance (Instance 1)" to use the new name and number "TM01 Infrastructure-Based Traffic Surveillance (Instance 1)". If you have customized the names then those will be retained.

7. The final conversion window asks if you wish to delete "discontinued" physical objects and flows from the original architecture. These are subsystems, terminators, and information flows that have been deleted (perhaps completely deleted, or split into other physical objects and flows) in current version of ARC-IT. Select "Yes" or "No".

    a. If discontinued flows are not deleted during the conversion, they will remain in the converted architecture, and will be marked with an asterisk (*) in the database and in tables as discontinued.
    b. These flows may be viewed on the conversion report titled "Discontinued Flows". This report can be displayed during the conversion, or with the other standard RAD-IT tables available on the "Output => Tables" pulldown menu.
    c. Discontinued flows can later be changed to user defined flows under the "Tools => Add Flows" option.

8. The "RAD-IT File Conversion" process step window remains displayed after you have selected to keep or discard discontinued flows, saying that the conversion has completed successfully and tells you that you should now do a "Build" on the Interfaces tab to add the latest flows to your architecture. Click "OK" to complete and exit from the conversion. The converted database is now open and available for editing.

9. Go to the Interfaces tab and do a "Build" to add flows to the tab and/or to your architecture.

10. Save the newly converted file.

## List of Conversion Tables
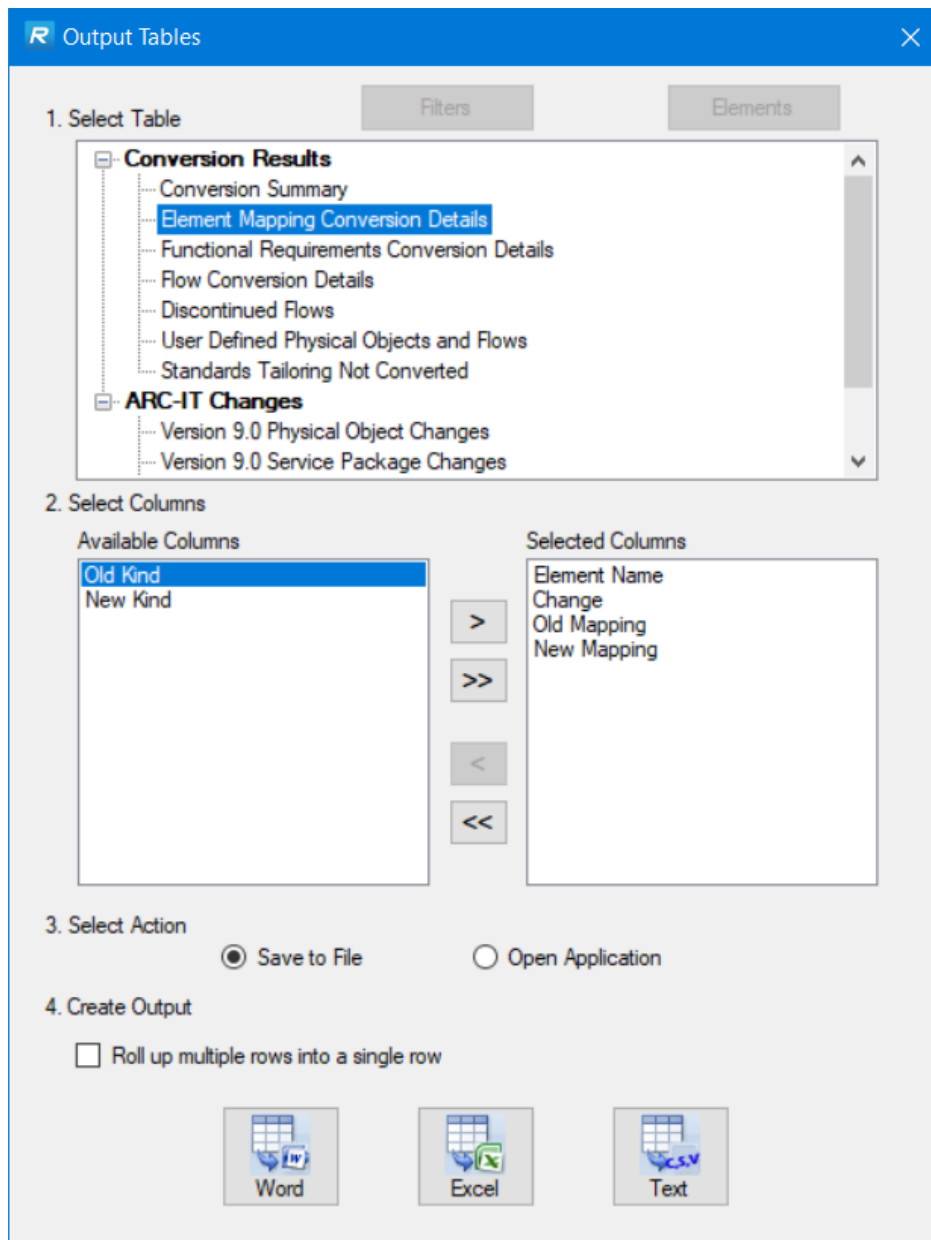


*Conversion Results:*

The Output Tables that may be displayed during the conversion process include the following:

Conversion Summary: This report illustrates information about the source and destination RAD-IT files, including version information, source and destination file names, and a list of the architectures that were converted.

Element Mapping Conversion Details: This report identifies the changes that were made to the mapping between elements and physical objects in the converted architectures. All mappings between architecture elements and the ARC-IT Physical Objects (subsystems and terminators) are listed by the change represented - new, modified, replaced, discontinued, including the old and new Physical Object names

where applicable. This report identifies the physical objects that were added, deleted, and renamed, along with the elements that are impacted by the changes. This report might be a couple of pages in length for a large architecture. The report shows new element mappings that were created, existing element mappings that were replaced, and any user defined physical objects that happened to match and were converted to ARC-IT Physical Objects during the conversion. Environmental type terminators such as traffic, vehicle physical characteristics, or pavement conditions are no longer represented in ARC-IT. If you had an older architecture that included elements mapped to those physical objects they will be classified as "discontinued" by the conversion process.

Functional Requirements Conversion Details: This report identifies changes made to the requirements in the converted regional or project architecture. In version 8.0, 8.1, and 8.2 there were no requirements so this report may not show any changes. However, for an old Turbo architecture, version 3 through 7.1 it will list the changes to the requirements for each element based on the underlying changes to the physical object and services mappings.

Flow Conversion Details: This report identifies specific information flow level changes that were made to the converted Regional and Project Architectures. This report lists the new information flows between elements, as well as the flows that changed names due to updates in ARC-IT. This report identifies all the information flows that were added, deleted, and renamed by the conversion. This will be a long (10s of pages) report for a large architecture. Similar to the previous conversion details report, it shows new flows that were added, existing flows that were replaced by new flows, and any user defined flows that happened to match new ARC-IT information flows and were converted.

Discontinued Flows: This report shows the discontinued information flows that are still included in the converted Regional and Project Architectures. This simple report shows all discontinued flows that remain in the architectures after conversion. If you choose to keep these flows, they can be edited individually on the "Interfaces" tab. This report also appears in the list of standard RAD-IT output tables. The "Interfaces" tab lists discontinued flows, user defined flows, and ARC-IT information flows, and distinguishes between them by using an asterisk for discontinued and National ITS Information flows if the database has been converted. The "Info" form (under "Interfaces" flows view) also distinguishes between the three types of flows.

User Defined Physical Objects and Flows: This report identifies all user defined physical objects and flows in the converted Regional and Project Architectures. This report allows you to review user defined physical objects and flows since some of these could be converted into new ARC-IT Physical Objects or flows. Note the last column, where the conversion may actually convert user defined physical objects and flows into equivalent ARC-IT Physical Objects and flows, yielding a "user defined" flow that actually consists only of ARC-IT Physical Objects, but not in a way defined by ARC-IT. During the conversion, if the software determines that there is a name conflict between user defined and ARC-IT flows and Physical Objects, you will be notified and the ARC-IT flow or Physical Object always takes precedence. These are also noted in the conversion output tables.


*ARC-IT Changes:*

Version 9.0 Physical Object Changes: This report identifies all subsystem and terminator changes. All physical objects are listed by the change represented - new, modified, replaced, discontinued, including the old and new name where applicable. This report is based only on ARC-IT and thus will generally be the same for each user who runs it during the conversion. The report may be longer if the original architecture was based on an older version of the National ITS Architecture.

Parking has changed in version 9. There are now 2 parking physical objects. If you had a parking management system in your architecture Conversion will map your old element to both the new Parking Management Center and the field based Parking Area Equipment. You may need to edit your architecture after conversion depending on if your parking element is more center based (back-office reservations, scheduling) or field based (occupancy monitoring, signage, etc.). And you may need to create a new element if you think you need to represent both aspects – center and field – in your architecture.

Version 9.0 Service Package Changes: This report identifies all Service Package changes. All Service Packages are listed by the change represented - new, modified, replaced, discontinued, including the old and new name and Service Package number where applicable. This report is based only on ARC-IT and thus will be the same for each user who runs it during the conversion unless their architecture is several levels back.

Version 9.0 Information Flow Changes: This report identifies all information flow changes. All information flows are listed by the change represented - new, modified, replaced, discontinued, including the old and new flow name where applicable. Also included is the source and destination Physical Object name for each flow. This report will identify all information flows that were created, substantially modified, or discontinued.

In Version 9 communications elements have been split up to distinguish between ITS Communications Equipment and Data Distribution Systems. You will now see 2 columns on the Interfaces tab.

Version 9.0 Functional Object Changes: This report identifies all functional object changes. All functional objects are listed by the change represented - new, edited, or discontinued including the old and new text where applicable. They are grouped by the physical object involved.

Version 9.0 Functional Requirement Changes: This report identifies all functional requirement changes. All functional requirements are listed by the change represented - new, edited, or discontinued including the old and new text where applicable. They are grouped by the physical/functional object involved.

NOTE: there used to be a Standards Changes report but since 9.0 represents such a drastic change to the communications view the communications standards and their solutions will need to be re-added using Auto Select after conversion. See the Communications tab for more details.

## Convert vs Open

When you click on a older Turbo or RAD-IT file you get a screen that asks if you want to Convert it or Open it. What's the difference and which should I choose?
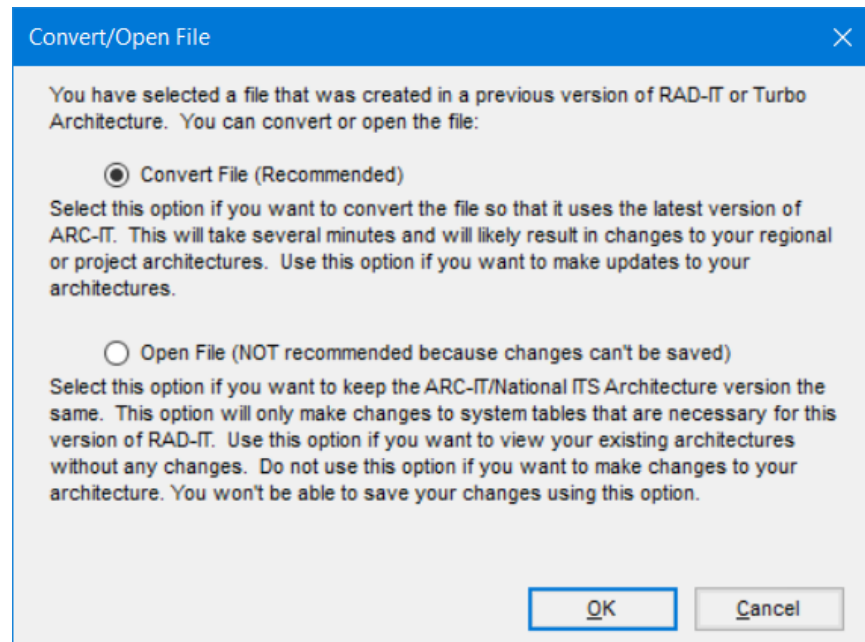


Convert, as has already been described, changes your old file and converts the information so that it uses the latest version of ARC-IT. This is the preferred method to make sure your file has the latest mappings to the ARC-IT (National ITS Architecture) physical objects, information flows, etc.

Open is also useful in certain situations. The main scenario where this is useful is when you need to look up something in an older version of the architecture or someone has sent you a file that is older and you just need to look at it.

With Open, RAD-IT will still make changes to the file but only enough to make the data tables match the schema as the RAD-IT user interface so you can 'see' the information on the various tabs.

> **NOTE:** only use OPEN to do just that – open an older file and look up something. Once you decide you need to make changes to that old architecture then go back to the original file and choose Convert.

You will not be able to first OPEN the file and then choose CONVERT on the same file; not everything may line up as expected – go back to the original and convert it.

# Data Input

This section describes the overall user interface for RAD-IT and some naming conventions.

## General Information about Data Input

Notice that the appearance of the tabs across the top of the RAD-IT window is oriented towards the work flow of generating a Regional Architecture (see the http://www.ops.fhwa.dot.gov/publications/regitsarchguide/index.htm document). There is one tab for each major step in the architecture development work flow.

The tabular input windows consist of the following tabs where inventory elements and services may be entered and customized:

- **Start:**  Create/modify/delete an architecture.
- **Planning:** Create/modify/delete planning objectives and strategies and relate these to the architecture.
- **Stakeholders:**  Create/modify/delete a stakeholder name or group, global to all architectures in the file.
- **Inventory:**  Create/modify/delete an element in the open architecture.
- **Services:**  Associate an ARC-IT service package with local inventory elements.
- **Needs:** Select/create/modify/delete needs for a region or project based on the service packages.
- **R&R:**  Create/modify/delete Role and Responsibility (R&R) areas to the current architecture based on service package choices and write/edit roles and responsibilities for each participating stakeholder.
- **Functions:**  Associate functional objects with inventory elements based on the inventory and service package choices and requirements based on the needs choices.
- **Interfaces:**  Build and customize the architecture.
- **Communications:**  Customize the list of applicable ITS communications solutions, including ITS standards, based on inventory, service package, and interface choices.
- **Agreements:**  Create/modify/delete lists of agreements between stakeholders and agencies in the region; Associate agreements with the stakeholders based on the information flows.

There is a certain order to be followed while using the tabbed windows. Several of the menubar options or menu tabs will be grayed out if they cannot be used yet. For example, a user is not allowed to customize the inventory and information flow list if an architecture has not been created or opened.

All tab windows indicate the deployment **status** of an item (element, service package, information flow).

As an aside, the items on the inventory input and customization tabbed windows (the Inventory, Services, and Interfaces tabs) are directly related to ARC-IT. There are physical objects (subsystems and terminators) and service packages that when built into the Project or Regional Architecture (i.e., selected and assigned to a local element) generate information flows that are directly associated with ARC-IT physical objects assigned to the elements.

It is strongly recommended that the user be trained in the terminology, relationships, and usage of the ARC-IT. The USDOT offers classes across the country on the Architecture. There is also the ARC-IT web site that may be used as a reference. The Regional ITS Architecture Guidance Document is also an excellent resource to see how to apply ARC-IT to regions and project situations.

## Naming of RAD-IT Items

GUIDELINE:  It is recommended that a RAD-IT database file be named based on the region name.

GUIDELINE:  A naming strategy for all user-entered names (element, stakeholder, user defined Physical Object/flow, project) should be established before designing the initial architecture in a RAD-IT database file.

**Remember** that when naming an element, stakeholder, architecture, etc., certain special characters (ampersand (&), apostrophe ('), and quotes (")) may not be used in the name. RAD-IT will give a warning message and not allow these names. Spaces, underscores (_), hyphens (-), are all acceptable in a named item in RAD-IT.

The following shows the Maximum Name Sizes in List Boxes by the number of characters:
- Element names:  255
- Stakeholder names:  255
- Architecture names:  255
- Project names:  100
- User-defined physical objects:  100
- User-defined flows:  100
- User-defined standards:  255
- Service Package names:  255
- Role and Responsibility Area names:  255
- Functional object names:  255
- Agreement names:  255

CAUTION:  While 200-255 characters may be the maximum length for some names it is not really practical to go over 80 characters and, ideally, even less if they are to appear as labels for boxes on diagrams such as the element and stakeholder names.

# Starting RAD-IT

As you click to start RAD-IT or double-click on a .radit file RAD-IT will start and a 'splash' screen will indicate what version of RAD-IT is starting.

RAD-IT will verify that you have the right version of RAD-IT for your version of Office. It will warn you if you are trying to run 32-bit RAD-IT with 64-bit Office or 64-bit RAD-IT with 32-bit Office.

Depending on your settings on the Options menu, RAD-IT will also check to see if there are any updates available from the ARC-IT website (www.arc-it.net).  You may see a notification in the bottom right corner of the RAD-IT window saying, either "RAD-IT up to date" or "Update available!" It may also say "Version check failed" if you are not connected to the internet or if the verification server is not available for some reason. Use the Options menu to check manually.

# Start Tab

Looking at the RAD-IT screen we will start working our way from left to right across the tabs at the top. This section discusses the first tab – the Start tab.



## Beginning a New Architecture

Managing the architectures contained within a file is done from the Start tab. This tab allows the user to create a new architecture or select an existing architecture. The tab allows the user to define scope, time frame, and other basic definition information for the new or selected architecture.

After opening an existing file all architectures contained in the file will be shown, and the architecture that was last opened in the prior use of the file will automatically be selected when the file is opened.

The left-hand side allows the user to create a new architecture, delete an architecture, or select an architecture. Selecting an architecture causes the right hand side of the window to be filled in and makes the selected architecture the current architecture shown in the banner and on other tabs. The following sections will explain in detail how to use these options.

A new architecture is created on the "Start" tab by selecting the "New" option under either the Regional or Project Architecture areas. This adds a new architecture to the file. The following process may be used to begin a new architecture:

1. Select the type of architecture:
   a. When creating a new Regional Architecture in an open database file, the name of the architecture must be entered. The other attributes of the architecture are optional. There is no "Status" field. There may only be a single Regional Architecture in a RAD-IT database file.
   b. When creating a new Project Architecture in an open database file, the name and status of the architecture must be entered. The other items are optional. The names of existing Project Architectures in this database file are displayed so you may see the existing names and enter a new name. The software prevents you from creating a project architecture with the same name as one previously defined.
2. Enter the attributes of the architecture. Items such as Geographic Scope, Service Scope, and Timeframe, are discussed in more detail in the "Regional ITS Architecture Definition" section of the ARC-IT website. All of these attributes may be changed later on the "Start" tab, and will be displayed for each architecture in the file, in the "Architecture Summary" report.
   a. Name: The name of the architecture. Required.
   b. Description: Description of the architecture. Optional
   c. Timeframe: Define the planning timeframe that the Regional ITS Architecture will address. Should the architecture encompass systems and services that are implemented over the next five, ten, or twenty years?  If this is a "planned" architecture for deployment in a future planning cycle (e.g., two years from now, or the five, ten, or 20 year planning horizon), this should be entered here. Optional
   d. Status: Status of the Project Architecture. If you have extended the list of status values, all will appear in this list. Required
   e. Geographic Scope: Where the architecture will be deployed (e.g., District 7, Southern California). Ideally, the geographic scope of a region should be established so that it encompasses all systems that should be integrated together. In practice, it is sometimes difficult to determine where to draw the line so that the architecture is inclusive without expanding to the point that the effort becomes unmanageable and consensus is difficult to achieve. While this is frequently called a "geographic" area, it is usually a political map that is being partitioned, defining a region along existing institutional boundaries. The regulation/policy states that metropolitan areas must consider the metropolitan planning area (MPA) as a minimum size for a region. The MPA is a good place to start since this boundary normally encompasses most integration opportunities and it coincides with the geographic region used for transportation planning. Optional
   f. Service Scope: Determine the basic scope of the services that will be covered. For example, determine if the Regional ITS Architecture should define commercial vehicle related services. Optional
   g. Developer: Name of the person or team that has developed this architecture. Optional
   h. Maintainer: Name of the person or team maintaining this architecture. Optional
   i. Version: Enter a value for this field that makes sense for the region. Architecture version numbers or names should be agreed to by all affected parties, and should be consistent across all architectures in the region covered by this regional architecture. Optional
   j. Date/Time: This field displays the current date and time when a new architecture is created. The field may be changed when the architecture attributes are modified. Optional

NOTE: Project Architectures have additional characteristics that can be defined:

    k. Alternatives Considered provides a field to describe any analysis of alternative system configurations and technology options that were explored as part of the development of the system architecture.

    l. Procurement Strategy may indicate what types of contacting or options that were explored before deciding on the approach to be taken on this particular project.

    m. Operations Resources briefly describes changes in the staffing, training, tools, or hours of operation in order for the systems modified or created in this project to work.

3. After selecting "apply" the architecture will be created.



## Continuing Development of an Existing Architecture

The following process is used to continue development of an architecture in progress.

1. To open an existing architecture, Click on the "Start" tab in an open database file, select the Project or Regional Architecture name from the lists on the left, modify the attributes for the selected architecture on the right, and click "Apply" (available only if attributes were changed). The architecture name will appear in the title bar of the RAD-IT main window, along with the file name.

2. To save and close this architecture and open another architecture from the same database file in the same RAD-IT session, select the other architecture name on the "Start" tab, or select the "New" option under Project or Regional Architectures (if a Regional Architecture does not already exist) to create a new architecture in this file. The RAD-IT tool allows only one

architecture to be opened at a time, so opening a second architecture will close the first. If changes have been made to the first architecture, you are asked to save them before the second architecture is opened. The new architecture is opened in the same RAD-IT session.

3. Because all of these architectures are stored as tables in the same database file, changes will not be saved to the database unless explicitly requested.

## Deleting an Architecture

The following process may be used to delete a Regional or Project Architecture from the database file. To delete an existing architecture:

1. To delete a Regional or Project Architecture in an open database file, go to the "Start' tab, select the architecture name to be deleted, then click the "Delete" option.
2. A verification window will appear where you may cancel the delete or continue.

**NOTE:** Deleting the architecture from the database file does not actually delete all references to elements used in this architecture that may be connected to other elements, stakeholders, physical objects, or information flows, in the rest of the Regional Architecture. This process is manual and must be done on the "Interfaces" tab after deleting the architecture.

**NOTE:** Architectures are stored as tables in a database file. However, changes made to the file are not automatically saved to the database (this works differently from Microsoft Access). You must explicitly save changes periodically. This also compresses the database file and removes the temporary files.

## Modifying the Attributes of an Architecture

The following process may be used to modify the attributes of a Regional or Project Architecture in the currently open database file. These attributes include the architecture name, description, status, and many other items.

To modify a Regional or Project Architecture name, description, status, or other available attributes in an open database file, go to the "Start' tab, select the architecture name whose attributes are to be modified, and update the attributes on the right-hand portion of the screen. Click "Apply" to accept the changes, or "Cancel" to ignore changes to the attributes of the architecture.

As with element and stakeholder names, the architecture name is stored by identification number in RAD-IT, so changing the name of the architecture on the Start tab will change it everywhere in the database file.

**TIP:** You can change the status of all the flows in a selected project just by changing the status of the project on the Start tab. This is useful when a project is complete and you are ready to change everything from Planned to Existing. You will be asked if you are sure with the following dialogue box:

**Propagate Project Status**

Do you want to change the status value of all items associated with the current project, TOMATO, to Existing?

The items that will have their status values changed are:
- Inventory elements,
- Service packages,
- Service package instances,
- Functional requirements,
- Information flows.

[Yes] [No]
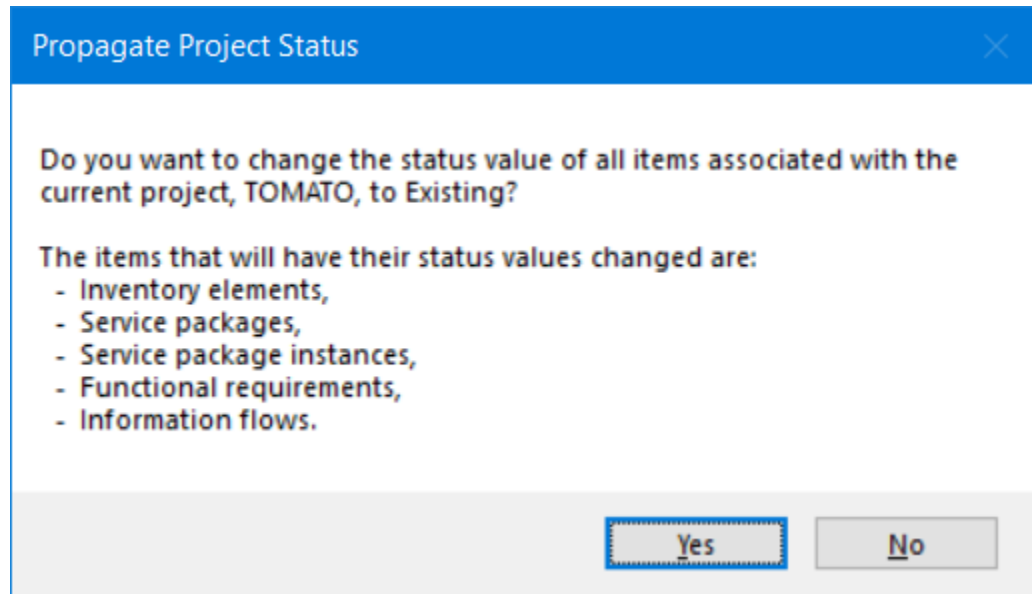
If you click No it will change the status of the project without affecting the other items like elements and flows. If you say Yes then you can see that all the elements, service packages, requirements, and flows will all have the same status to match that of the project.

## Change Log

Architectures are not static; they will undergo change. RAD-IT includes a Change Log that provides the ability to record the changes made to the RAD-IT file. This log includes a record of the changes made to the selected architecture as recorded by the user. The user can add/modify/delete entries in the change log. Each entry includes timestamp, name, version, and change description.

1. Select the "Change Log" option at the bottom of the "Start" tab for an existing architecture in an open database file. The change log window will appear.
2. The window title identifies the architecture by name.
3. The left-hand list box lists all maintenance records for the current architecture, ordered by Date/Time. Standard operation - picking an item on the left causes all information for the record to be displayed on the right.
4. This example displays a list of existing change log entries. The user is creating a new entry by selecting the "New" option. Today's date/time has come up automatically, but this may be changed by the user. The user then enters the name of the person (50 characters max) updating the log (this could be a different person from the "maintainer" shown on the "Start' tab for this architecture), a new version number (default is the version on the Start tab, 50 characters max), and a description of the change. All fields are optional except for the date/time.
5. The "Delete" option can be used to delete maintenance records (change log entries).
6. Click "Apply" to accept the changes, or "Cancel' to ignore the changes, then "Close" to close this window. The "Close" option toggles to "Cancel" and "Apply" is active when the user is editing.
7. The "Date/Time" and "Version" fields have buttons to the right of them with the title "Apply to Start Tab". Selecting these buttons will cause the date/time or version number that shows on the Start tab to be updated.

    **NOTE:** If the person making the change is the same as the "Maintainer' on the Start tab, then the "Apply to Start" buttons will default to checked. If the person is not the same as the "Maintainer", then the buttons will default to not checked.

## Related Architectures

There are now more than 300 ITS architectures representing statewide areas, metropolitan regions, corridors, or districts within a state. There are also a small number of multi-state architectures. With so many architectures across the country there is bound to be some overlap, either in geographic scope or in the types of services that are represented. A regional ITS architecture can be developed to cover a metropolitan area but it could also be developed for an entire state. In many places, both exist - the cities have their architecture for their existing and future services and there are district or statewide architectures covering services planned by the state DOT for larger areas.

RAD-IT includes a couple of features to help document that there are other architectures involved and track the elements that may be included in another architecture. This can help the maintainers of an architecture coordinate their updates with the stakeholders of the other architectures.

On the Start tab, the Related box, shown in the figure above, lists other architectures that have been input. These other architectures are meant to be other regional/statewide architectures that are in other databases somewhere. It could also include a project architecture that is stored in another file.

To add a Related architecture, click the "New" button below the "Related" architecture box. The right side of the screen will change to allow for data entry of the new related architecture. The Name is the only required field but the Description, Timeframe, Status, Geographic Scope, Service Scope, Developer, Maintainer, Version, and Date/Time can also be edited.

The *Description* field of the Related Architecture should be complete enough to understand something about the other architecture and its relationship to the current architecture. Include the filename, the overall scope, and the main agency responsible for it. Other information to include might be the reason that this other architecture is related to the regional or project architectures in the current database.

> **TIP:** An easy way to populate the Related Architecture information is to open that other architecture in another RAD-IT window (Yes, you can have 2 copies of RAD-IT running at once). Then copy the information from the Start tab of one screen and paste it into the Start tab of the other screen.

Once you hit "Apply" the information is stored and the name is added to the list on the bottom left side of the Start Tab. To edit the information of a Related architecture, simply click the name on the left side of the screen, change the attributes on the right as needed and click "Apply".

To remove a Related Architecture, click the name of the Related architecture and click "Delete". Click "Yes" on the confirmation box and the name of the related architecture and its attributes will be removed from the database. This would be useful when, perhaps, a project that used to be in a separate file has been imported into this file.

The Related Architecture will be available on the Inventory tab to be able to identify an element as being "Shared" with elements in another architecture.

## Additional Architecture Management Options on "Start" Tab

In addition to the options that add, modify, or delete an architecture on the "Start" tab, there are two additional options. They each contain a topic area of their own.

- The "Project to Region" option is used to merge a Project Architecture into an existing Regional Architecture, and may be used in various situations, one of which is after an "Import." See the *Merging* section below.
- The "Region to Project" option may also be used in a variety of situations, and is handled as an "Advanced Topic" later. See the sections on *Importing* and *Converting a Region to a Project* below.

## Maintaining Consistency between the Regional and Project Architectures

If changes are made on the "Inventory" and "Services" tabs while in a project, these changes will be reflected in the Regional Architecture, and vice versa. This applies ONLY to element inventory, Physical Object, project, and status changes on these windows. In order to regain consistency of information flows and interconnections between the Project Architectures and the Regional Architecture, such as customization done on the "Interfaces" tab in a project, the Project Architecture MUST be merged (or merged again, if previously done) into the Regional Architecture via the "Project to Region" option on the "Start" tab.

> NOTE: If flows have been deleted from the Project Architecture, then "Project to Region" (to merge the project into the regional) and the "Build" button on the "Interfaces" tab (to build the architecture) are not necessary. They will not change the Regional Architecture. The flows must be deleted manually from the Regional Architecture. The "Build" button to build the architecture only adds new elements and flows to the "Interfaces" tab (for instance, if a new inventory element was created or a service package was selected), and "Project to Region" only makes the two architectures consistent if customization has been done to the project.

> GUIDELINE:  If an interconnect is selected in the Regional Architecture that is already in the project, only flows are selected that are in the Regional Architecture. If an interconnect is removed in the Regional Architecture, it does not affect the Project Architecture.

## Import

In RAD-IT, the Import tools provide the ability to import project architecture information from another file.

There are essentially 2 types of import supported by RAD-IT:
- Importing a project architecture from another RAD-IT file (see "*Importing an Existing RAD-IT Project Architecture*" below)
- Importing project information from a SET-IT project (see "*Importing a SET-IT Project*" below)

> NOTE: Either type of Import only applies to Projects and Import only applies to files of the same version. If you have an older file then convert that file to the latest version and then it can be imported into your RAD-IT file.

*Importing an Existing RAD-IT Project Architecture*

The following process may be used to import an existing Project Architecture from a second RAD-IT database file (source file) into the open database file (destination file).

1. It is a good safety measure to do a Save As… of the destination RAD-IT database file prior to importing. Once an architecture is imported into this file and saved, it is not possible to undo the import.
2. For a Project Architecture to be imported from the source database file, the project must already be fully defined in that database file. That is, the Project Architecture to be imported must be built, via the "Build" button on the "Interfaces" tab, so that all elements and information flows appear in the "Interfaces" tab and are present in the architecture.
3. To import the external Project Architecture into an open database file, on the menubar select: File => Import…
4. A window will appear asking you to select the name of the RAD-IT database file from which to import the Project Architecture. Select the desired path and file name. Click "Open" to open this file.
   > **NOTE:** You cannot import from a file that is open in another session of RAD-IT. Close that copy of RAD-IT and then you can import the project from that file. If you forget then you may get an Error message from RAD-IT that says "Error accessing the import file." If you get that just close the other copy of RAD-IT and try again.
5. If you attempt to import a prior release architecture, you will be notified that the file must first be converted and the import process will exit. At that point, do the following:
   a. Close your destination file,
   b. Open the source file in RAD-IT and
   c. Let it convert to the current version and then
   d. Save the file as the new source file for your import.
   e. Close the source file and
   f. Reopen your Destination file.
   g. Start the Import over to get through step 4.
6. The next screen lists the Project Architectures included in that database. Select the Project Architecture to be imported (only one project at a time may be imported). The path name may also be changed without returning to the previous screen. Click "Import" (or double click on the project name) to begin the process.
7. If the project name already exists in the destination file, a window will appear stating that you must rename the existing project in either the source or the destination file.
8. The next screen lists elements that are defined in the project being imported, but not included in the Regional or Project Architectures in the destination database file. Select "Yes" to import these elements, or "No" to ignore them. Only the elements with unique names are listed in this window, although ALL elements from this project will appear in the imported project in the destination file. The elements that already exist in the destination file will continue to have those elements' associations and attributes. If you intend to keep these as completely separate elements, they may be changed on the tabbed windows in the imported Project or Regional Architecture.
9. The next window asks if you wish to add user defined physical objects that are in the imported project but not in the destination file. Answer "Yes" or "No". This window will not appear if there are no user defined physical objects in the architecture.
10. The next window asks if you wish to add stakeholders that are in the imported project but not in the destination file. Answer "Yes" or "No".
11. The next window asks if you wish to add Service Packages and Needs that are in the imported project but not in the destination file. Answer "Yes" or "No".

12. The next window asks if you wish to add Planning objectives and strategies that are in the imported project but not in the destination file. Answer "Yes" or "No".
13. The next window asks if you wish to add stakeholder Roles & Responsibilities that are in the imported project but not in the destination file. Answer "Yes" or "No".
14. At this point, a window may appear asking if you wish to add user defined flows that are in the imported project but not in the destination file. Answer "Yes" or "No". This window will not appear if there are no user defined flows in the architecture.
15. Then you are asked if you would like to add the information flows (with source and destination elements) from the project being imported into the "Interfaces" tab in the imported Project Architecture in the destination file. Select "Yes" or "No". By selecting "Yes", ALL flows in this window are imported.
16. The next set of windows concerns the Communications view and asks if you wish to add user defined standards, standards profiles, communications solutions, or issues that are in the imported project but not in the destination file. Answer "Yes" or "No".
17. The next window asks if you wish to add Agreements that are in the imported project but not in the destination file. Answer "Yes" or "No".
18. The import process is completed and the destination project is built. You must save the destination (currently open) database file in order to save the changes from the import.
19. Finally, the original "Import" window appears allowing you to import another project from the source file into the destination file, or to "Close" (exit from Import).

## Importing an Existing Regional Architecture

A Regional Architecture may be imported from a source file into a destination file, similar to importing a Project Architecture. This is a two-step process, as follows.

1. First, the Regional Architecture must be converted into a Project Architecture in the source file using the "Region to Project" option on the "Start" tab.
2. Next, the new Project Architecture (converted from the Regional Architecture) may now be imported into the destination file using the "File => Import" option, built via the "Build" button on the "Interfaces" tab, and merged into the Regional Architecture in the destination file via the "Project to Region" option on the "Start" tab.

## Importing a SET-IT Project

A project architecture developed in Systems Engineering Tool for Intelligent Transportation (SET-IT) and also be imported into RAD-IT as a project architecture. SET-IT is a graphical tool used to create customized drawings to represent the physical, communications, and enterprise views for an ITS project, including connected vehicle services.

The process works similarly to importing a project from another RAD-IT file. The SET-IT file is identified and RAD-IT analyzes the file to determine what needs to be imported and provides the user feedback through the process.

Steps to Import from SET-IT:
1. On the Start tab click "New" under Projects to start the creation of a new project architecture. The screen on the right changes to add an area to identify a SET-IT project to import.

2. Click the blue hyperlink that says, "Not Set (Click to Browse)" which will open up a Windows File dialog box to find the SET-IT project you would like to use.
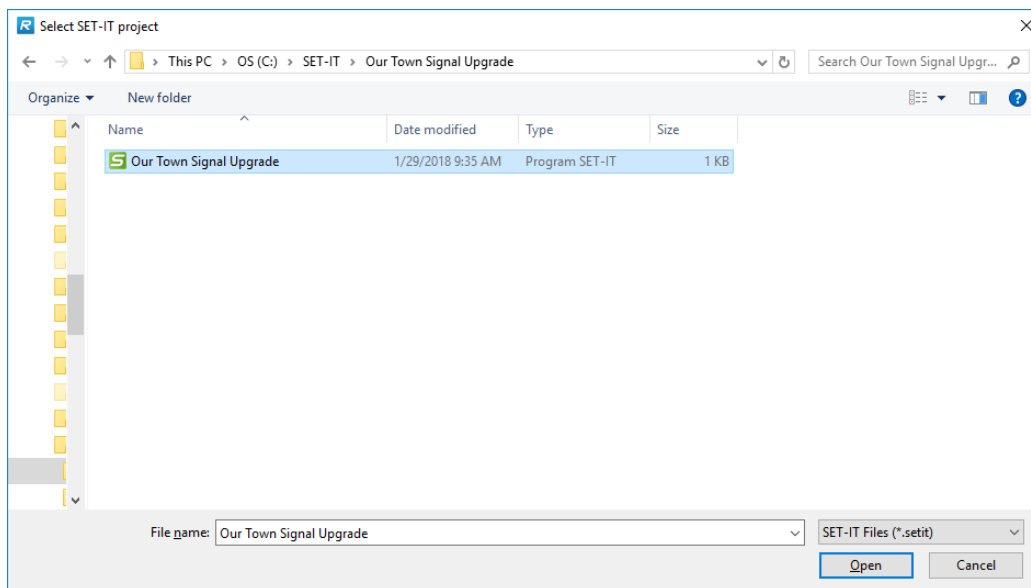


3. Find the 'SET-IT' project you want to import and click "Open" to read the database and format the information for RAD-IT.  You may get a "Locked file selected" message if the project you want is currently being used by SET-IT.  The message will say, "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file."  If this happens simply close the SET-IT application and try again.
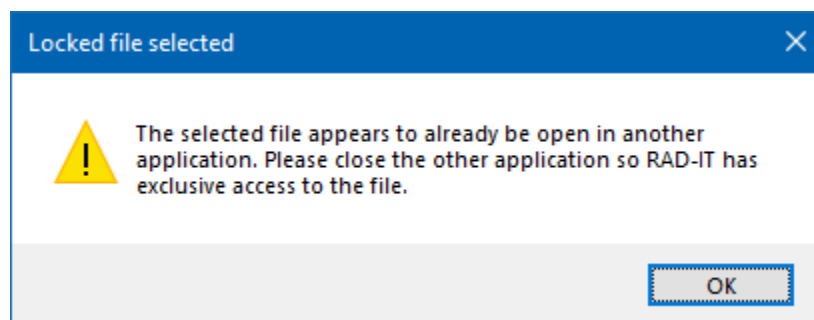
4. Once you have the SET-IT project selected, the Start Tab in RAD-IT will change to show the SET-IT file name selected.

Project Architecture Attributes
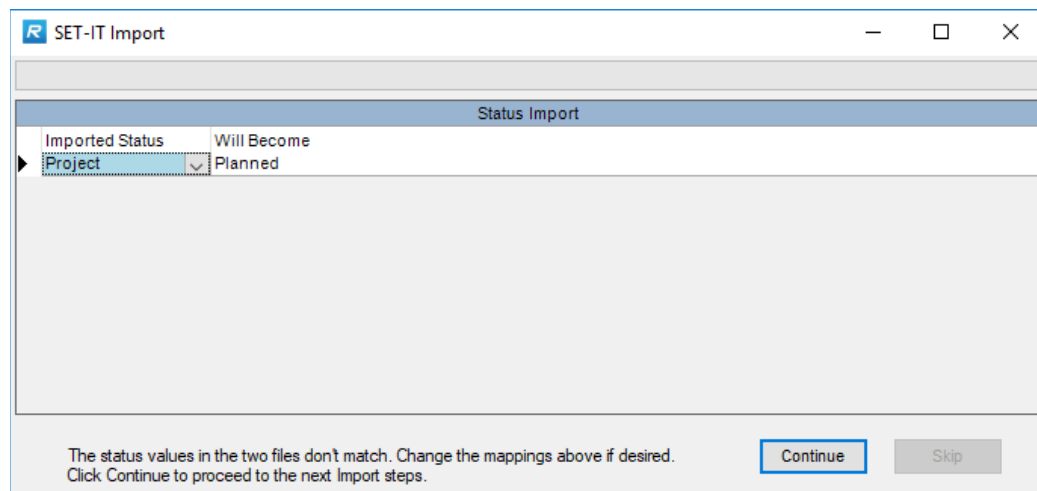
SET-IT Project:    Our Town Signal Upgrade (Click to Disconnect)
Note

Import
Open

5. Click "Import"

6. This will then walk through the information in the SET-IT file to show the information and present any changes that are needed to the data before it can be imported into RAD-IT:

   a. Status – shows the default status used in the imported SET-IT file compared to the default status used in your RAD-IT file. If it is different then the RAD-IT status value will be used. Typically, SET-IT files have a default status of 'Project' which means that thing being shown will be built or developed as part of the Project in question. RAD-IT files typically use a default status value of 'Planned' as in, this is what we Plan to do. You can use the pull-downs to change the mappings if desired or click "Continue".

   R SET-IT Import                                               —    □    ×
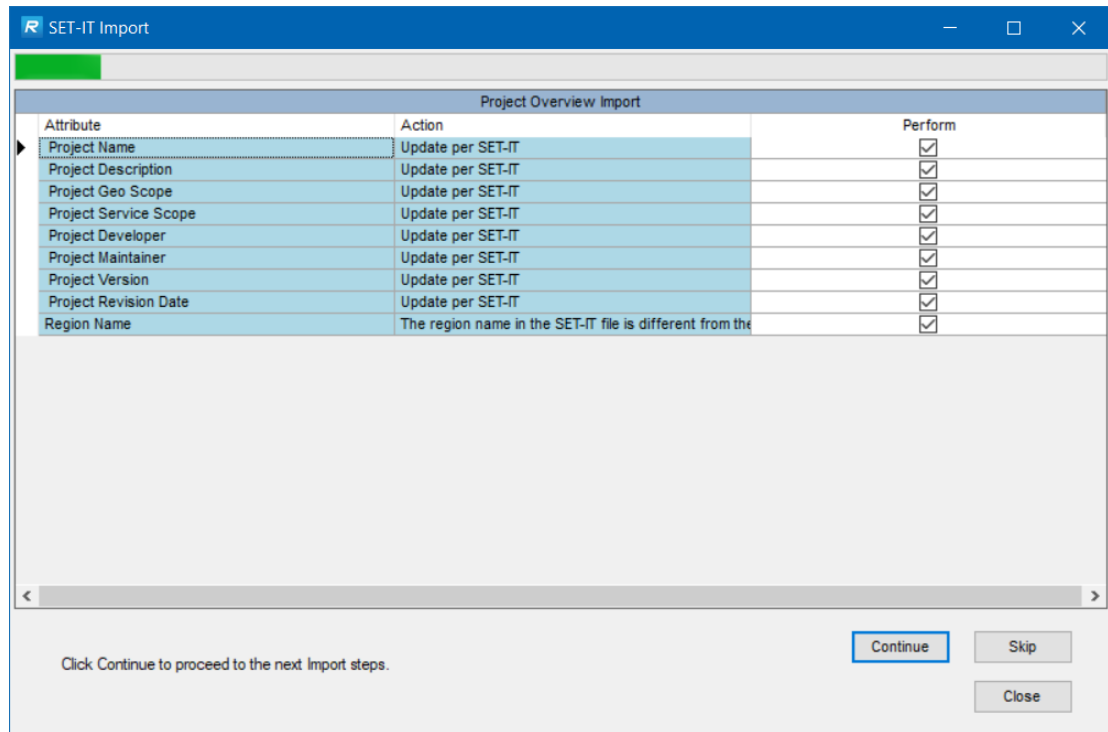
   Status Import
   Imported Status    Will Become
   ▶ Project        ∨ Planned

   The status values in the two files don't match. Change the mappings above if desired.      Continue      Skip
   Click Continue to proceed to the next Import steps.

   b. Project Overview Import – an information only screen that shows what will be imported to populate the start tab, including the project description, scope, developer, maintainer, version

numbering, and date. You can select which element of the overview to import using the "Perform" checkboxes. Click "Continue".



c. Stakeholders Import – shows the list of Stakeholders that will be added from the SET-IT file. If a stakeholder with the same name already exists in your RAD-IT file this screen will show that as well.

d. Physical Objects Import – shows any user defined physical objects (not defined in ARC-IT) that are in the SET-IT file.

e. Functional Objects Import – shows any user defined functional objects (not defined in ARC-IT) that are in the SET-IT file.

f. Elements Import – shows the list of elements that are going to be imported into the RAD-IT file from the SET-IT project file.

g. Service Packages Import – shows the list of service packages, including the shorthand identifier, e.g. TM03, the long name of the service package instance, and the action to be taken. SET-IT treats all service packages that are selected and included in a SET-IT file as a service package *instance*.
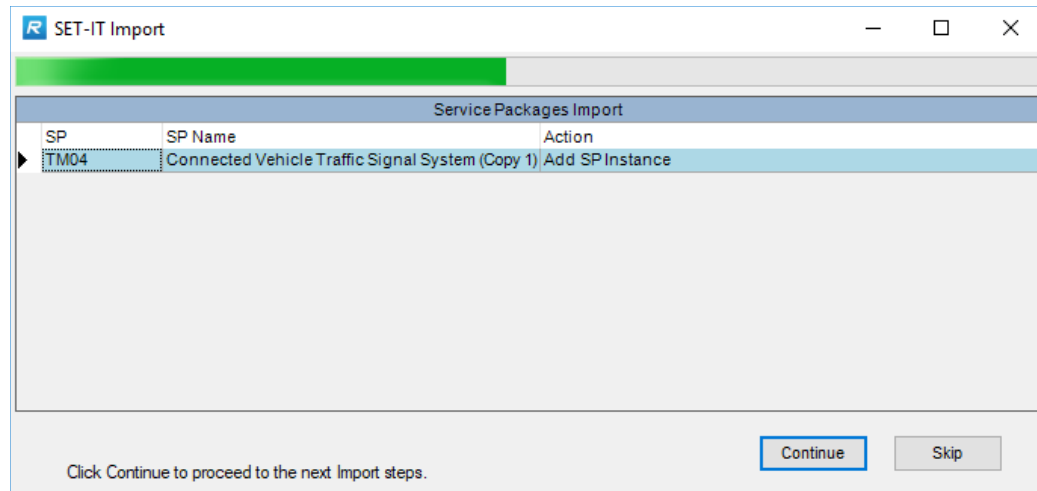


NOTE: ARC-IT v9.1 now includes a concept of a Service Package Implementation which is a subset of a service package that defines an approach for meeting the user needs of a given service package. SET-IT allows users to include Service Packages Implementations as a starting point for their project. During Import RAD-IT will simply include those as any other service package instance.  You may see a name like TM06.1 Dynamic Message Sign to indicate that it came from the implementation option of TM06 Traffic Information Dissemination that is focused on using Dynamic Message Signs.

h. Flows Import – this screen will show any user defined physical information flows (not defined in ARC-IT) that are in the SET-IT file.
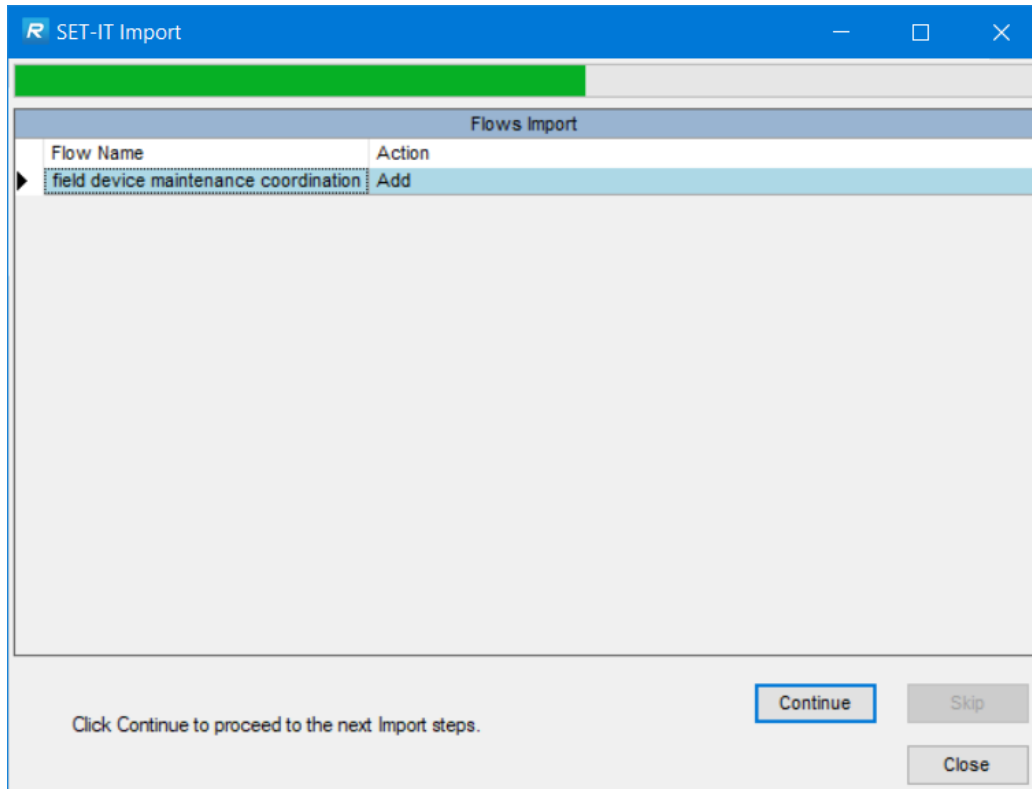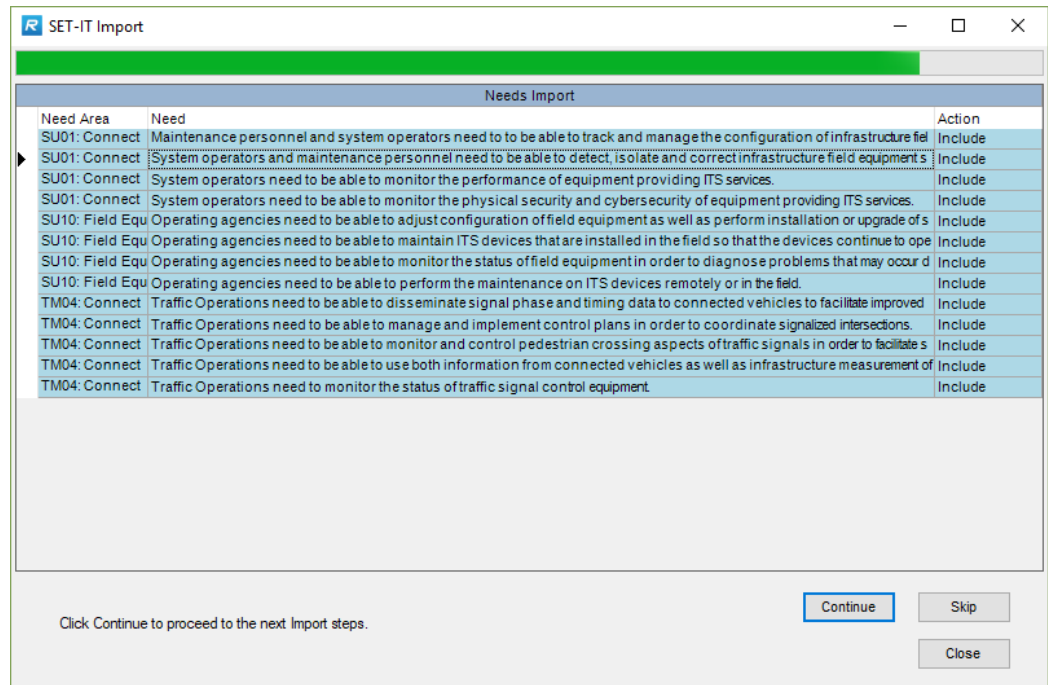
i. Interfaces Import – this screen shows the list of information flow triples (source element, destination element, and flow name) that will be imported.
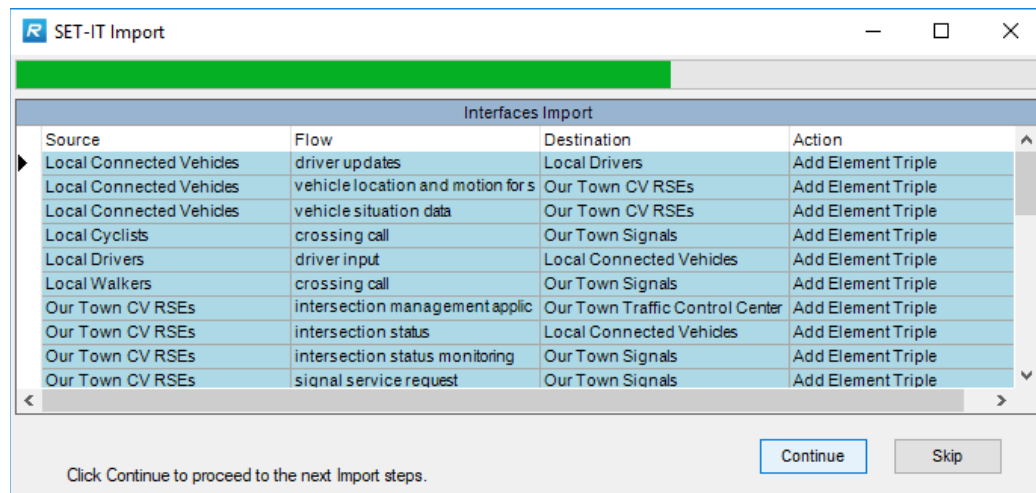


j. Communications Issues Import – lists any issues or gaps that the imported communications solutions may have that are unique from ARC-IT, including any at the standards, profile, or solution level.

k. SDO – lists the Standards Development Organizations (SDOs) that are to be imported that are user defined in the SET-IT project.

l. Standards Import – lists the standards from the SET-IT project that need to be imported, including any that are user defined.

m.  Profiles Import – lists the Data and Communications Profiles to be imported from the SET-IT project

n.  Communications Solutions Import – lists several communications related items to be imported. First it lists any user defined standards that were defined in the SET-IT project and may be needed in the RAD-IT file. Then it lists any Data or Communications Profiles – groups of standards that combine to define the standards required to communicate at the various protocol layers across an interface. Then it lists any Communications solutions in the SET-IT project that may be needed in the RAD-IT file. Then it lists any Communications Issues that have been defined in the SET-IT project that may apply to the communications solutions or their standards. In some cases, it will say "excluded" since it is not needed in the RAD-IT communications tab. Also included will be any standards that are mapped to physical objects. You may also see a list of user defined Standards Development Organizations (SDOs) that need to be imported.

o.  Need Areas Import –shows the list of Need Areas to be imported. Need areas are groupings of needs, usually based on Service Packages.

p.  Needs Import –shows the list of needs, including any customized needs that will be imported, organized by the service package to which the need applies.



q.  Requirements Sources Import – lists any unique (user defined) sources for the functional requirements that are about to be imported from the SET-IT project.

r.  Requirements Import –shows the list of Functional Requirements to be imported.

NOTE: if a SET-IT project was built to include System level requirements vs. Element or Functional Object based requirements then you may not see any requirements after import. Currently, RAD-IT only supports Element or Functional Object based requirements. After import you can use the Autoselect function on the Requirements tab to pre-select requirements for your project based on the functional objects assigned to your elements.

s.  Agreements Import – lists the stakeholder agreements from the SET-IT project to be imported.
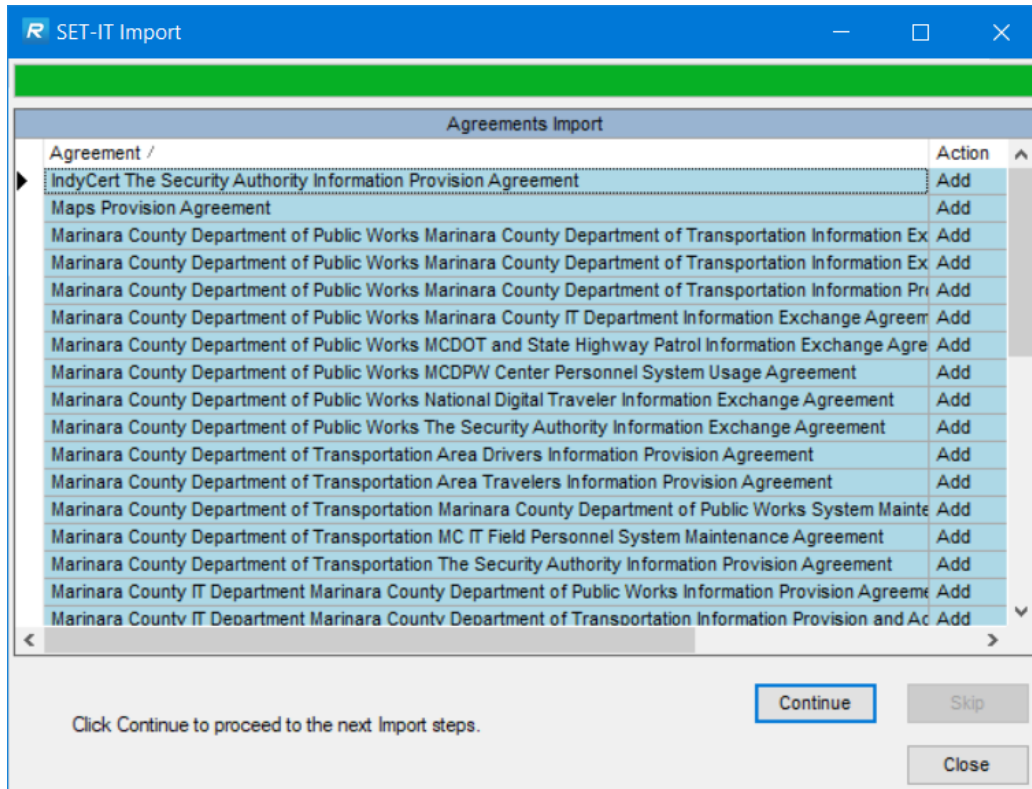
Once all the steps have been conducted one final screen will say "Import Complete". Click the Close button or the "X" in the upper right corner to close this window and an Import Report screen will give you an opportunity to create an output report in Word, Excel, or Comma-Separated Values (CSV) Text format that lists all the changes made to the file.

> **TIP:** *Uncheck* the Roll-Up option for import reports – it takes longer and creates giant cells that try to include too much. The Excel option works best and you can then use Filtering in Excel to inspect any potential issues.

Click the "X" again to close this window after you have exported the report and you will go back to the Start Tab.

Now you can go to each tab and see the project information that is now part of the RAD-IT project.

### *Rules of Importing*

These rules apply whether the project was imported from another RAD-IT file or from a SET-IT project.

1. The Project Architecture you imported will be the architecture currently selected in the file. You can see this by looking at the title bar and in the info boxes on each tab which will show the architecture currently open and selected in the file.
2. All the elements in the source Project Architecture may not be imported into the destination file. If the source project includes inventory elements that are not actually connected into the architecture, i.e., no information flows are connected to these elements on the "Interfaces" tab

after building the architecture via the "Build" button on this tab, then these elements are not imported into the destination file.

3. For each element with a distinct element name the entire set of information was imported -- element name, element description, stakeholder, status, and project association.
4. For each element whose name identically matches an element name in the destination file, the only piece of information always imported is the association with the new project. NOTE that if the element had a different stakeholder, description, or status than in the destination file, that information will NOT be imported.
5. Service packages that are associated with the selected project are imported along with the elements and flows from the project. The service package status is imported under the following conditions:
    a. The service package is associated with the selected project.
    b. The service package status in the import file is something other than "Not Applicable".
    c. The service package status in the destination file is "Not Applicable".
6. Under these conditions, the service package status in the destination file will be set to match the status in the import file. The status in the destination file will never be changed to "Not Applicable" during Import. Thus, the service package choices that were made in the destination file are preserved, and any new service packages that were associated with the imported project are added.
7. A Service Package / Element pair that is selected before Import will always still be selected after Import. In addition, Service Package / Element selections in the destination file are preserved in this way. Elements associated with a service package are selected during Import when the following conditions are met:
    a. The service package is associated with the selected project.
    b. The element is associated with the selected project.
    c. The Service Package / Element pair was selected in the import file.
8. Information flows are imported if they are not already used in the destination file. What if the flow already exists?  It is assigned to the project being imported. But what about its status?
    a. If the status in the destination file is "Not Applicable", then the import process will give it the status from the source file.
    b. If trying to import a project with a flow that is "Existing", but the flow is contained in the destination file with a status of "Planned", for example, the status of the flow will not be changed in the destination file.
    c. Similarly, if the imported status is "Planned" and the status in the destination file is "Existing", the status will remain "Existing" after Import.
    d. A new project association is added on the "Inventory" tab to the existing Regional Architecture element that links to this flow.
9. Following the "Import", the "Interfaces" tab will display just the source element / information flow / destination element triples that were selected in the original file (but not any of the possible flows or interconnects that were "Not Applicable" in the original file). In order to add all of the "Not Applicable" flows, you must build the architecture by running the "Conservative Build" step for the imported project either during "Import", or manually via the "Build" button on the "Interfaces" tab after the "Import".
    *Why would you want the "Not Applicable" flows as part of the imported project?* Maybe there is more customization of the imported project planned in the new file, and some of these flows will be required later for additional integration with the other projects and the Regional Architecture in this file.
10. The "Interfaces" tab for the imported project will preserve all customization that was done in the source file.
11. If the project has a unique name, it will be imported into the open database file. If you try to import a project that already exists in the destination file, an error message is displayed and the

import is terminated. If you would like to import a project into a file that already contains a project of the same name, you may:

    a. Rename the existing project in the destination file to a name that is different from the project that will be imported, or

    b. Rename the project in the source file to a unique name before it is imported.

12. User defined Physical Objects and flows may be fully or partially imported into the project. Source and destination information is imported for user defined flows that are included in the imported project. NOTE that only source and destinations that are actually associated with the project elements are included. In some cases, this will result in only part of the user defined flow source and destination information being imported (if, for instance, the project only maps to a subset of the source and destination physical objects). In rare cases, no source or destination information could be imported (if, for instance, you build the architecture, then remove the source and destination Physical Objects from the project elements).

## *Tips on Importing*

The importing of a project (either from RAD-IT or from SET-IT) into a file can have some complexity. Below are some of the common issues you may run into, and how to handle them.

1. Close the file you want to import *from* first. RAD-IT may give an error if you try and import from an already opened file.

2. What if you end up with an imported element that has a slightly different name from one in the destination file (and you wanted them to be the same)?  First, how would you recognize this?  Look at the "Inventory" tab and see if they show up as two elements. So now what do you do?  Probably the easiest way to fix this is:

    a. Do not save the destination file (i.e., throw away your import).

    b. Go back to the imported (source) file and change the element name so it matches the element in the destination file.

    c. Re-import the architecture with the matching names.

3. What if you have already saved the destination file (i.e., the import can't be reversed)?  The fix is not quite as simple, but this is what you would do:

    a. Identify all the source element / information flow / destination element triplets involving the incorrect element name (the element you imported). You can get a printout of these as part of the "Project Architecture" report.

    b. Associate the correct name with the imported project, and unassign the imported name with the project. This may be done on the "Inventory" tab.

    c. Build the architecture via the "Build" button on the "Interfaces" tab.

    d. On the "Interfaces" tab, add all flows associated with the correct element, and change to "Not Applicable" all the flows associated with the incorrect element. If your project was large this could be a lot of flows. That's why the first approach is usually going to be easier.

4. What if some information relating to an imported element was lost because it had the same name as an element in the destination file?  Let's consider two cases here.

    a. The first is that you want the element names to be the same but want the information from the imported element. Then go to the "Inventory" tab, select the element, and change its description, stakeholder, or status. BUT,

        **NOTE:**  If you do this for the project you imported it will apply for all architectures in the file (both regional and project). This is a "global" (file-wide) change.

    b. What if you really want two sets of definitions, stakeholders, or status?  Then you need to define two elements.

5. Importing just loads the Project Architecture into the destination file. If you want to add this project to an existing Regional Architecture, or start to create a Regional Architecture with it, you need to go

to the "Start" tab and run the "Project to Region" option to merge the Project Architecture into the Regional Architecture.

6. Beware of going back and forth between RAD-IT and SET-IT too much; there may be some issues where not everything is always mapped the same way between tools. The import tools will take care of most data schema differences but too many 'round-trips' may have issues that will need to be addressed manually.

## Questions about Import

- What if I Make Changes to that SET-IT file?  You can reimport that SET-IT project into RAD-IT and RAD-IT will update those same components to reflect the changes. It will basically go through all the steps outlined above to import a project and will tell you the places where it will "Update per SET-IT file".
  - But to be able to take advantage of this, you must keep the name of the SET-IT file the same. If you were using the filenames to help keep track of your configuration it may be better to keep the filename the same and zip it up and put a date or version indicator on the zip file name.

## Output Tables That Reflect Imported Data

Once the Project Architecture has been imported, the architecture will be opened in the destination file. All output tables and diagrams are available for this architecture, but the following reports may indicate specific information regarding the imported data.

- <u>Inventory</u>:  shows the elements and the stakeholders associated with them.
- <u>Stakeholders</u>:  presents all the stakeholders assigned to the project.
- <u>Project Architecture</u>:  a detailed report of all the elements and information flows in the project, including user defined flows.
- <u>Region to Project Comparison</u>:  lists information flows that are in the region but not in the project, as well as flows in the project but not in the region. This report is only available if there is a Regional Architecture in the file. This report, if displayed immediately after the Import, will show all new flows that have been imported since none of these new project flows will have been merged into the Regional Architecture yet. This report should be printed before merging the project with the Regional Architecture.
- <u>User Defined Flows/Physical Objects</u>:  lists the user defined physical objects and flows and their associated elements. This report includes all imported user defined physical objects and flows.

## Merging Projects and Regions

Importing architectures from other files and then merging the projects into a regional architecture are powerful tools to help manage complex regions over time and involving different architecture maintainers.

As mentioned on the <u>Start Tab</u> discussion there are a couple of buttons to help manage regional and project architectures.
- ➢ "Region to Project" – used to turn a region into a project that can be imported into another file (RAD-IT or SET-IT)
- ➢ "Project to Region" – used to merge work done at a project level into the region, see below.

*Turning a Regional Architecture into a Project Architecture*

This process may be used in several instances:

1. Your design in a previous version of RAD-IT was done using Project Architectures, they were merged together into a Regional Architecture, and the Regional Architecture was then customized instead of customizing the projects and merging them again into the Regional Architecture.
2. You are using the suggestions for creating a three-tier architecture (for your state, for example), and need to convert the Regional Architectures at the various local and regional levels into a project to import to the next higher level.
3. You are now using an older version of RAD-IT and have a need to import a Regional Architecture into another file.

The following is a suggested method for converting a Regional Architecture into a Project Architecture. Here the general process is to create a project that includes the entire Regional Architecture. Once we have a project that includes the entire Regional Architecture, we can import the project into another file using the "Import" process. In the current version of RAD-IT there is an option for converting a Regional Architecture into a Project Architecture and placing it in the same database file. The procedure for doing this follows.

1. In the source file, create, build, and customize the Regional Architecture that is to be converted into a project.
2. Do a "File => Save" to save the original database containing the Regional Architecture.
3. Now, do a "File => Save As…" to create a new database that will include the rest of the steps prior to "Import".

4. Create a new, empty project in this file. The project must be open in order to convert the Regional Architecture into it. See "Project S" on the example below:
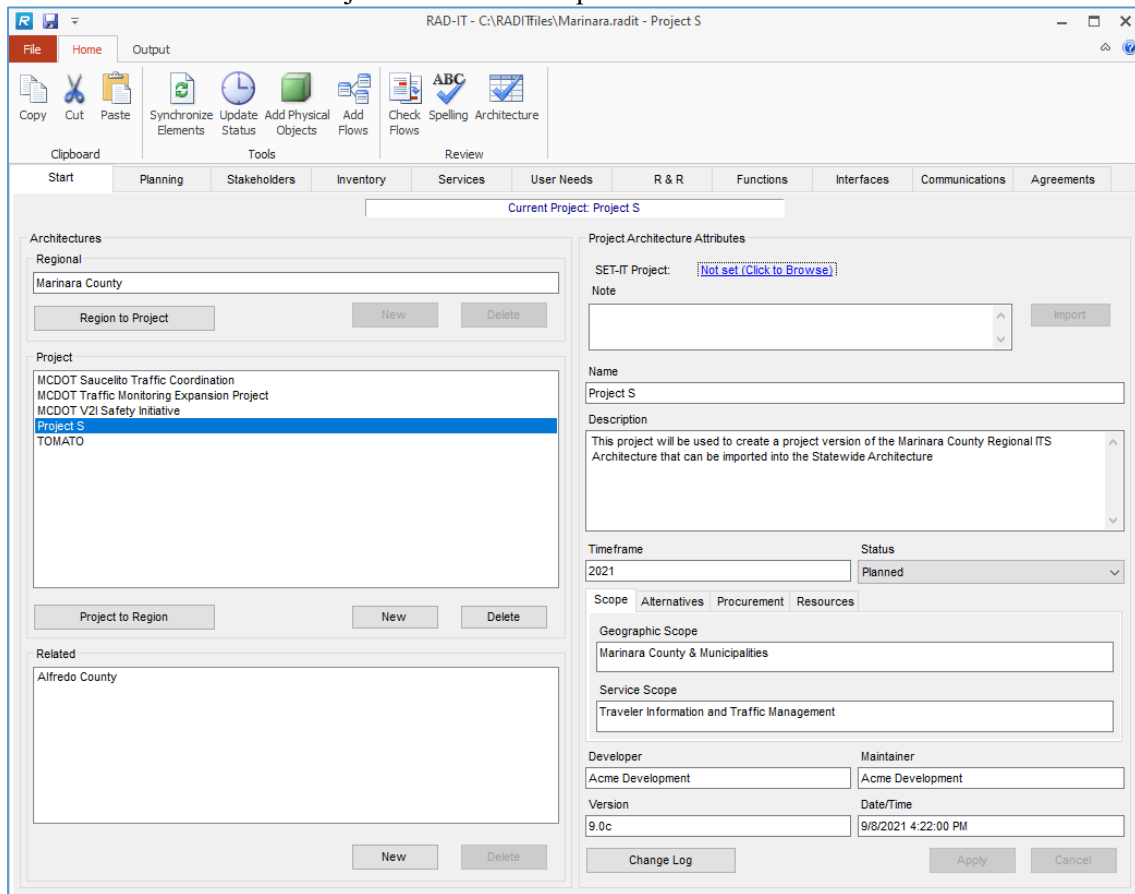


5. With the project highlighted, Select the "Region to Project" option on the "Start" tab. This option is not available unless a Project Architecture is open.
6. If you are in the new Project Architecture, the regional to project conversion will continue.
7. The process copies the Regional Architecture into the Project Architecture.
8. The conversion process places all Regional Architecture inventory elements in the new project, associated all service package choices with the new project, and maintained all project-to-element relationships from the Regional Architecture.
9. At this point, you should do a "File => Save" to save the changes to this new (temporary) database, and to save the new Project Architecture that is to be imported. This new database will only be used temporarily, to hold the Project Architecture that is the same as the Regional Architecture. You do not want to overwrite the original file with this change. The reason is that the new file now contains the Regional Architecture twice: once as the Regional Architecture and once as a Project Architecture. When the import of this project is complete, the second (temporary) file can be deleted. Any changes to the Regional Architecture should then be made in the original file, or in the imported project.
10. You have now created a Project Architecture that includes all Regional Architecture information.
11. Open RAD-IT and use the "Import" Process to import the Project Architecture that you just created into the destination file. Once the project has been imported, it can be Merged into the Regional Architecture. At this point, you will have successfully imported a Regional Architecture from one RAD-IT database into another.

## *Merging a Project into an Existing Regional Architecture*

The "Project to Region" option on the "Start" tab adds all information flows associated with a Project Architecture to the Regional Architecture. This option allows you to initially merge a project with the Regional Architecture (i.e., populate the Regional Architecture with project data), or to merge the project again if it has been changed (i.e., if new customization has been done).

If there is no Regional Architecture in the database and you have defined a Project Architecture, create an empty Regional Architecture, then add (merge) the project into it. At this point, the Regional and Project Architectures should be identical. Any changes or customization made to either architecture will, of course, change the associations between these two architectures.

The following process is used to merge an existing project to an existing Regional Architecture in the same RAD-IT database file. Only one project at a time may be merged into the Regional Architecture.

1. Make sure that a Project Architecture has been built (the architecture has been taken through the "Build" button on the "Interfaces" tab, and perhaps tailored via the "Interfaces" tab) and is open. Open the Project Architecture that you want to merge by selecting the architecture on the "Start" tab. Also make sure that a Regional Architecture has been created in the database. The Regional Architecture can be an empty architecture.
2. On the "Start" tab select the project to merge, then "Project to Region".
3. A number of screens will appear to walk you through each component of the architecture to be merged into the Region. In each case it will list items that are not in the region and need to be added to make the region consistent with the project. You have the options to respond Yes or No and then click Continue to go to the next architecture component.
   a. Objectives & Strategies
   b. Stakeholders
   c. Elements
   d. Status Values unique to the project but not yet used in the Region
   e. Service Packages
   f. Service Package Status Values
   g. Roles & Responsibilities
   h. Needs
   i. Functional Objects
   j. Requirements
   k. Information Flows – as triples: source, destination, flow name; along with their status
   l. Communications Elements
   m. Flow Status Values
   n. Standards to be Included
   o. Standards to be Excluded
   p. Project unique entity/flow standards mappings
   q. Project unique element/flow standards mappings

4. By running the "Project to Region" option, the new information flows that were added or modified in the Project Architecture will appear in a list to be added to the Regional Architecture. Click "Yes" to add them or "No" to cancel the operation. (If there are no new flows or project customization to associate with the Regional Architecture, then a message is displayed that there is nothing to merge.)
5. Select "Close" on the "Project to Region" popup window and the operation is completed.

*Merge Two Similar Elements*

Two elements may be created that have similar names. A common type of problem is that one version of the name has imbedded blanks, and the other name includes underscores. Another common problem is when one version of the name includes an acronym (TMC, for instance), and the other name is spelled out.

If you meant to use the same element name, the process to merge these elements is manual:

1. First, look at all the associations and elements related to both elements with similar names. Decide which to keep and which to throw away later.
2. You may wish to see if the interconnects are identical for the similar elements. The "Interconnect" and Information "Flow" diagrams may be displayed and printed by selecting one element on the "Element Selection" option of the diagrams pulldown menu, then selecting the "Show All" option on the diagrams menu. Either diagram will show the interconnections and data that flows between the selected element and all other elements it connects to in the architecture. Diagrams for both the element that is to be kept, and the element that you would like to merge into it, should be displayed, printed, and checked to see if the interconnections and flows are identical. Discrepancies between the diagrams should be resolved before deleting the old element(s).
3. Next, if all associations (stakeholders, subsystems/terminators, service packages, projects, and customizations - interconnections and information flows) are the same as the element(s) that will be kept, then reassign the element associations on the "Services" tab for the element(s) to be deleted to the element(s) that will be kept. Finally, go to the "Inventory" tab, and delete the unwanted elements.
4. If the associated items and related elements are different, decide which you wish to keep, reassign the stakeholders, physical objects, service packages, etc., on the kept elements as appropriate, go to the "Inventory" tab, and delete the unwanted elements.
5. Make sure that any customization done on the deleted element(s) is also applied on the element(s) that are kept. The links to flows and interconnects must be re-established for the kept element(s) and the unwanted element(s), flows, and interconnects deleted. The output tables and diagrams should help to re-establish the associations.

# Planning Tab – Connect with Planning

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 2nd tab – the Planning tab.

## Planning Tab General Information

The purpose of the planning tab is to link the objectives and strategies of the transportation planning process with components of the regional or project ITS architecture and thus linking the needs of the community to the deployment of ITS. The vision and goals of the region establishes the foundation of the transportation planning process. Transportation goals may be defined in multiple levels and called by different names including goals, objectives, or priorities.

Once the transportation vision and goals are set for a region, improvement strategies to address them are identified and evaluated. Both capital strategies to build new facilities as well strategies to operate existing facilities more effectively and efficiently are considered. A large proportion of the operational

strategies can be implemented with ITS and are covered in the regional architecture. Other non-ITS operations include access management and travel demand management.

For example, a region has a goal to "provide an efficient and reliable transportation system". This goal covers a lot including all modes of transportation. One of many objectives that was defined to help meet their goal is to "reduce the mean time per incident by 20 percent in 5 years". The strategies identified to meet the objective include:
- Implement a multi-agency incident management program,
- Deploy emergency vehicle pre-emption,
- Develop towing agreements and
- Provide traveler information on incidents.

To help determine when they have met their objectives the region defined performance measures, parameters used to measure the extent to which a program is reaching the desired results. For our example, the performance measure for our objective to reduce the mean time per incident by 20 percent in 5 years is the mean incident response & clearance time.

There is a relationship between the transportation planning process and a region's ITS architecture. Specifically, the ITS operational objectives and strategies & related performance measures are related to ITS services and projects of an ITS architecture. ITS services or Service Packages are provided by stakeholders for the direct or indirect benefit to users of the transportation system.
The planning linkage for the ITS Architecture is entered on the Planning tab in RAD-IT

## Planning Tab Customization

In RAD-IT, you can enter up to two levels of planning goals. By default the two levels are titled "Objectives" and "Strategies" (and we will use these terms generically throughout help to refer to the two levels). If desired, these titles can be changed by selecting the Customize button.



In this window you can select to have one or two levels of planning goals. You provide the titles to be used for each level. For each level, you need to provide the singular and plural terms to be used as the title. If you only want to enter a set of local Initiatives (so the ITS services of the architecture can be related to them) then you select one level (use the "1" radio button) and can enter the terms Initiative and Initiatives. After clicking OK to accept the changes, the tabs on the Planning tab are labeled Regional Initiatives and All Initiatives.

## Planning Tab – Using the Tab

Looking at the Planning tab, with the default Objectives/Strategies hierarchy the left side of the tab shows the list of objectives and strategies. Since there are two levels, the higher level objectives are shown as folders with the lower level strategies included in them. There are two tabs so you can view only the objectives and strategies in the current architecture or all in all architectures in the database.



To add an objective or strategy, you select the New button. To delete one, you highlight it and select the Delete button. Following the RAD-IT convention, for the selected (i.e. highlighted) item in the list on the left, its attributes are given and can be edited on the right side. The level can be assigned using the Type pull down menu. For a lower level strategy, the objective that it supports can be selected from the Supports pull down menu. For each objective or strategy, you enter its name. If desired, you can enter a number for it which will be used for sorting. You may use a hierarchical numbering scheme. You may enter a description for the objective or strategy. You can identify the source of the objective or strategy. To enter a source, you just type in the box. You can also identify the performance measures related to the objective or strategy. To enter a performance measure, you select the Edit button. You can select the service packages (a.k.a. ITS services) that support an objective or strategy. You select the service

packages from the All Service Packages tab. Then those selected are listed on the Selected Service Packages tab.

If you need assistance in selecting service packages, you can perform a search to identify service packages related to an objective or strategy. You perform a search by selecting the Search button to the right of the service package tabs.

## Planning Tab – Performance Measures

To access performance measures, select the Edit button on the right side of the Planning Tab. To add a performance measure you begin typing in the Performance Measure box. If you desire, you can assign categories and/or numbers to the performance measures but it is not required. The columns for category and number can be shown or not by using the toggle button at the top of the window.



You may enter as many performance measures as desired while in the Performance Measures window. The Include checkboxes are used to associate each performance measure with the objective/strategy shown in the menu bar at the top of the form. When you apply your changes, the performance measures and "include" associations are copied from the performance measures form back to the Planning Tab.

## Service Package Search

If you need assistance in selecting service packages, you can perform a search to identify service packages related to an objective or strategy. You perform a search by selecting the Search button on either the Planning Tab (right side of the tab) or the Services Tab (on the left side).

There are three ways to search for service packages:
1. First, you can search for service packages that support an ITS goal. There are eight ITS goals identified from which you can select one using the pull down menu. Once a goal is selected, you press the Go button or combine the Goal Search with the other two criteria.
2. There are many defined transportation related objectives from which you can select one using the pull down menu. Once an objective category and objective has been selected, you press the Go button to perform the search or continue to the content based search.
3. Enter keywords or other text that will be used in a content search of the Service Package titles and descriptions.

Once the criteria are set, the Go button may be pressed to search for service packages that meet all supplied criteria.

Checkmarks indicate which service packages are:
1) already associated with the current objective/strategy when the search is performed from the Planning Tab, or
2) already included in the architecture when launched from the Services tab. Highlighting one of the resultant service packages will cause the description to be displayed in the box below.

Use the Show Diagram button to display a graphic of the Service Package from ARC-IT. Use the Hide Diagram to restore the display back. Click or unclick the checkboxes to add or remove the service packages. Then click Apply to incorporate the changes into the architecture. Or select Close to exit this window and return to the main RAD-IT window.

# Stakeholders Tab – Managing Stakeholders

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 3rd tab – the Stakeholders tab.

## Stakeholder Tab General Information

The Stakeholders tab is used to carry out all changes to the architecture's stakeholder list. The Stakeholders tab is used to create, modify, or delete a stakeholder name or group. The stakeholder name may be a primary or secondary stakeholder that is to be associated with (in charge of) a center or element on the Inventory tab. Stakeholders are also used on the R&R and Agreements tabs.

Stakeholders can be associated with the Regional architecture or one or more Project architectures. Shown in the figure above is the list of stakeholders when a project architecture is active. Note the sub-tabs on the left for *Project Stakeholders* and *All Stakeholders*. Clicking on Project Stakeholders would only list the stakeholders that are in that project. Clicking on All Stakeholders as shown above shows all of the stakeholders in the file and the check marks on the left identify which are associated with the current architecture.

The *Autoselect* button on the Stakeholders tab preselects stakeholders to add to the list by looking through the inventory elements associated with the current architecture. If any of the stakeholders associated with those elements are not already part of the list of stakeholders for the current architecture they will be added to the Stakeholders tab. This feature is useful if you started with the inventory tab to create or select a list of elements for this architecture and now want to update the list of stakeholders.

Autoselect has 3 options:
- Add Stakeholders that support selected inventory elements.
- Remove Stakeholders that do not support selected inventory elements.
- Add/keep all stakeholders associated with included stakeholder groups.

A stakeholder *group* may also be associated with an inventory element. This could be a group of stakeholders, such as several emergency services agencies, that may be in charge of an emergency center in the Regional Architecture which is actually a group of emergency centers. On the Stakeholders tab,

individual stakeholders are represented by the single person icon while stakeholder groups are shown using the multiple person icon. Create a Stakeholder Group when you want to associate more than one stakeholder with the same element.
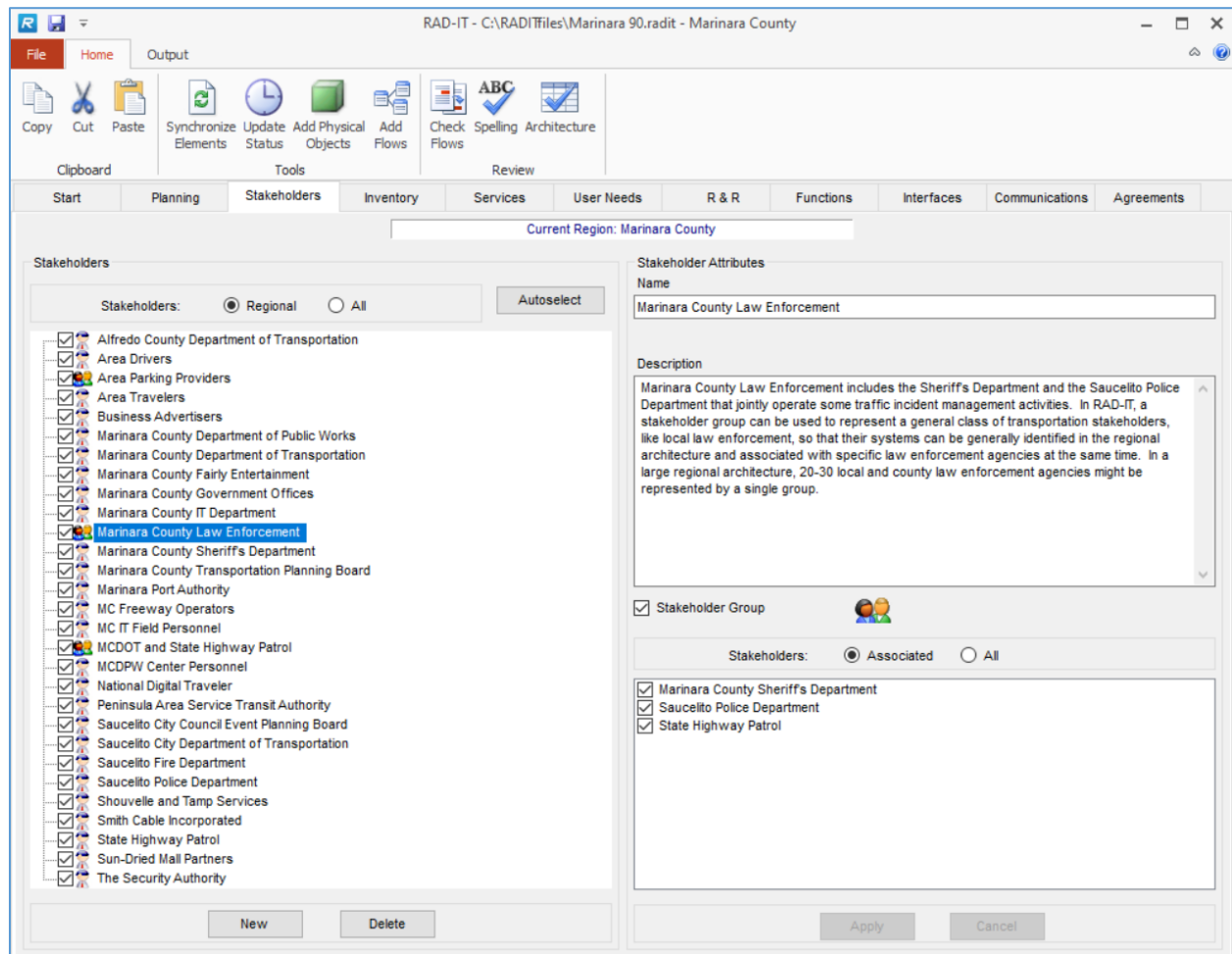


In the figure above, a stakeholder group is highlighted on the left side of the screen and the Associated Stakeholders that make up that group are listed on the right.


## Stakeholder Tab - Creating a New Stakeholder

To create a new stakeholder or stakeholder group:

1. On the "Stakeholders" tab select the "New" button.
2. Enter the name and description of the new stakeholder on the right-hand side of this screen.
3. If you are creating a new stakeholder group (see also Working with Stakeholder Groups) check the "Stakeholder Group" checkbox and associate existing stakeholders with the group.
4. Click "Apply" to create the stakeholder. If you wish to cancel this change, select the "Cancel" button.

Alternatively: You may also create a new stakeholder when creating a new item on the "Inventory" tab. In this case, select the "create new stakeholder" option under the stakeholder pull down selection.

## Modifying an Existing Stakeholder

To modify attributes of an existing stakeholder name or group:

1. Enter the "Stakeholders" tab.
2. Select the name of the stakeholder or group from the list on the left-hand side of the window.
3. The information on the right-hand side of the window may be modified for this stakeholder. This includes the stakeholder name and description, and the list of associated stakeholders if this is a group.
4. Select "Apply" to make the changes. Changes will be propagated throughout the database. For example, if the stakeholder is renamed in this fashion, all references to the stakeholder name or group also receive this new name in the database.

## Deleting a Stakeholder

To delete an existing stakeholder or group:

1. On the "Stakeholders" tab, select the name of the stakeholder or stakeholder group from the list on the left, then click "Delete".
2. A verification screen appears asking if you wish to delete the stakeholder.
3. Click on "Yes" or "No" to delete or cancel the operation.

This will delete all associations between this stakeholder (or group of stakeholders) and any elements that are assigned to it. If the group designation for a group of stakeholders is deleted, then the groups element associations are also deleted. However, the stakeholders that were associated with the group still exist - only the group name is gone.

It is recommended that the elements assigned to a stakeholder name or group to be deleted be reassigned to another stakeholder name or group on the "Inventory" tab *before* performing the delete. Deleting the stakeholder first will result in the interconnect and flow associations being wrong in the diagrams - there are many more permutations than there should be. If you reassign these elements to a new stakeholder first, the interconnect and flow associations from the first stakeholder are maintained.

## Working with Stakeholder Groups

Stakeholder groups are used in those situations when more than one stakeholder may need to be assigned or is responsible for a single element, Physical Object, etc. They can be created, modified, deleted, etc. in much the same way as individual stakeholders. A stakeholder group can only include individual stakeholders, not other groups.

1. To create a new stakeholder group, select "New" on the Stakeholder Tab. Check the "Stakeholder Group" checkbox. This name will be marked with a "group" icon to separate it from the others in the list.
2. Enter the name and description of the new stakeholder group on the right-hand side of this screen.
3. Associate already existing stakeholders from the list on the bottom right with this group designator, then click "Apply". If you wish to cancel this change at any time, select the "Cancel" button. Notice that the list on the bottom right only includes stakeholder names, not groups. The

right mouse button works as on other windows – it expands the list of stakeholders, then another right click shrinks the list back to its original size.

# Inventory Tab – Managing Elements

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 4th tab – the Inventory tab.

## Inventory Tab General Information

The Inventory tab provides a window where the user may create a new (or view an existing) element, and view all attributes associated with it, in the open architecture. A new user defined physical object, stakeholder, or project may be created via the pulldown menus or other tabs, and then associated with the inventory element on the Inventory tab window. RAD-IT guides the user in characterizing the element in terms of ARC-IT physical objects (subsystems, terminators, and user-defined). Physical objects, stakeholders, and projects are listed for each element, and items may be added to or deleted from these lists via the pulldown menus and other tabs. User inputs of multiple instances of an element are supported (e.g., two or more Emergency Management Centers in a region's inventory).

If the user performed service package analysis then removed a physical object associated with an element on the Inventory tab, information flows for this physical object association will still appear on the Interfaces tab after a building the architecture. They must be deselected manually on the Interfaces tab if no longer needed - items are only added, never deleted, by the "Build" option on the Interfaces tab that builds (or rebuilds) the architecture.

Inventory elements can be one of 5 types: Transportation, Communication, Human, Environment.
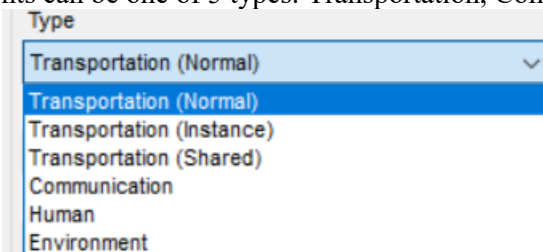


- **Transportation** elements are those that have existed since RAD-IT has been around. They represent an ITS or non-ITS element in the inventory for a regional or project architecture. They are named, associated with a stakeholder, given a status, described, associated with a physical object and, perhaps, to a project. They can be Normal, or Instance, or Shared.
  - ➢ **Instances** are used to represent elements that are more detailed versions of other elements. For example, a higher-level regional architecture may define roadway elements as simply "State Field Equipment" but later you may want to define "State Highway CCTV Cameras" and "State Highway Ramp Meters" with different interfaces and functions at the project level. Defining an element as an Instance allows you to retain the higher-level associations and be able to define different details.
  - ➢ **Shared** elements allow you to reference the fact that some elements may also be defined in other architectures, e.g. a statewide architecture. The other architectures are listed on the Start tab.

- **Communications** elements provide a way to create an inventory element that may or may not provide a transportation related service but does supply important communications services to the region or project.
  - Elements that are Communications type can either be Support Class or Field Class. Support Class Communications elements can be mapped to one of the following physical objects:
    - Data Distribution
    - ITS Communications Equipment
    - Wide Area Information Disseminator
  - Field class Communications elements can be mapped to:
    - Roadside Communications Unit
- **Human** elements are the human operators or users that interact with the system elements and devices. While no functionality can be assigned to a human element their interfaces can sometimes be instructive to reviewers of an architecture to see how users interact with the ITS elements.
- **Environment** elements represent the things that the vehicle based or roadway sensors sense – the roadway environment, vehicles in traffic, potential obstacles.

Inventory elements can also be one of 5 Classes: Center, Field, Personal, Support, and Vehicle. These correspond to the classes of physical objects that make up the ARC-IT physical view. In ARC-IT, a physical object represents a system or device defined in ARC-IT physical view, or a user defined (locally defined) object. In RAD-IT, each inventory element represents a physical object. Examples include the Traffic Management Center (TMC), the Vehicle Onboard Equipment (VOBE), and the ITS Roadway Equipment, corresponding to traffic operations centers, connected automobiles, and legacy ITS field equipment.

- Center: represents the primary Administration or Management "Element". This may often be a physical building (such as a Freeway Management Center) and include one or more physical object such as traffic management or transportation information functionality.
- Field: represents the intelligent infrastructure distributed along the transportation network which performs surveillance, information provision, traffic control functions and whose operation is governed by a center object. Some field objects such as the Connected Vehicle Roadside Equipment (RSE) include the wireless communications to communicate directly with mobile devices, e.g. connected vehicles.
- Personal: represents equipment used by travelers and personnel to access transportation services pre-trip and en route. This includes equipment that are owned and operated by the traveler as well as equipment that are owned by transportation and information providers.
- Support: represents the computer systems required to 'support' the transportation related services and applications. These may include security, data warehousing, network administration, and system monitoring or management systems.
- Vehicle: includes general driver information and safety systems applicable to all vehicle types. Four fleet vehicle subsystems (Transit, Emergency, Commercial and Maintenance and Construction Vehicles) add ITS capabilities unique to these special vehicle types.

As you define inventory Elements in your architecture it will be important to know what class your element is a part of because this will be used to determine the specific physical objects to map it to and the types of communications that can be used.

# Inventory – Creating a New Element

The RAD-IT Inventory tab is shown below



To create a new element on the Inventory Tab:

1.  Select the "New" option on the lower left-hand side of the window.
2.  On the right-hand side of the window enter the element name.
3.  Select the type of element:
    a.  Transportation (Normal) is the most common since they are completely defined within the current architecture.
    b.  Transportation (Instance) is used to define an element as being an instance or sub-element of another parent instance. You could have a fairly generic element defined like "ITS Field Devices" and then define Instance elements for Cameras, Signs, Detectors, etc.
    c.  Transportation (Shared) or related elements are those that are defined in another architecture file. The pull-down list of Related Architectures is activated to choose the other architecture defined on the Start tab.
    d.  Communication is used when you want to define an element that is part of the communications domain rather than a transportation system domain. This would include

Data Distribution System elements or basic communication elements in your region or project.

    e. Human elements are the users or operators of the system elements.

    f. Environment elements represent the things that the sensors sense – examples include other vehicles in traffic, pedestrians or other vulnerable road users, or the roadway environment itself. These are important for the automated vehicle and vehicle safety service packages.

4. Select the class (Center, field, personal, support, or vehicle)
5. Select the Status of the element – does it already exist, is it planned, is it a future or other user defined status? See "*Customizing Status Values*."

    a. Select the stakeholder.

    b. Enter a description (this is optional but you'll want it for your documentation and/or generated website).

6. Then select the ARC-IT physical objects (subsystems, terminators, or user defined objects) to associate with the element. The right mouse button works as on other windows – it expands the list of physical objects, then another right click shrinks the list back to its original size. When you right-click to expand the list you can also see a read-only description from ARC-IT of that object. (See the notes below on assigning elements to physical objects and the section on Aggregation)
7. Select the project(s) that this new element is to connect to. If working in a Project Architecture, the current project should be selected in order to connect the new element to the other elements in this project. To connect this element to elements outside this project but in the region, other projects in this database file may also be checked. If working in a Regional Architecture, to connect this element to elements in various projects in the region, select the appropriate project boxes. The right mouse button works as on other windows – it expands the list of projects, then another right click shrinks the list back to its original size.
8. After entering the information on the right-hand side of the window, select "Apply" to add this new element to the database, or "Cancel" to abort the element creation.

Stakeholders are now automatically included in a Project when they are created at the same time a new element is created for that project. This way you don't have to go back to the Stakeholder tab and do an Autoselect. This does that step for you.

Can I assign an element to map to anything and everything in ARC-IT? Not Quite. RAD-IT is very flexible in how an element can be mapped to one or more physical objects from ARC-IT but it does impose some limits:

1. It does not allow system type elements to contain human Physical Objects.
2. If it is a Transportation type element then it must contain at least one transportation domain Physical Object.
3. You cannot assign Communications domain element to a transportation domain physical object.

Older Turbo and RAD-IT architectures provided more flexibility in this area so conversion will now check to make sure the rules above are followed. For example, during conversion, if a transportation element (like a TMC) is found that is mapped to only comm domain Physical Objects (like a Data Distribution System), the domain for the element will be switched to Communication.

## Inventory – Assigning a Stakeholder

The Inventory tab includes a pull-down to assign a Stakeholder to an element. As the screen shows, this Stakeholder is the entity or organization that 'owns' or has primary responsibility for the existence of this

element. Click the pull-down and scroll down the list of stakeholders created on the Stakeholders tab to find the one you want and click it.
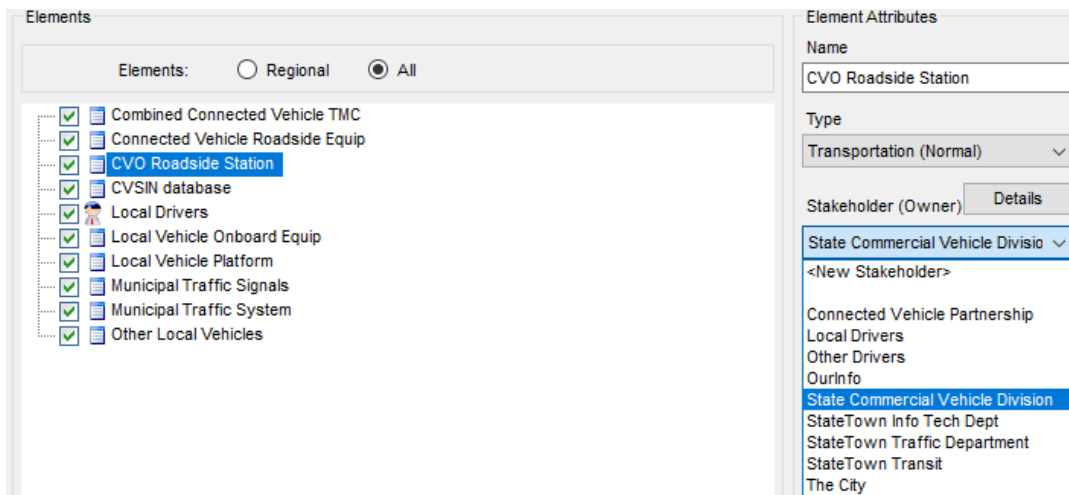


If you don't see the stakeholder you want you don't have to go back to the Stakeholders tab. You can simply click "<New Stakeholder>" and it will bring up a form to create a new stakeholder that can be used for this or any other element.
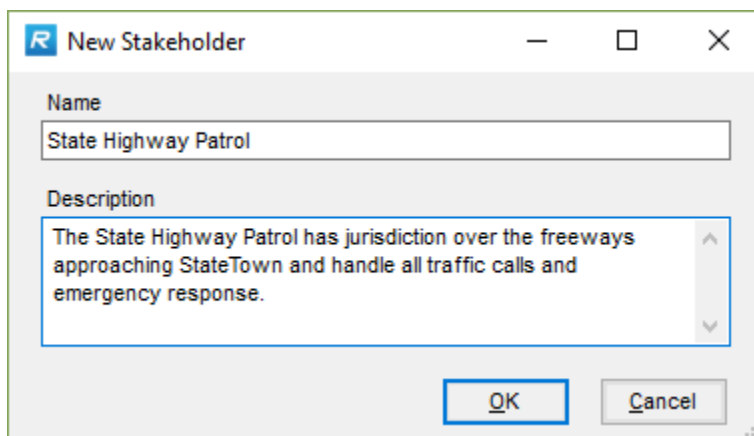


The "Details" button just to the right of the Stakeholder label on the Inventory tab is to support cases where, "It's complicated." Perhaps for your element there is an owner today but that is going to transition to someone else or you want to describe different roles that stakeholders have with respect to that element. For example, you may want to show who 'owns' the element but also who 'manages' it and go even further to identify the organization that will 'maintain' that element.

ARC-IT defines 12 roles in the Enterprise View though RAD-IT currently lists Owns or Manages as the defaults which are typically what most regional and project architectures will focus on.

Again, if you don't see a Stakeholder you want you can click on "New Stakeholder…" to bring up the New Stakeholder screen. From there, you can create and describe a new stakeholder for this element or any element in the project.

The Element's Stakeholders screen allows you to use the Role pull-down to select from various roles they could play and the Status column allows you to assign the Owns or Manages status for that Stakeholder / Role combination.

**NOTE:** With the Element's Stakeholders screen you can only have one Stakeholder/Role for each Status. That means you can't have 2 planned owners of a center. If you do have the need to show a combination of ownership then create a Stakeholder Group made up of the stakeholders that will jointly own that element.

## Modifying an Element

To modify an existing element:

1. Enter the "Inventory" tab.
2. Select the element from the list on the left-hand side of the window that you wish to modify.
3. The information on the right-hand side of the window may be modified for this element. This includes the element name and description. If the element is renamed in this fashion, all references to the element also receive this new name. Click "Apply" to save your changes.

Normally, elements will only be mapped to Physical Objects of the same class. There may, however be times when you need to define an element as being from more than one class. For instance, if your TMC is also acting as a Map Update System for the region, while you are editing an element, change the Class pull-down to Support and select the Map Update System Physical object from that class.

When you do this RAD-IT will warn you to make sure this is something you really want to do.

**RAD-IT - Complex Subsystem/Terminator Mapping**

This element is mapped to Center, Support subsystems/terminators.
Normally an element should only be mapped to subsystems and terminators of a single class.
Are you sure you want to use this complex mapping?

[ Yes ]  [ No ]
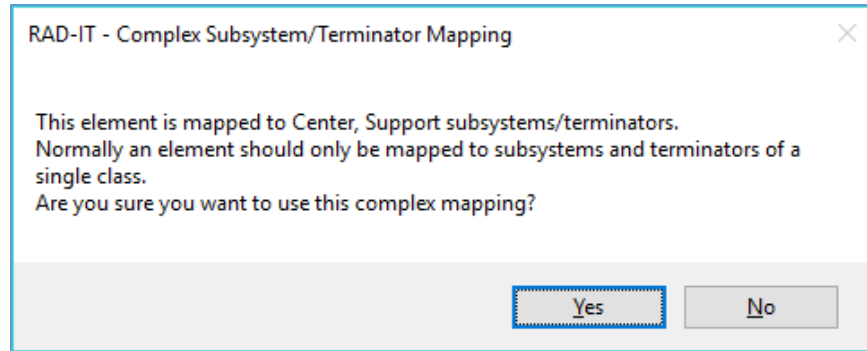
**NOTE:** Elements have to be from the same Type/Domain.

## Deleting an Element

To delete an existing element from the system inventory:

1. Select the element on the left-hand side of the Inventory Tab window.
2. Select the "Delete" button. The element associations are listed on the right, and a confirmation window pops up asking if this is really what you want to do. Select "Yes" to actually delete the element (and all of its associations) from the database, or "No" to cancel the delete.

**NOTE:** Deleting a TMC, for instance, connected to 1,000 information flows, could destroy a perfectly good Regional Architecture. It is recommended that you save the current architecture before the delete.

## Physical Element Instances

The Transportation (Instance) type element is used to depict the relationship between a higher-level definition and a more specifically defined element. Choosing any one of the elements in the inventory will bring up a window to ask if you want the instance to automatically take on the other inventory attributes of the parent: description, stakeholder, status, and physical object mapping. Once you say Yes, edit the other attributes as needed and click Apply. Now on the left side of the screen the element that was just changed has a different icon to show that this element is now an Instance of some other element in the inventory. The attributes on the right side now show the Instance button selected and the name of the Parent Element is shown. The attributes of the instance element can also be changed independent of its parent by editing as you would edit any other element.

To synchronize other attributes of the instance element, e.g. its service package mappings, functions, etc. go to the Tools section of the menubar and click the "Synchronize Elements" tool. Similarly, for Shared or Related elements a similar process is followed. The icon between the check-box and the name is now changed to represent the type of element chosen.

The attributes of this can still be changed by editing as you would edit any other element. For example, you may want to revise the description slightly to remind users that it is in another architecture and potentially any different interfaces being developed for this deployment that may differ from the original/related architecture.
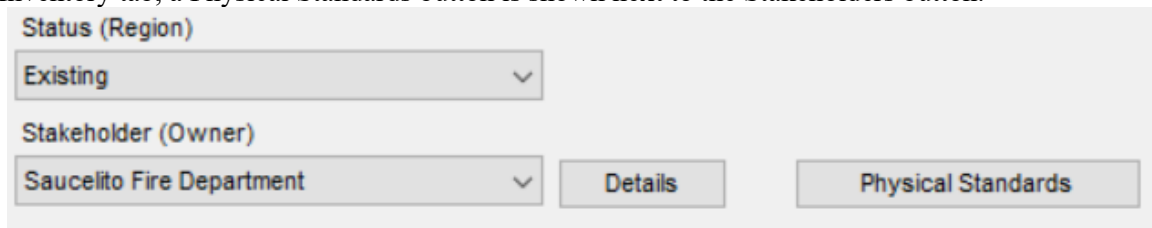
## Physical Element Standards

Traditionally, standards have been associated with communications interfaces in ITS. Now, ARC-IT associates standards with physical objects and these mappings have been made available to the elements of your physical inventory.

*What is the difference between Physical Standards and Communications Standards?* Within ARC-IT, communications standards include all standards and specifications that make up part of the communications 'stack', as defined in the communications viewpoint. That is, any standards dealing with signaling (e.g., Ethernet), networking and transport (e.g., TCP/IP), middleware (e.g., HTTPS), cybersecurity (e.g. IETF X.509) and application layer specifications (e.g., GTFS). Physical standards on the other hand are more concerned with electrical, structural and environmental concerns (power, cabinets, temperature ranges etc.) of a particular device or type of device, such as a traffic signal controller.

Physical object standards establish requirements for the physical device, including the physical workmanship or the functionality of the devices, e.g., ITE Advanced Transportation Cabinet standard and the US DOT Roadside Unit Specification. The physical standards also include standards to define cybersecurity protections.

On the Inventory tab, a Physical Standards button is shown next to the Stakeholders button.



If standards have been defined for the physical objects associated with an element the button will change to show a book or document icon:
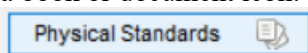


Not every element or physical object will have a physical standard associated with it. Only Transportation System type elements can have a physical standard.

RAD-IT will determine what standards to associate with an element based on the physical object mapping and then based on the functional object mapping which comes after you have assigned your elements to service packages. An example might be a standard for a particular function like work zone traffic control, like NEMA's TS 5 Portable Signals will only be mapped if you have an ITS Roadway Equipment element that is mapped to the Service Package MC06 Work Zone Management or TM19 Roadway Closure Management that have the Roadway Work Zone Traffic Control functional object.

Highlight an element and to select the physical standards details click the "Physical Standards" button to bring up the Physical Standards Details screen.

On the Element's Physical Standards screen you can see the Document # and Title for standards written for physical devices and systems. An Include column shows which standards have been 'included' or associated with this element. You can un-include standards or include standards for your element. As you make changes that are different than those imported from the ARC-IT reference the Override column will show that the selection is different than the default.

Make your selections and click OK or Cancel.



If you want to restore changes back to the default, click the "Restore" button and OK.

## Inventory Tab Tips

GUIDELINE:  On the "Inventory" tab, the tool forces you to map to a physical object every element that is defined, either to an ARC-IT subsystem or terminator, or to a user defined physical object.

GUIDELINE:  If an element or stakeholder name is to be changed or deleted from the Regional Architecture, you must return to the Regional Architecture "Inventory" step.

GUIDELINE:  In mapping the inventory, if there is a TMC (Traffic Management Center) element defined in the architecture, there should also be other elements in the inventory to connect this to, such as an TIC (Transportation Information Center) or EM (Emergency Management Center) elements. The interconnects between the elements and centers on the "Interfaces" tab will appear correctly if there is more than one center.

GUIDELINE:  Inventory elements can either be Normal, Instances, Shared, Human, or Communications. At this point, you can only choose one type, so you cannot define a communications element that is also an instance or shared. Instances may need to be edited to show how they differ from their parents and Shared elements may need to be edited in coordination with the maintainers of the other architecture.

> NOTE: When a Human type element is created you won't need to select a class – just the stakeholder and the physical object (terminator).

Creating a Communications element for your regional or project architecture may be important to show stakeholders how a significant investment in networking or communications technology is going to be related to the Intelligent Transportation System. As a New element is created, given a name, assigned the communications type, and the user has completed a description, checked-off the appropriate stakeholder, and assigned it to a project(s). The icon between the check-box and the name is now changed to represent the fact that this element is a communications type element.

CAUTION: You can change an element from a Human class to a System class (Transportation or Communications) but you will get a warning that this will invalidate the choices of physical objects you had before. You will need to add new Physical Object mappings or click Cancel to undo the change.

## Sorting the Inventory List

The list of inventory elements may be sorted by element name, stakeholder, or ARC-IT physical object, by selecting a radio button at the bottom left of the screen. The default view is sorted by element.

When sorted by stakeholder or Physical Object, the plus and minus symbols may be selected to expand or contract the list of inventory elements associated with each stakeholder or physical object. Selecting the stakeholder or physical object name also expands or shrinks the list of associated element names, but no attributes are displayed on the right-hand side of the window unless an element has been selected.

## View All Available Projects, and Objects

All "tabbed list boxes" behave the same way. If you right-click on the box displaying stakeholders, Projects, or Physical Objects it expands or grows to allow additional entries to be visible. You may select or deselect physical objects by clicking the view Selected, Related, or All projects or physical objects buttons. To shrink the list back to its original size simply Right-Click again.

## Physical Object Aggregation and Replication

Functionality of physical objects can be aggregated together into one physical center or the functions of one physical object from ARC-IT can be replicated across different physical centers within a region. GUIDELINE:  The same element name may be mapped to two different physical objects (subsystems, terminators, or user defined). This is not an error.

**Aggregation** means you can combine the functions of multiple physical objects, i.e., one center may be mapped into multiple parts of ARC-IT.

A single computer complex may serve both TMC and EM functions. It still has to do the functions of traffic management and emergency management, but it does not have to be two different centers, two different computers, or even two different programs. An example of a stereo system comes to mind. A stereo system involves the Tuner and Amplifier functions. Some stereo systems have a separate Tuner and a separate Amplifier unit, possibly from two different manufacturers. Other stereo systems are based on a single unit called a Receiver that implements both functions. There are advantages and disadvantages to aggregation.

Elements are mapped, that is linked to, physical objects based on their functions. In the example shown, the element "State DOT Freeway Operations Center" has two functions; it manages traffic and provides information to the traveling public. Therefore, it is mapped to two physical objects, Traffic Management Center and Transportation Information Center.

If you think of the National ITS Architecture (ARC-IT) as a template with generic physical objects, mapping is a way to connect a specific, local element with a generic object based on the function of the element.
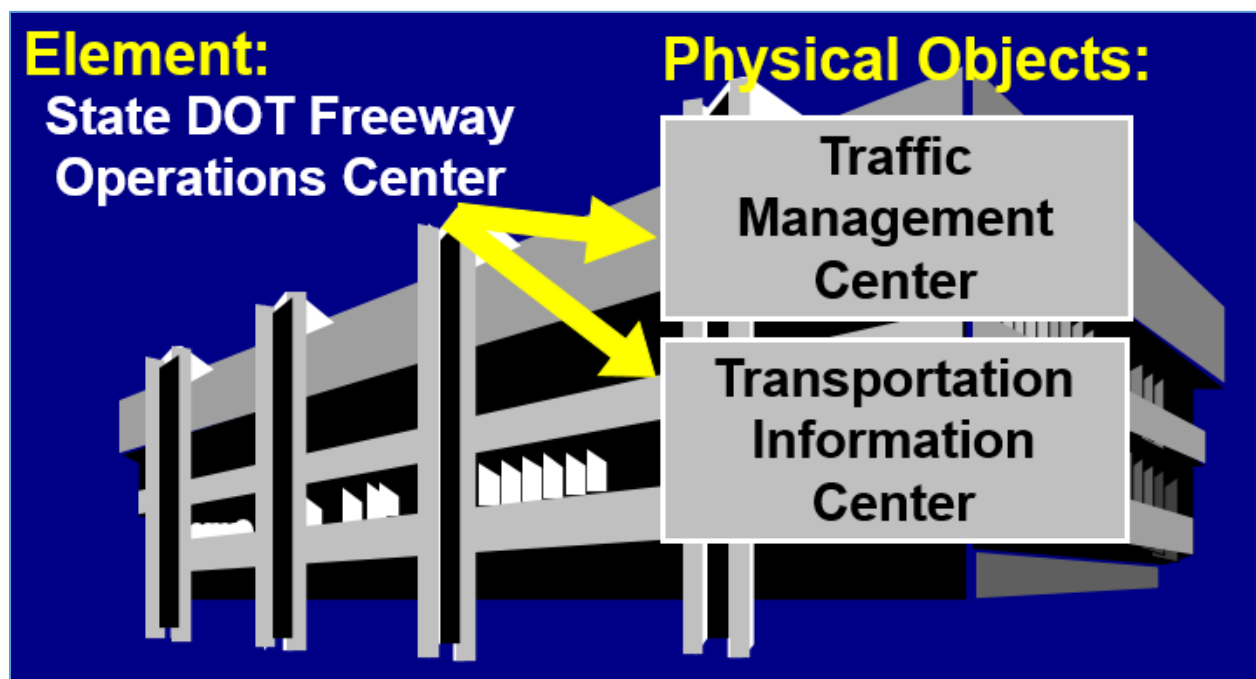
**Replication,** another element mapping concept, simply means that a specific implementation of the ARC-IT physical object may be repeated in different physical locations. That way, regions can have more than one of any given type of physical object. Using traffic management as an example, one center may be doing freeway management and another traffic management may manage the signals and other functions along the arterial streets.

The "Inventory" tab in RAD-IT supports this process of deciding how to aggregate and replicate physical object functions across a region.

## ITS and ITS Communications Objects

The list of physical objects may show some from an "ITS" class. This means that they have characteristics – functionality, interfaces, security characteristics that could be common to any system in an ITS architecture.

### The ITS Object

From the http://www.arc-it.net/ website we learn that the general 'ITS Object' includes core capabilities common to any class of object.

As shown in the following figure, the ITS Object is at the top of the hierarchy of physical objects. The ITS Object includes the core capabilities and interfaces that may be included in any ITS system or device. Using the ITS Object, we can define these core capabilities and interfaces once in ARC-IT. Below the ITS Object are class-level physical objects that are used to define capabilities and interfaces that are common for a specific class of physical objects like "Center". The specific physical objects like "Authorizing Center" and "Traffic Management Center" at the second tier of the hierarchy define the specific capabilities and interfaces for that particular ITS system or device.
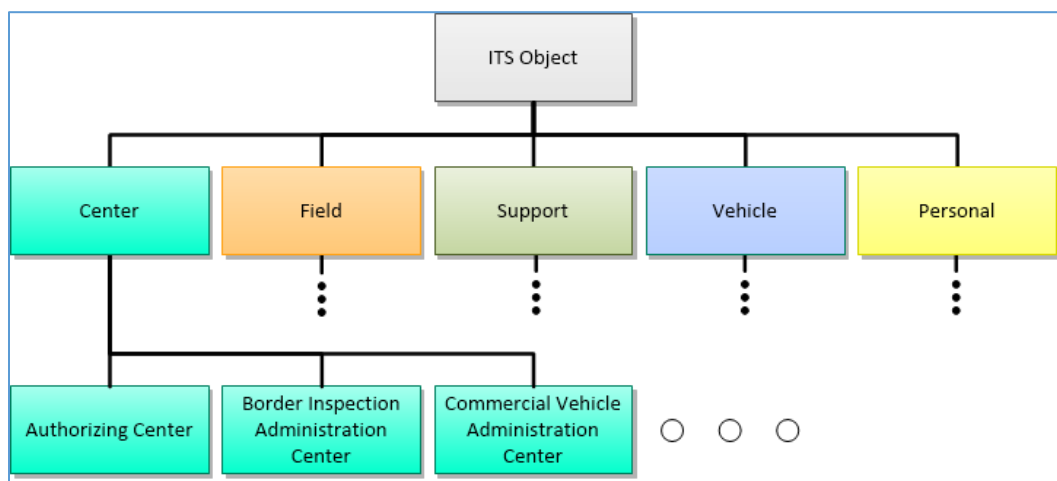


This physical object is included in the following Service Packages:
- SU01: Connected Vehicle System Monitoring and Management
- SU02: Core Authorization
- SU06: Object Registration and Discovery
- SU07: ITS Communications
- SU08: Security and Credentials Management
- SU09: Device Certification and Enrollment

The ITS Object has 3 functional objects:
- ITS Communications Support
- ITS Management Support
- ITS Security Support

The mapping to the ITS Object will be transparent to most users. RAD-IT will automatically map the ITS Object to your element if it is also mapped to an ARC-IT subsystem physical object. If you have a traditional regional ITS architecture you may not notice a difference but if you start including support services in your architecture then you may notice some changes. The inventory tab will show the same mappings that you already make to physical objects. The services tab will also be the same. Once you start including functionality and interfaces then RAD-IT will start adding mappings to the appropriate functional objects that are part of the generic ITS Object as well as the generic Center and Field physical objects as appropriate.

For example, if you Autoselect functions (f-objects) then all elements will get the appropriate 'system executive' and 'system monitoring and diagnostics'. All elements mapped to subsystems get ITS Communication Support since they will need that basic functionality to support its interfaces. Because of the security requirements of the connected or cooperative ITS environment, any mobile element that communicates with any another Onboard Equipment (OBE) or Roadside Equipment (RSE) gets ITS Security Support. In addition, any mobile element that communicates with an OBE, RSE or Personal Information Device (PID) gets ITS Management Support.

Let RAD-IT take care of these additional mappings to functional objects and requirements. These types of functions will be important to the system developers to make sure they are included in their projects in the future. These are also mapped to the appropriate standards which will also be important to consider.

## ITS Communications Equipment

The Data Distribution System (DDS) physical object is for the movement and management of data within a region or between systems in a project. The ITS Communications Equipment is for when you want to show lower level communications – fiber infrastructure, satellite, municipal WiFi, etc. that is needed in a region to support ITS. The Wide Area Dissemination System is used to send messages to equipped vehicles using wide-area wireless communications such as satellite radio, terrestrial FM broadcast subcarrier, or cellular data networks.  Roadside Communications Unit (RCU) is used to provides wireless communications between roadside infrastructure and nearby equipped vehicles or mobile devices. It is a communications only device where the Connected Vehicle Roadside Equipment takes the communications functionality and adds software to support higher-level ITS applications.

Back to the http://www.arc-it.net/ reference architecture, ITS Communications Equipment includes the communications hardware and software that supports secure, reliable communications. It provides the layered protocols and communications services and includes the physical network plant and network hardware that supports ITS communications. It also encompasses security services that protect communications and the management services that support network management. This physical object allows transportation stakeholders that are implementing their own communications solution to represent this implementation in their ITS architecture. The communications capabilities provided by this physical object are frequently purchased from a third party provider. When communications is a purchased service, the hardware and software included in this physical object are largely transparent to transportation stakeholders and may be transparent to the ITS architecture.

This physical object is only included in the SU07: ITS Communications Service Package but that service is not available for including in RAD-IT since it is only used in ARC-IT to model communications.

**NOTE:** RAD-IT does not let a user include service package SU07 ITS Communications in their architecture because it only includes 'super flows' that are really place holders to include other actual flows. This was created to be able to analyze the communications requirements for physical objects in the ITS world. As you can see in the diagram below this service includes the ITS Object and generic flows called "ITS Information". Follow the steps below to include communications equipment and use it on the Interfaces tab to show how information can be routed through these types of objects.
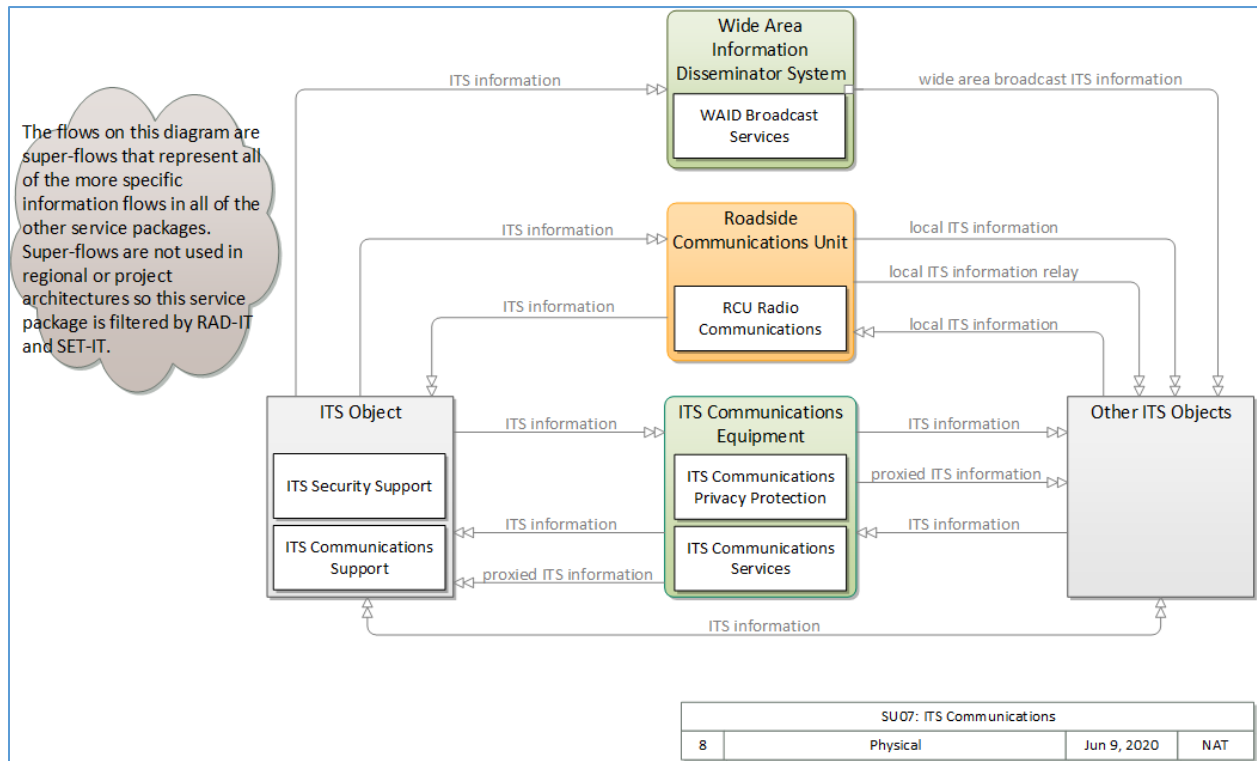


In RAD-IT you can map an element to this type of object by selecting Communications as the Type and Support as the Class. Then you can scroll down the list of Physical Objects and click "ITS Communications Object.

## Element Attributes

**Name**

County Cloud Platform

**Type**

Communication

**Class:**

Support

**Status (Region)**

Planned

**Stakeholder (Owner)**

Marinara County IT Department

[Details] [Physical Standards]

**Physical Objects:** ○ Selected ● Related ○ All

- ☐ Data Distribution System (Subsystem)
- ☑ ITS Communications Equipment (Subsystem)
- ☐ Wide Area Information Disseminator System (Subsystem)
- ☐ Other Data Distribution Systems (Terminator)

'ITS Communications Equipment' includes the communications hardware and software that supports secure, reliable communications. It provides the layered protocols and communications services and includes the physical network plant and network hardware that supports ITS communications. It also encompasses security services that protect communications and the management services that support network management. This physical object allows transportation stakeholders that are implementing their own communications solution to represent this implementation in their ITS architecture. The communications capabilities provided by this physical object are frequently purchased from a third party provider. When communications is a purchased service, the hardware and software included in this physical object are largely transparent to transportation stakeholders and may be transparent to the ITS

Then on the interfaces tab you can choose this element as the communications element through which your Interconnects will communicate.

| Element | Element | Communications | DDS | Include |
|---------|---------|----------------|-----|---------|
| ▶ MC Freeway Management Center (BASIL/PINCH) | MCDOT CV Roadside Equipment | Not Identified | Not Identified | ☑ |
| MC Freeway Management Center (BASIL/PINCH) | MCDOT Detectors | Not Identified<br>Communications for Alfredo Networking and Oper | Not Identified | ☑ |
| MC Freeway Management Center (BASIL/PINCH) | MCDOT Dynamic Message Signs | County Cloud Platform | Not Identified | ☑ |
| MC Freeway Management Center (BASIL/PINCH) | MCDOT Environmental Sensors | MC Transportation Communications Network | Not Identified | ☑ |
| MC Freeway Management Center (BASIL/PINCH) | MCDOT Field Equipment | Not Identified | Not Identified | ☑ |

## Reassigning Element/Stakeholder Names

You can reassign the element and stakeholder names on the "Inventory" tab to different regional physical objects (subsystems, terminators, and user defined objects), after initially creating the inventory. ITS projects may be reassigned to a different element, resulting in different associations with regional subsystems, terminators, and user defined objects. If you reassign portions of the Regional Architecture, the tool will be able to detect if conflicts and discrepancies are created only if projects have been created or service package analysis has been done. For example, if an element is assigned to one ARC-IT physical object, then later reassigned to another, a conflict may have been created. If that physical object is tied to a Project Architecture, you may generate the "Regional to Project Comparison" report that will warn you about conflicts between the Regional Architecture and the Project Architectures in the database file.

You can also reassign the element and stakeholder names to different project physical objects, after doing the inventory the first time. You will be able to reassign the ITS project services (service packages) to different project elements (and indirectly, to different physical objects). If you reassign portions of the Project Architecture, the tool will be able to detect if conflicts and discrepancies are created only if service package analysis has been done.

It is your responsibility to ensure that any reassigning done in the Regional or Project Architecture does not conflict with the existing ARC-IT physical objects, and information flows, or with any tailoring that may have already been done. Changing the output of preceding steps may affect the entire architecture. However, the RAD-IT tool preserves previous customization, so this problem should be minimal.

GUIDELINE:  You are allowed to reassign element and stakeholder names only by returning to the "Inventory" step. This may not be done on the "Interfaces" tab. Only the status of information flows, and whether or not a flow or interconnect is included in the architecture, may be changed during the customization step.


## Editing a Project Inventory

The Inventory tab for projects varies in that you can use the left side to Include/Exclude elements in the project. Then you can use the Description field on the right to provide a note about the element and why it is or isn't in the project.
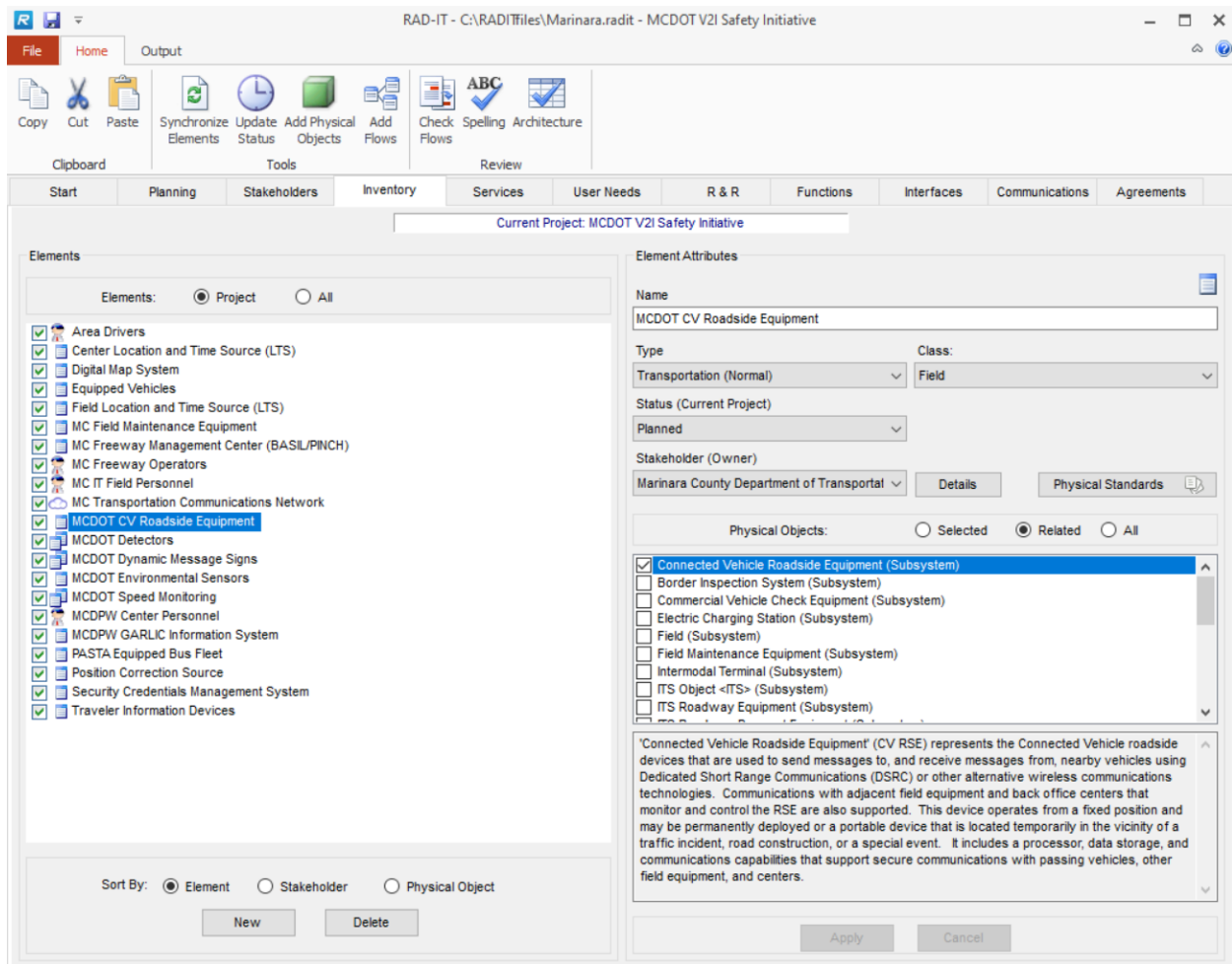
## Remote Access Device

RAD-IT supports the inclusion of a Remote Access Device which is a subsystem from ARC-IT used to show when secure remote communications are being used by center and support system operators to access their center/support systems.

To create an element mapped to a Remote Access Device on the Inventory tab, set the Class to Personal and then select the Remote Access Device physical object as shown below.
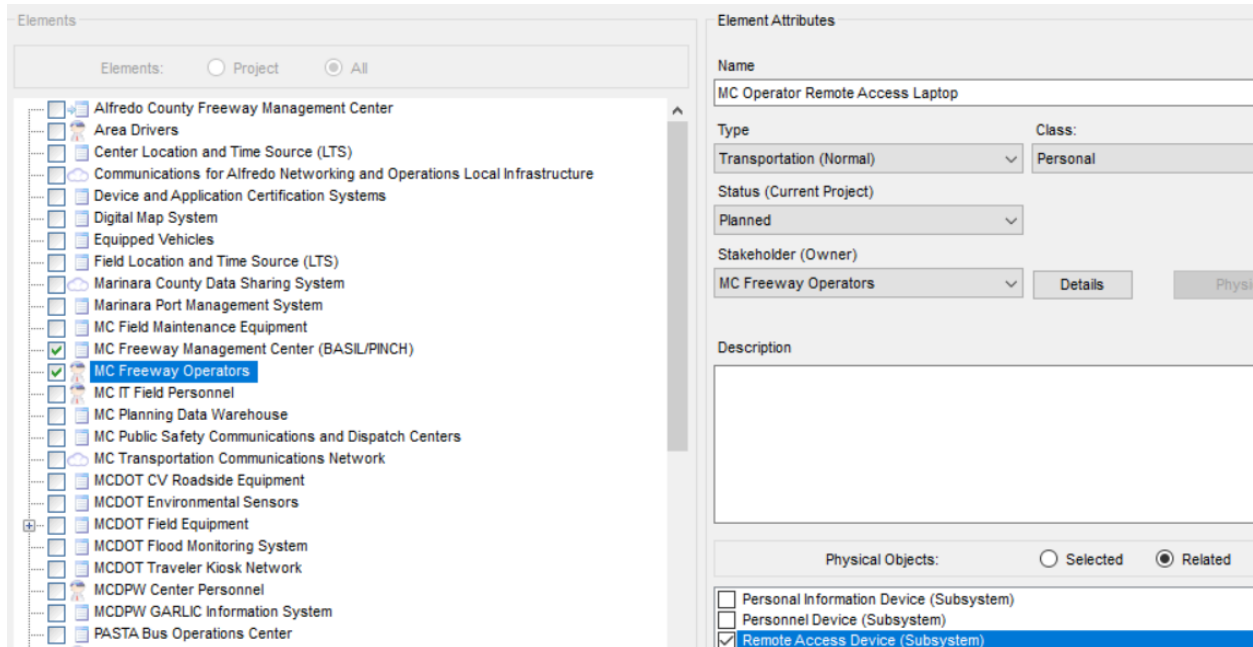
Now that element is available to select as a communications device between the human system operator and their center or support class system. See the "Communications / DDS" instructions in the Interfaces Tab section for more information.

# Services Tab – Managing Service Packages

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 5th tab – the Services tab.

## Service Package Basics

In ARC-IT, a Service Package is a way of looking at subsets of each of the architecture's view focused on a specific service or group of services. Service packages are derived from documentation like ConOps, System Requirements, standards, and other documents that have been written to describe parts of the ITS environment. It should be noted that this is not an exhaustive list - new services will be developed over time and the architecture modified appropriately. Service Packages are a concise, comparatively easy to read and follow set of diagrams and text that communicates notions of service delivery, functionality, information exchange and concerns related to those concepts.

The "Services" tab allows you to associate inventory elements (and indirectly, ARC-IT physical objects-subsystems and terminators) with a service package, which may be represented as "existing", "planned", "not applicable" or a local status value, for the project or region. When a service package is selected, all information and attributes pertaining to that service package in the architecture appears on the right-hand side of the window. This includes the element names, project, and status of the service package, as well as a user defined comment pertaining to the service package assignments. Instances of service packages can be created to represent the variations that may exist across a region or among projects in the way in which a service is implemented.

The "Services" tab includes ITS-related projects and services for a region. The tool guides you in characterizing the projects for a region in terms of ARC-IT service packages. When a service package is

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selected from the list on the left, all information and attributes pertaining to that service package in the architecture appears on the right-hand side of the window. This includes the element name, project, and status of the service package, as well as a user defined comment pertaining to the service package assignments. There are also items on this window that may not be changed - service package id, name, and description.

On the "Services" screen, stakeholders are not associated directly with a service package. They are associated indirectly with service packages via the associations of each stakeholder to the elements on the "Inventory" tab. The "Services" tab lists elements and projects selected for each service package.

The "Services" tab may be used in the following situations:

1. The "Services" tab is allowed before or after customization.
2. In a Project or Regional Architecture, element to information flow associations, plus any customization that may have been done in the Project Architectures, will be maintained.
3. When creating a Project Architecture when a Regional Architecture exists, a set of elements and flows (perhaps including customization) has already been selected. The "Services" tab is allowed. The "Build" step on the "Interfaces" tab to build the architecture will actually only add new interconnects and information flows that may result from associations made on the "Inventory" and "Services" tabs. All customization is maintained, and no flows are deleted by the "Build" step. Flows may be deselected on the "Interfaces" tab.
4. When creating a Project Architecture when a Regional Architecture does not exist, the "Services" tab is allowed.

You are able to select service packages from several different projects and connect them together in a Regional Architecture. In this way, portions of various Project Architectures may be merged into the Regional Architecture.

## Services Main Tab

The Services tab works in a similar way to the Inventory tab - select a service package on the left, and the various attributes of the service package are displayed and (most are) editable by the user on the right. Service packages are grouped by the areas of high-level ITS services as in ARC-IT.

The list below shows the ITS Service Package Areas and their abbreviations used on the Services tab in RAD-IT:

- Commercial Vehicle Operations (CVO)
- Data Management (DM)
- Maintenance and Construction (MC)
- Parking Management (PM)
- Public Safety (PS)
- Public Transportation (PT)
- Support (SU)
- Sustainable Travel (ST)
- Traffic Management (TM)
- Traveler Information (TI)
- Vehicle Safety (VS)
- Weather (WX)

The left-hand frame has tabs to only show service packages that the user has selected for the current architecture (region or project) or to view all service packages by selecting the All Service Packages tab on the left-hand side of the window. The "All Service Packages" View allows the user to easily select additional service packages for the region or project.

The left-hand frame includes check-boxes to include or uninclude the service package into the current architecture. Any changes made on the left hand frame in this way must be applied (click "Apply") first before being able to edit any of their attributes on the right.

The right-hand frame includes the service package id, name, and description for the selected service package as a convenience to the user. These come directly from the ARC-IT and may not be changed. All other fields in the right-hand frame may be changed by the user.

The right-hand controls allow the user to view or update project assignments, element assignments, status, and comments (e.g., why the service package is or is not appropriate for the region or project) for the selected service package.
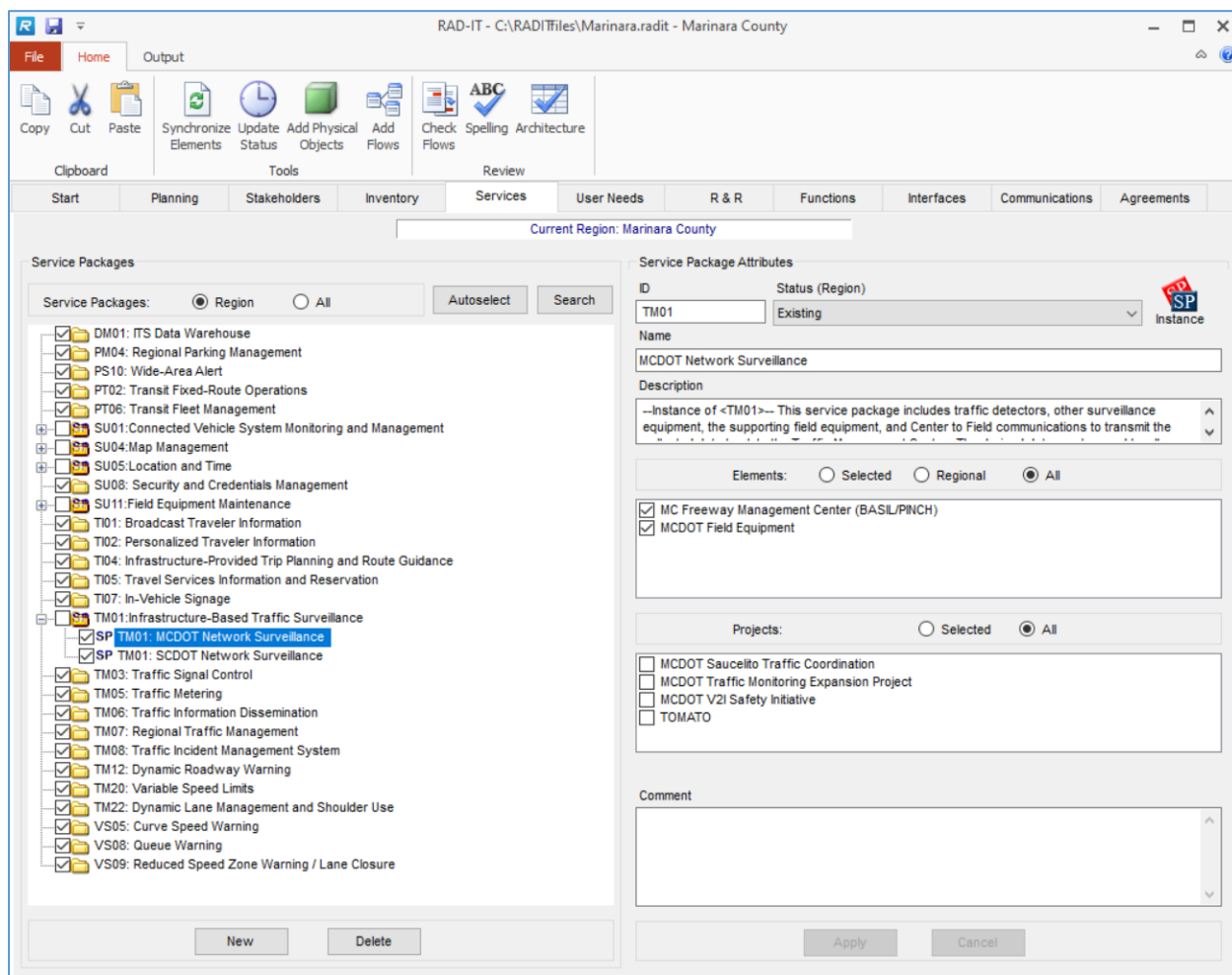


In the regional view, the selected elements and selected projects are displayed. The user may deselect any element or project from the list. Displaying all projects or all related elements may be desirable in order to

see all that are available. For elements, the user can click on "Regional Elements" to see the list of all elements included in the regional architecture that are appropriate for this service package and decide whether to include or un-include them. In addition, there may be some that are in projects but not in the regional architecture - that superset list can accessed using the All Elements tab. Similarly, for projects, click All Projects to see the complete list of projects that could be associated with this service package.

Once the user makes any change to one of the right-hand side controls, the user is given the "Apply" and "Cancel" options. The user can change any or all of the available attributes and then select "Apply" to commit the changes to the RAD-IT database file. Selecting "Cancel" aborts the changes and returns all attributes to their original state. Once "Apply" or "Cancel" are selected, they are disabled until the user makes another change to the right-hand side associations. The left-hand service package list is disabled since the user must choose to "Apply" or "Cancel" the changes before moving on. Once the user has selected "Apply" or "Cancel", the list of service packages is again enabled.

The Project Service Packages tab shows which service packages are included in the project and the checkboxes are there to change the mappings if desired. On the left-hand pane there is an icon - a blue circle with a check mark or an X - to signify whether the service package is also part of the regional architecture.

The right side of the screen is also slightly different for a project architecture. The status is the status of the service package as it pertains to the current project (not the entire database). The elements area now has tabs for Selected Elements, Project Elements, and All Elements. There may be elements selected for this service package labeled as "Not in Project". These are inventory elements that are in the database and can be used to support this service package but they are not mapped to this project on the Inventory tab. This is OK - think of a project that is adding a few cameras to a larger system where the center is already built.

On the Project Service Packages window an additional area is included above the comment to indicate whether or not the highlighted service package is part of the regional architecture and if so what the status of it is in that other architecture.

## View All Service Packages

To view all service packages, select the "All Service Packages" tab on the left-hand side of the Services window.

This allows you to easily select additional service packages for the region or project without leaving this screen. You can select any service package on the left and alter the properties on the right.

## Instances of a Service Package

On the "Services" window, notice that two buttons become available at the lower left of the screen. These options allow you to create, modify, and delete instances of a service package. RAD-IT allows instances of a service package to be defined for a regional (or project) architecture. For example, several traffic surveillance service packages could be defined, one for each TMC that provides traffic surveillance in a region. Alternatively, different service package instances could be defined for different status (existing / planned / local status) levels. Service package instances allow the services that are planned in the region to be identified with better accuracy and fidelity, improving support for the DOT regulation/policy. This feature allows a Regional ITS Architecture to be reviewed and customized almost entirely using a service packages view.

GUIDELINE: It is fine to use service package instances for some service packages and the general ARC-IT service package for other service packages in your architecture definition. For example, you might create instances for service packages that are broadly implemented in the region (e.g., traffic surveillance) and use just the ARC-IT parent service package where the service is only implemented by a single center. If you decide to use service package instances, it is good practice to remove all element and project associations from the related ARC-IT parent service package. The reason to do this is so the general relationships defined in the ARC-IT parent service package don't override or negate the specific relationships that are defined in the service package instance.

In other areas of RAD-IT:

- Service package instances are available when enabling the service package based filter which provides filtering based on a specific service package instance in the RAD-IT Diagrams, RAD-IT Tables, and "Interfaces" tab when selected.
- Service package instances may also be viewed on the "Service Packages" output tables.
- RAD-IT uses the specific service package instance information entered to determine the changes that are made to the "Interfaces" tab by the build algorithm.
- RAD-IT conversion preserves service package choices made in previous versions of RAD-IT (or Turbo). A single service package instance will automatically be created for each service package that is included in a converted architecture.

The following describes the options available to create and delete a service package instance:

- "New" – On the left side of the SP tab, highlight a parent service package and click "New" to Create an instance of that service package. Give the instance a name (the default is the name of the selected service package with "(Instance <number>)" added). Then you can assign it to various elements and projects in the region, enter an optional description, and all other attributes as described above. Perhaps an instance of a service package is being created for every element or center associated with the primary service package. When the selections are made, click "Apply" to accept the additions or changes, or "Cancel" to abort the change.
- "Delete" - Delete an instance of a service package. Select the instance, click "Delete" (note that only a service package instance may be selected causing "Delete" to become available - a primary service package cannot be deleted). A popup window asks for verification. Click "OK". The "Delete" option is only available if instances of any service packages exist.

## View All Available Projects and Elements

To view all elements or projects that may be associated with the selected service package right-click on the list box. You may then select or deselect an element or project. Right clicking on the list box again toggles it back to the original size.

Now you can see many more of the available projects or elements that may be mapped to this service package. The projects or elements that are checked are those that are selected for the current service package. These are displayed when you select the "Selected Elements" or "Selected Projects" tabs. The "All Related Elements" and "All Projects" tabs are used to make other selections within the Project or Regional Architecture for the selected service package. The related projects and elements are always displayed at the top of the list with other candidates listed below in alphabetical order.

The same is true if deselecting a project. This must be done on both the "Inventory" and "Services" tabs. A project can apply to more than one service package, or to parts of different service packages.

## Change a Service Package to Project or Element Association

Once any change to one of the right-hand side associations for a selected service package is made, you are given the "Apply" and "Cancel" options. You can change any or all of the available attributes and then select "Apply" to commit the changes to the RAD-IT database file. Selecting "Cancel" aborts the changes and returns all attributes to their original state. Once "Apply" or "Cancel" are selected, they are disabled until you make another change to the right-hand side associations. The left-hand service package list is disabled since you must choose to "Apply" or "Cancel" the changes before moving on. Once you have selected "Apply" or "Cancel", the list of service packages is again enabled.

## Entering Comments

The Services Tab has a Comments field on the right side that is optional but allows the user to make a comment about a particular service package – why it was included, why it wasn't included, or perhaps a note about what elements may be participating or not in this service package.

## "Not Applicable" Status on Services Tab

NOTE: The status "Not Applicable" is listed on the "Services" tab for a variety of reasons, listed in the guidelines below. If a "Not Applicable" service package is associated with an element in the architecture (but not with the project), the flows associated with this service package will appear as "Not Applicable" on the "Interfaces" tab after a Build. This may or may not be what you intended. If it is what was intended, these flows may be included in the architecture later. If this was unintentional, then changing the status of the service package on the "Services" tab and re-building will have no effect on these flows (they have already been added, so will not be added again). You must change the flow status for each flow (or click the "Include" box) on the "Interfaces" tab. However, changing the status of the service package AND assigning the service package to this project on the "Services" tab, THEN re-building, will change these flows to "Planned" or "Existing" (and the "Include" box will be checked) on the "Interfaces" tab.

GUIDELINE:  If a new service package has been selected for this architecture on the "Services" tab, and you simply begin associating elements and projects to it, the status remains unchanged. The status of a newly selected service package with no previous associations defaults to "Not Applicable". This must be changed to "Existing", "Planned", or a local status, in order for its flows to actually be included later on the "Interfaces" tab as part of this project.

GUIDELINE:  "Not Applicable" is available on the "Services" tab so that a list of additional flows may be associated with elements in the project on the "Interfaces" tab, creating additional possibilities for integration. This status is also available on the "Services" tab so that you may enter a comment about why a particular service package is not going to be used in the Project or Regional Architecture. On the "Interfaces" tab, these flows are listed as not included in the project - the "Include" box is not checked for these flows. These flows may be included later by checking the "Include" box, and the flow status may be changed to "Existing" or "Planned".

One reason "Not Applicable" is available on the Services tab so that the user may enter a comment about why a particular service package is not going to be used in the Project or Regional Architecture. On the

Interfaces tab, these flows are listed as not included in the project - the "Include" box is not checked for these flows. These flows may be included later by checking the "Include" box, and the flow status may be changed to "Existing" or "Planned" or a local status value.

## Add a Service Package Association to a Project

New elements are created on the "Inventory" tab. However, additional information flows are sometimes required later to enhance an architecture, or to make it more complete. These may be added to the architecture by selecting a new service package to add to the architecture.

If elements have been created on the "Inventory" tab, then one way to add flows to the architecture is to add service package associations for these new elements. Another way to add flows to the architecture is to simply make Physical Object (subsystem and terminator) associations on the "Inventory" tab for the new elements. This will pull in information flow and interconnect associations from ARC-IT for the new elements.

To add a new service package to an element, go to the "Services" tab and select the service package. Check the status ("existing", "planned", or a local status), then make the element selections. This will connect these elements together via the flows that will be added to the architecture by the new service package selection.

In addition, if working in a Project Architecture, you must check at least the current project box to add these flows to the project (later, on the "Interfaces" tab, the "Include" box will be checked for these flows). To connect these flows to elements in other projects in the region, check the other appropriate project boxes. For a Regional Architecture, check the projects whose elements are to be connected by the new flows. If your database file only includes a Regional Architecture and no projects, then there would be no project associations for an element or service package. Select "Apply" or "Cancel".

Finally, to add the new service package and its associated flows to the architecture and to the "Interfaces" tab for customization, select the "Build" option on the "Interfaces" tab to build the architecture.

## Service Package Autoselect
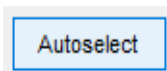


The Planning Tab allows transportation goals and objectives to be defined and related to performance measures and service packages. If a user defined goals and objectives on the Planning Tab and related them to ARC-IT Service Packages, the user now should come to the Services Tab and use the Autoselect button to transfer those service package selections from the Planning tab to the Services tab. The other possibility is that the user could have edited the Needs for the architecture on the Needs tab and made changes to the service package mappings to Needs.

Pressing the Autoselect button on the Services tab will open the following window:
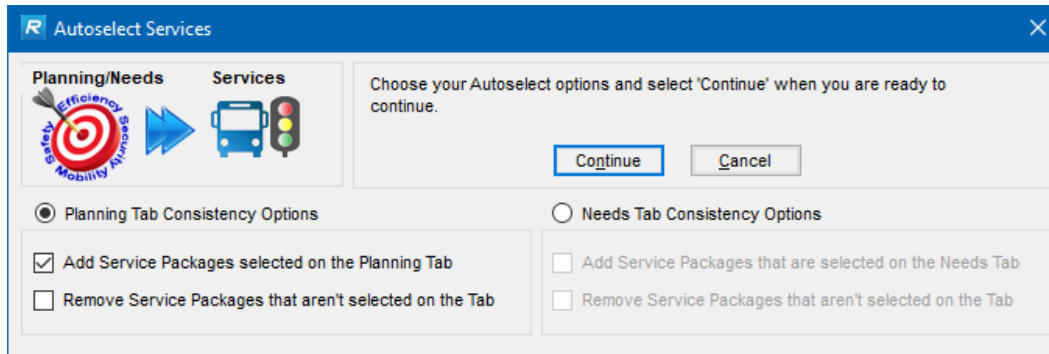
The user is provided the option to either Options include whether to Add Services Packages selected on the Planning tab or to Remove Service Packages not selected by the Planning Tab. The user can also click the Needs Tab Consistency Options button add Service Packages that are selected on the Needs tab or remove the ones that aren't.

Once the user selects the option and selects continue, the next screen will show the service packages to be added or removed based on the analysis of the Planning Tab selections.

## Service Package Search

If you need assistance in selecting service packages, you can perform a search to identify service packages related to an objective or strategy. You perform a search by selecting the Search button on either the Planning Tab (right side of the tab) or the Services Tab (on the left side).

There are three ways to search for service packages:
1. First, you can search for service packages that support an ITS goal. There are 8 ITS goals identified from which you can select one using the pull down menu. Once a goal is selected, you press the Go button or combine the Goal Search with the other two criteria.
2. There are many defined transportation related objectives from which you can select one using the pull down menu. Once an objective category and objective has been selected, you press the Go button to perform the search or continue to the content based search.
3. Enter keywords or other text that will be used in a content search of the Service Package titles and descriptions.

Once the criteria are set, the Go button may be pressed to search for service packages that meet all supplied criteria.

Checkmarks indicate which service packages are:
- already associated with the current objective/strategy when the search is performed from the Planning Tab, or
- already included in the architecture when launched from the Services tab. Highlighting one of the resultant service packages will cause the description to be displayed in the box below.

Use the Show Diagram button to display a graphic of the Service Package from ARC-IT. Use the Hide Diagram to restore the display back. Click or unclick the checkboxes to add or remove the service

packages. Then click Apply to incorporate the changes into the architecture. Or select Close to exit this window and return to the main RAD-IT window.

# User Needs Tab

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 6th tab – the User Needs tab. The User Needs tab allows you to associate needs with your regional or project architecture. It starts by presenting the needs from the ARC-IT database that are developed for each Service Package selected in the architecture.

A *user need* is a capability that is identified to accomplish a specific goal or solve a problem, specifically to be supported by the intelligent transportation system. It describes "what" is needed while avoiding the implementation specifics, or the "how." Each need is identified uniquely, contains a description, which when worded properly includes a rationale. That rationale may include examples of how the system capability may be exercised.

In a systems engineering project a set of needs are part of the Concept of Operations to explain or justify what is driving an agency to create a new system or update what they have. Typically, in a Concept of Operations the System Needs are designed to answer two basic questions:
- What does the System need to do?
- What do users need from the System?

## Autoselect Needs

You can use the AutoSelect Button to let RAD-IT pull in the Needs from ARC-IT's database that were written for each of the Service Packages included in your architecture as shown below:
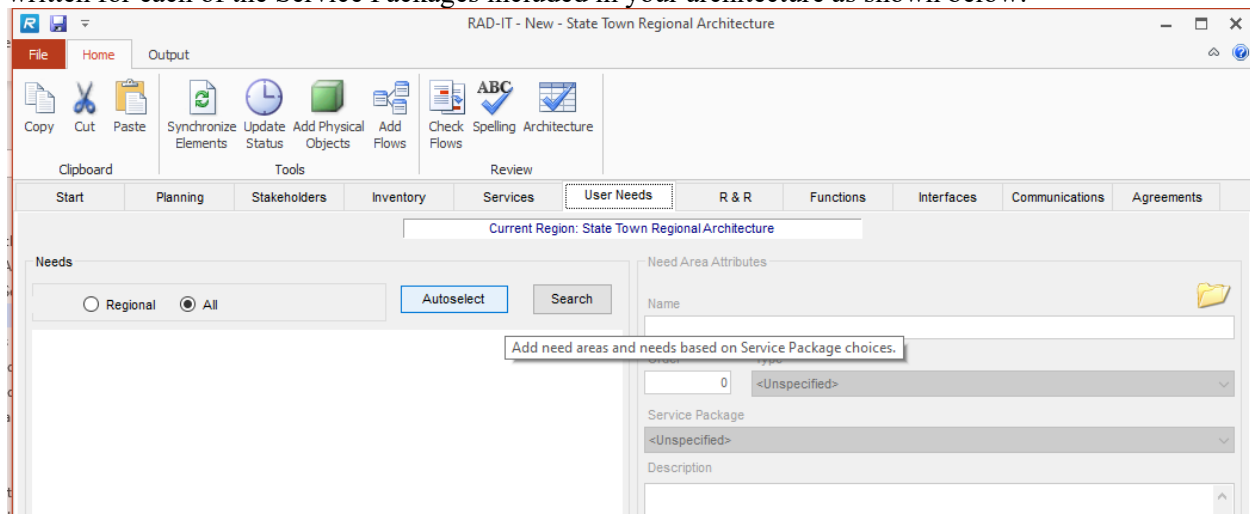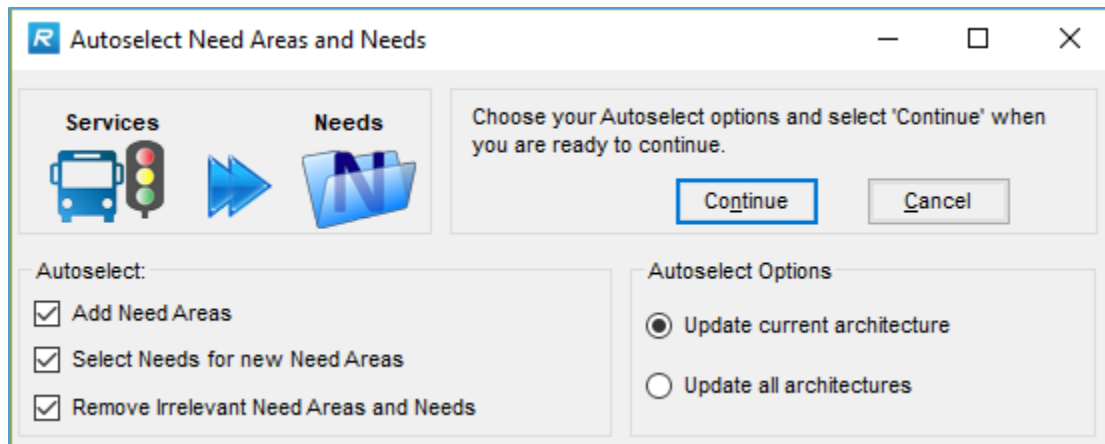
The options on the Autoselect tool here allow you to:
- Add Need Areas
- Select Needs for new Need Areas
- Remove Irrelevant Need Areas and Needs

The Options buttons on the Autoselect tool are to either:
- Update the current architecture (see the white box at the top of the tab area to see which architecture is currently selected).
- Update all architectures in the file.

When you use the Autoselect Need Areas and Needs feature it will add a "Need Area" for each Service Package selected. A Need Area is just a way of organizing your stakeholders needs and service packages provide a good starting point to that organization. You can also use the New Area button later to add your own.

## Search for Needs

The Search button on the Needs tab lets you search the database to look for a particular need that may match your own region or project stakeholders needs.



When you click the Needs button you can filter the search by Need Area Type, e.g. Mobility, Safety, etc. Then you can enter a string of text to search by.  As you type the table of needs will be populated with the Needs from ARC-IT or user defined needs that you may have already written that have that word or phrase.

NOTE: to see the entire text of the Need hover your mouse over the field and a tool tip will pop-up to show then entire text of the Need.  You can also make the column wider.

If you click the Include box the Apply/Cancel buttons will be activated.

**NOTE:** not every service package is included in the scope of the search. For instance, SU07 ITS Communications is excluded from this search function because users are not able to include that generic service package in their architecture.

Once you click Apply a new Need Area will be created with the selected Needs. Or you can click the Cancel button to undo those selections.

Click the X to close the Search window.

Then back on the Needs tab you will see a new Need Area to indicate that the new needs were selected based on a search, as opposed to an Autoselect that is based on service packages then needs.
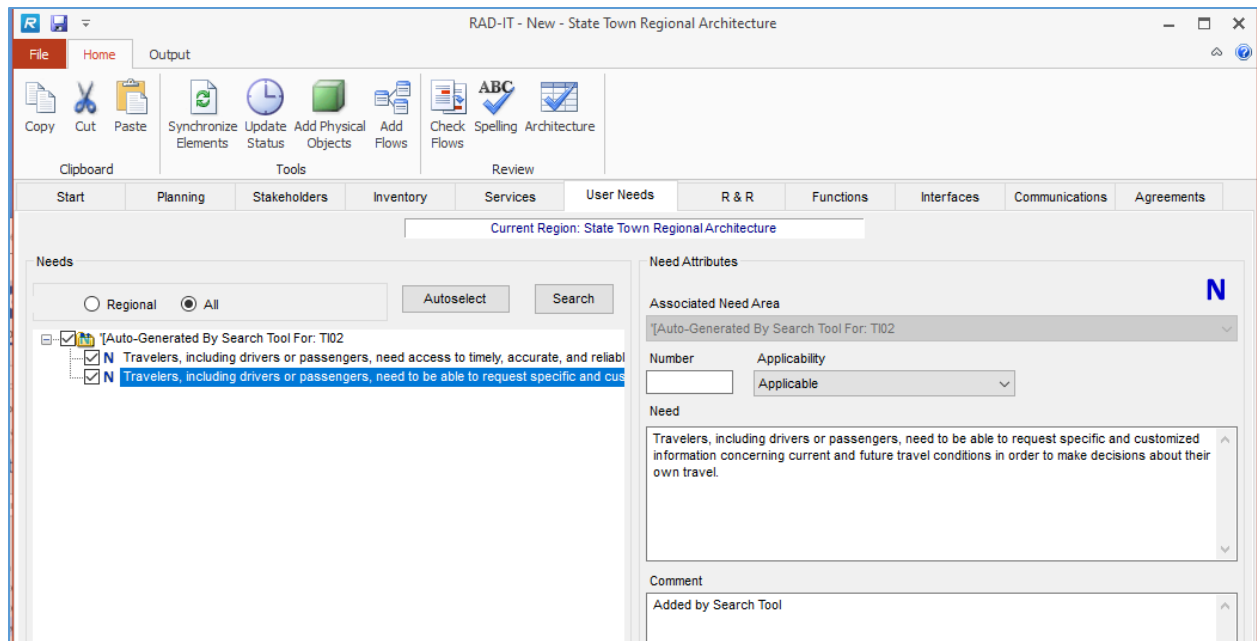
**TIP:** After doing a Search to add needs to your region/project, edit the name of the Need Area to match your region or project.

## Customizing Need Areas

Once you have a need area created by RAD-IT using the Autoselect button you can customize the imported Needs by editing the Name, Order, or Description.

What is a Need Area?  A Need Area is just a collection of Needs.

In ARC-IT needs were written for every service package so one way to organize needs is to let RAD-IT autoselect the needs and create Need Areas for each service package in your architecture. You can also decide to organize your needs differently by creating your own Need Areas.
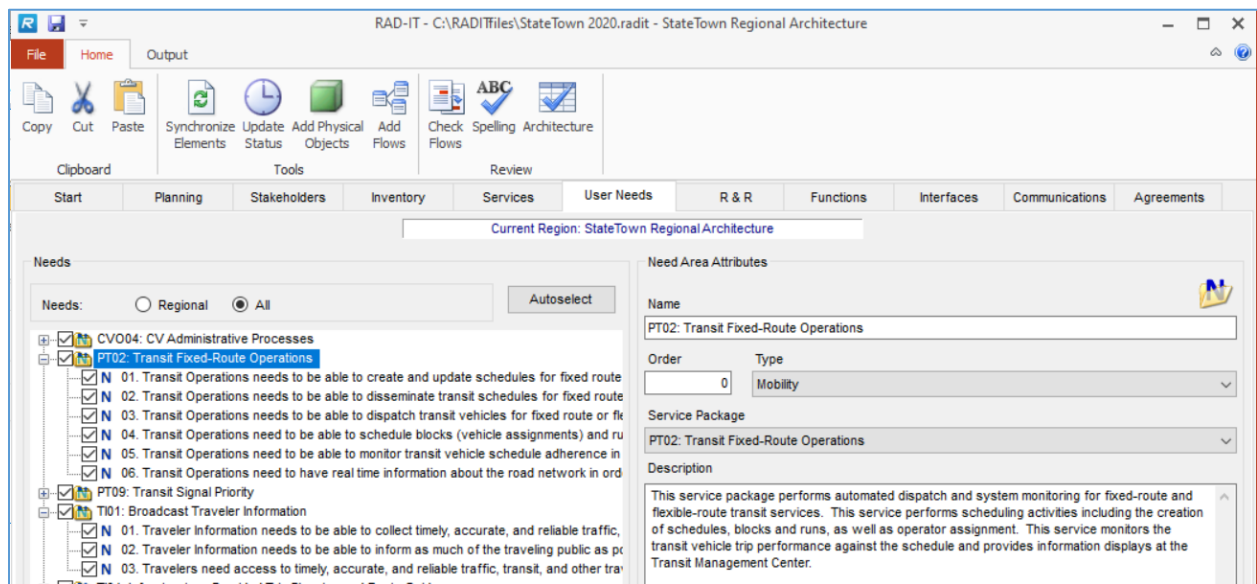
**NOTE:** if you decide to change the Name, Description, or Service Package mapping for a Need Area then it may no longer match what RAD-IT generated for you. You can change those settings and wording but just beware that it may no longer be consistent. If you want to have Need Areas that are different than the ones that RAD-IT automatically generated then create your own Need Areas.

Need Areas have an Order number associated with them to know in which order they should be sorted in the output tables and documentation. It must contain a number and must not be left blank.

It is possible to change the Service Package mapping for a Need Area. This may lead to undesired outcomes since most Need Areas are automatically associated with an ARC-IT Service Package when they're Autogenerated. If you change the service package associated with a Need Area that already has associated ARC-IT Needs, then you will get a warning that the ARC-IT needs associated with the Need Area will be removed if you decide to continue. This check is smart enough to allow Service Package changes without warning if you are simply changing from one instance to another of the same service package, if you are creating a new need area, or if you have otherwise not yet associated needs with the Need Area. If you are warned and answer 'Yes', the Service Package change is made and the ARC-IT needs are removed from the Need Area. If you answer 'No', you are returned to the tab with 'Apply' and 'Cancel' enabled, just like with other validation errors.

## Customizing Needs

Once the Need Areas are defined the user can select and customize the needs for the regional or project architecture.
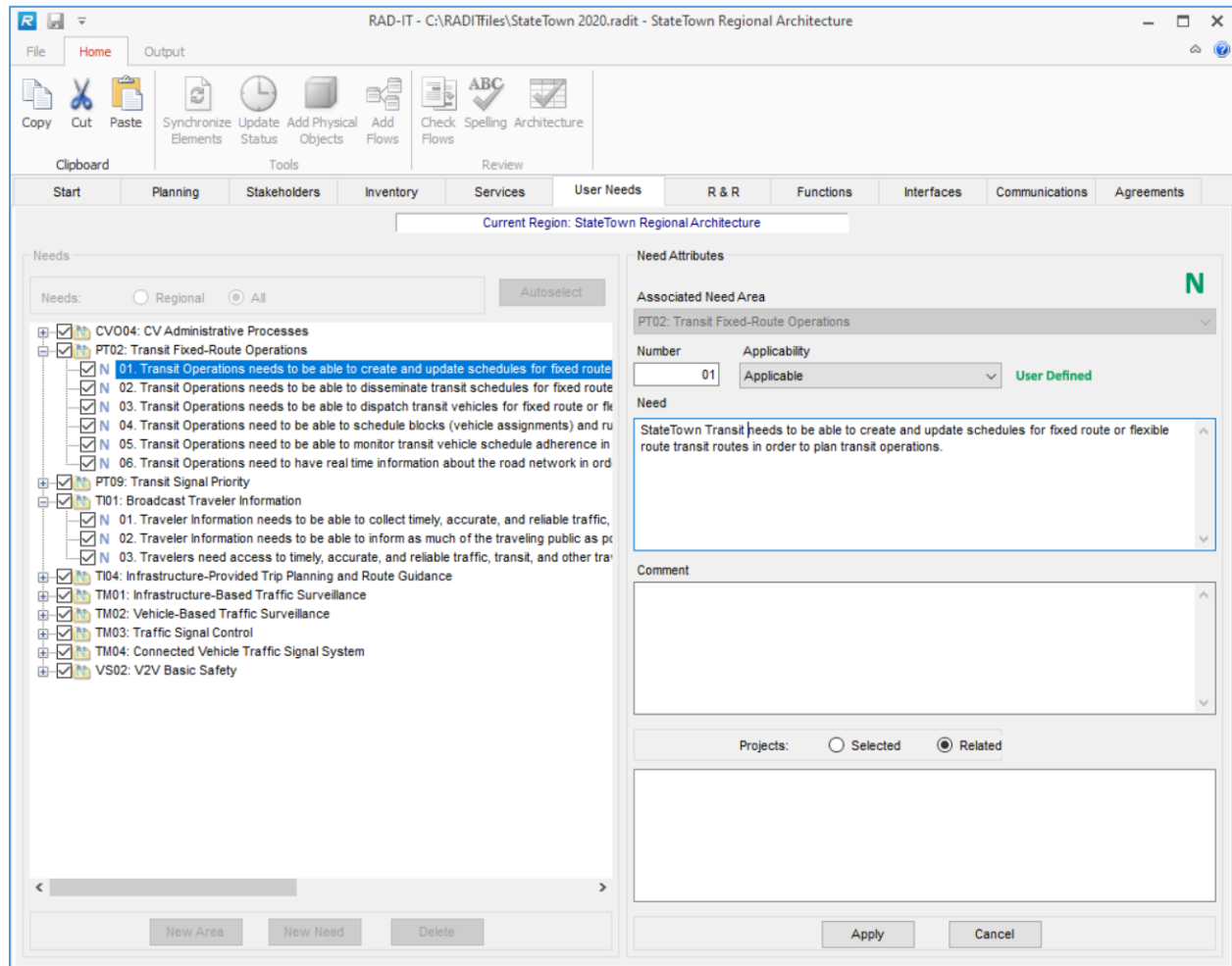


Note as we started typing in the Need text box above the color of the Need icon changed to Green and a "User Defined" indicator appears next to the Applicability box.

Customizations made to the text of a need will result in a User Defined need for your architecture. Any requirements that had been mapped to the original need will now be mapped to the user defined need on the Functions tab.

## Needs Tab General Information

The needs tab is populated with data either using the Autoselect button to pull in Need Areas and Needs based on the Service Packages are selected for your architecture – region or project. You can also use the "New Area" and the "New Need" buttons to add your own need areas and needs.

**TIP:** If the Needs tab is blank it is probably because no services packages have been selected; go back to the Services tab. Alternatively the Needs tab may be blank because the AutoSelect step has not yet been performed for the architecture.

The left side of the screen shows a list of Need Areas as a set of folders. Click each folder icon to expand the list and see the Needs for that Need Area.

When you use the Autoselect Need Areas and Needs feature it will add a "Need Area" for each Service Package selected. A Need Area is just a way of organizing your stakeholders needs and service packages provide a good starting point to that organization. You can also use the New Area button later to add your own.

Adding a need to your architecture is done by either Checking the box on the left side of the screen next to the need or by Highlighting the need on the left and changing the Applicability on the right to Applicable from Not Applicable.

This tab works like other tabs in that you can select and make changes on the left of the screen and the Apply / Cancel buttons will activate on the left side. Or as you select a need on the left and make changes on the right then the Apply / Cancel buttons will activate on the right side.

RAD-IT is pre-loaded with the service package based needs from ARC-IT, the reference architecture. You can select and edit them for your region or project's needs.

Alternatively, you can add Needs to your region or project by simply clicking New on the left side and entering the information on the right.

Unchecking a Need Area will un-Include that need area from the current architecture. It may still be available for other architectures in the file. When a Need Area is Un-Included the Needs under it are also un-included.

## Adding a New Need Area

Click the "New Area" and you can give it a Name, assign an Order to govern how need areas can be sorted in the outputs, Type (as in type of Service Packages, see ARC-IT). Service Package, and a Description. As shown in the example, you don't need to assign a service package for a Need Area; in fact, it may be a general collection of needs that will apply across the board for a region or project.

Click Apply to add it to the list or Cancel to cancel the change.

*Adding a New Need*

Highlight a Need Area or a Need and Click the "New Button" button. This will set up the right side of the screen to let you add a new need to the Need Area you are in. You can also use the pull-down to change the Area or leave it where it is. Then you can give the user defined Need a Number, the text of the Need, and an optional comment. Use the Applicability pull-down to assign it to the current architecture – the choices are Applicable or Not Applicable. There is also room on the form to assign the new need to a project if there are any in the file at the time. The Number field is required – it will not let you exit the form without a number to support traceability between needs and requirements later.

Click Apply and the new need will be added in the order it should be based on the number and will show a Green "N" to highlight the fact that it is User Defined.

RAD-IT will warn you if it detects a duplicate need.
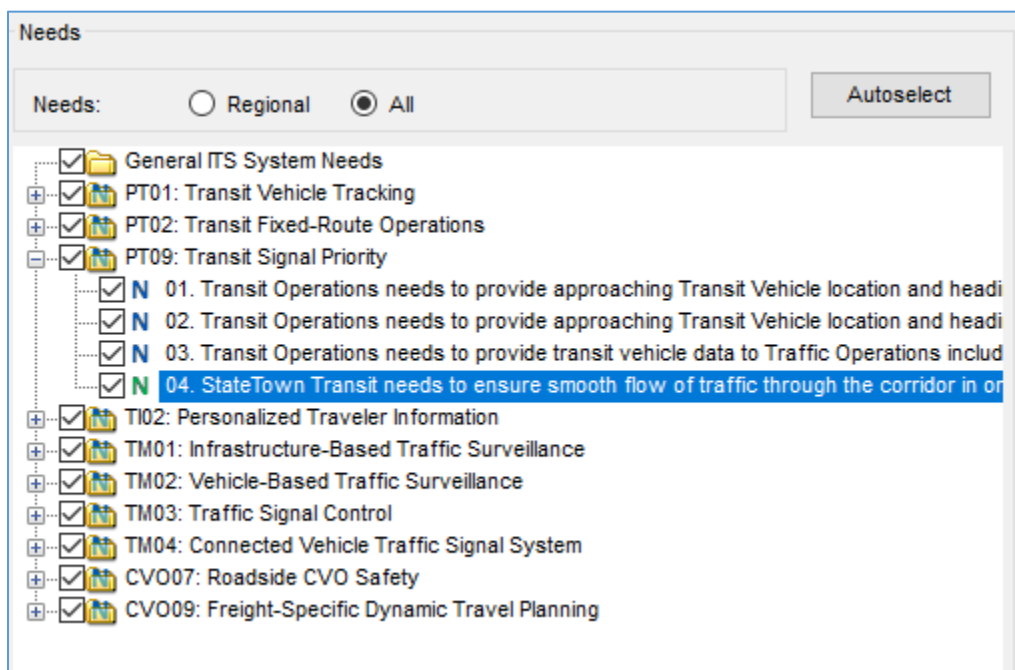


The "Delete" key at the bottom of the left side of the screen lets you delete either a Need or an entire Need Area from the file. You will be prompted to verify that this is what you really want to do.
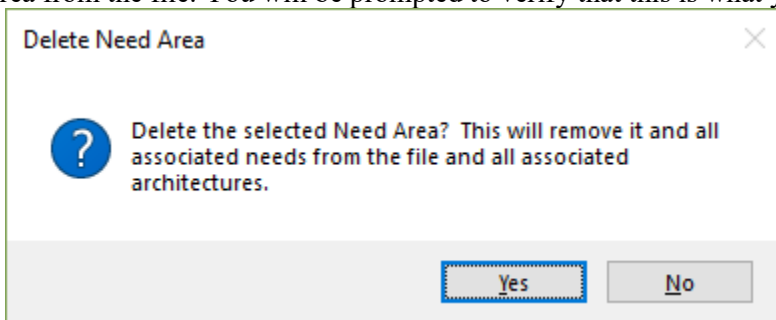


# Roles & Responsibilities Tab (R&Rs)

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 7th tab – the R&R tab.

## Roles & Responsibilities General Information

An Operational Concept for a Regional ITS Architecture captures each stakeholder's current and future *R*oles and *R*esponsibilities in the implementation and operation of the region's transportation systems. For ITS Projects, the term "Concept of Operations" may be more familiar but contains essentially the same elements - roles and responsibilities for each of the stakeholders as they pertain to the major areas of

services to be provided. Roles and responsibilities can be generally defined at a region wide level or they can be service specific (e.g., SDOT operates and maintains the freeway system and also provides incident images to support incident management). Roles and responsibilities can also be defined once for a stakeholder group if the same roles and responsibilities apply to each stakeholder in a stakeholder group.

There are a number of ways in which Operational Concepts can be developed and documented. The Regional ITS Architecture Guidance Document contains more information on the topic.

RAD-IT provides a flexible user interface for you to identify the major ITS Areas that you will need to capture, assign stakeholders to each of those areas, and then write the Roles and Responsibilities for each of your stakeholders.

This feature was developed to primarily support Regional ITS Architecture developers that are carrying out the requirements of the FHWA CFR 940.9(d)3 and FTA Policy 5.d.3. However, this feature can also be used in Project Architectures to document portions of a Concept of Operations for the project.


## Role and Responsibility Areas
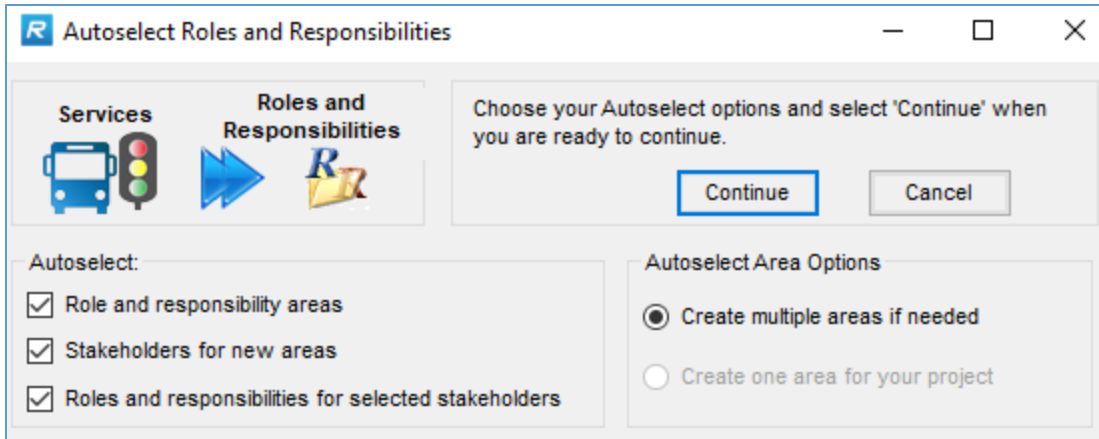
The R&Rs tab is where you can enter Role and Responsibility Areas for the stakeholders. RAD-IT provides the user with an "Autoselect" tool that will build a default set of areas based on the service packages that have been selected and then presents the user with the list of stakeholders that are assigned to the appropriate inventory elements. For a new architecture, the users will need to first document their stakeholders, develop their inventory of elements (with stakeholders assigned), and select service packages on the Services tab.

The buttons on the bottom allow the user to create "New" Role and Responsibility Areas or "Delete" them. The more experienced user might opt to create his own areas using the "New" button, instead of using the architecture defaults that the "Autoselect" option will provide.

When the user makes changes to the name, description, selected service packages, or selected stakeholders; the user will need to hit the "Apply" button to save the changes or "Cancel".

The left hand side of the R&Rs screen shows the Role and Responsibility Areas that have been added for this Regional ITS Architecture. For a new architecture, you will need to first document the stakeholders, develop inventory of elements (with stakeholders assigned), and select service packages on the Services tab.
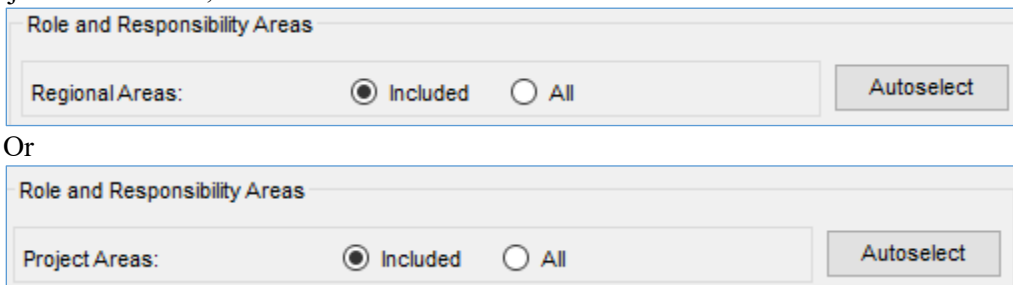
Once that is done, you may use the R&Rs tab to either develop your own areas or let RAD-IT create a default list of areas by clicking on the "Autoselect" button. Options are shown allowing users to decide how much to add to the R&R window - new areas, new stakeholders within the new areas, and any default roles and responsibilities for those new stakeholders.

Based on the service package selections and changes made on the Services tab, RAD-IT will fill in the left side of the screen with a list of areas for the regional or project architecture based on the Service Package selections. Each area that RAD-IT adds roughly corresponds to the major Service Packages or groups of service packages: Traveler Information, Freeway Management, Transit Services, etc.

**NOTE** that RAD-IT automatically builds names for the Role and Responsibility Areas that include both the generic area name (e.g., Parking Management) and the architecture name (e.g., Marinara County). This allows the same default areas to be used or tailored for both Regional and Project Architectures. The user can see only the role and responsibility areas included in the current architecture or see all areas that have been defined in the file using the "Regional Areas" for a Regional Architecture, "Project Areas" for a Project Architecture, or "All Areas" tabs.



Or



The following is a list of the default Role and Responsibility areas that RAD-IT can create based on your service packages:

| | |
|---|---|
| Surface Street Management | Data Management |
| Freeway Management | Road User Payment |
| Incident Management | Vehicle Safety |
| Electronic Toll Collection | Support |
| Parking Management | Sustainable Travel |
| Maintenance and Construction | Weather |
| Transit Services | International Border |
| Traveler Information | Security |
| Commercial Vehicle Operations | |
| Emergency Management | |

For each Role and Responsibility area, whether created from scratch or added by RAD-IT, you can edit the Name and Description on the right hand side of the screen.

> **NOTE:** The "Included in Regional Architecture" box is checked by default for both a Regional and a Project Architecture. This box associates the highlighted Role and Responsibility Area with the Regional Architecture.

As a R&R area is included in your architecture RAD-IT will also include the stakeholders that own elements that are part of the service packages in each area.



The "RR" icon will be displayed over the icon folder if roles and responsibilities have been written for the stakeholders within that Role and Responsibility Area.

Below the Description of the Role and Responsibility Area, you can associate one or more service packages with each area. When RAD-IT adds the areas it will preselect the service packages appropriate to that area (for example, traveler focused service packages are in the Traveler Information area). Only service packages that have been associated with the architecture on the Services tab can be selected here.

The Service Packages area has 2 buttons - "Selected" and "All". If the user wants to add service packages to a Role and Responsibility Area, perhaps in addition to what RAD-IT's Autoselect picked up, use the "All" button to check off any service package in the architecture.



Below the Service Packages list of the "Role and Responsibility Area" is where stakeholders are mapped to each area. A default list of possible stakeholders is based on 3 things:
   a) the service packages assigned,
   b) the service package to inventory element associations, and the
   c) inventory element to stakeholder associations created by the user.
The user must make these stakeholder assignments based on the needs of the region or project.

There are 3 Stakeholder buttons - "Selected", "Related", and "All". "All" stakeholders shows all stakeholders that are associated with the architecture, e.g., allowing the user to select other stakeholders that are not on the recommended list.

The user may enter more than one stakeholder for each Role and Responsibility Area. "Selected" shows the stakeholders that have been selected for the area. "Related" shows only the stakeholders that are associated with the selected service package(s). There are some cases when the "Related" stakeholders may be blank because RAD-IT cannot determine what the related stakeholders should be. This happens when: 1) the user has not associated any service packages with the Role and Responsibility Area, or 2) the user changes the selected service packages for the region.

Below the Stakeholders list on the "Role and Responsibility Area" is the project assignment area. There are 2 Project buttons: "Selected" and "All" projects. This is only visible when a Regional Architecture is currently selected.

Once the stakeholders have been selected for the "Role and Responsibility Areas", the stakeholders associated with each area are indented under the name of each R&R area. Expand/collapse the display so that stakeholders are shown/hidden by double clicking on an area or clicking the "+" and "-" symbols. The "*RR*" icons show the stakeholders which have Role and Responsibility descriptions.

The buttons on the bottom allow you to create "New" Role and Responsibility Areas or "Delete" them.

When changes are made to the name, description, selected service packages, or selected stakeholders; you will need to hit the "Apply" button to save the changes or "Cancel".

> **NOTE:** You may encounter a situation where doing "Autoselect" on the R&R tab didn't add all the areas you expected. For example, if you have an architecture with a lot of Traffic Management (TM) related Service Packages (SPs) and do "Autoselect" you will typically get both Freeway Management and Surface Street Management areas. If you later delete one of those areas and then try to use Autoselect to add it back in you may not get that area to show up again. This is because there is some overlap between those two areas, Freeway and Surface Street Management, and the Autoselect sees that you already have an area for those service packages. In this situation you may need to manually add that R&R area back into your architecture.

## Defining Stakeholder Roles and Responsibilities

From the list of Role and Responsibility Areas, when you select one of the stakeholders from the indented list, the right side of the R&Rs tab changes to show the roles and responsibility descriptions for that stakeholder.

With the Stakeholder highlighted on the left, enter one or more Role and Responsibilities (R&Rs) for each stakeholder in each area.



The "RR" icon at the top right provides a quick check to show when roles and responsibilities have been entered for a stakeholder.

**TIP:** The stakeholder description and list of inventory elements may assist the user in defining the role and responsibility for a stakeholder.

There are two check-box columns in the list of Roles and Responsibilities:
- In Project/Region: When working with the Regional Architecture, the check indicates whether this particular R&R is included in any project architecture in the file. In a Project it indicates that the R&R is included in the Regional Architecture. This gives the user an idea that the R&R is used somewhere else and that any changes made to this R&R may affect other architectures.
- Include: indicates that the R&R is in the current architecture. An easy way to use this tool is to select the "All R&Rs" sub-tab and check/uncheck the Include boxes to add or remove R&Rs that apply to this area in your architecture.

A 3rd column for the Role and Responsibilities shows "Status". Here, you can assign a status - existing, planned, etc. - for each of your roles/responsibilities entries.

**TIP:** The status of R&Rs could be used to differentiate between roles a stakeholder plays today with current system versus roles it will play once the new system is in place.

The "New", "Delete", "Apply", and "Cancel" buttons at the bottom work as they do elsewhere.

The R&Rs tab for **Project Architectures** work a little differently in Version 8.0 compared to previous versions. Previously, if you selected a R&R area that is part of the regional architecture and start to make changes to it - either adding/removing stakeholders or adding/removing/editing the text of a role/responsibility you would be warned that a new area will be created that includes your changes. Then it would create a new R&R Area based on the original that was being edited and the new default name would be the same as the old area with "(Copy 1)" appended to the name. This allowed a project architecture to define its unique characteristics without affecting other architectures in the file.

Now R&R areas are considered the same for either the region or project within the same file. This simplifies the data entry and user experience somewhat but you should keep this in mind as you edit a project's R&R characteristics.

GUIDELINE: to define the characteristics of a project and develop a concept of operations (ConOps) for that project it will be best to use SET-IT > it supports more detailed definition of a ConOps including Sequences for Operational Scenarios.

On the right of the R&Rs tab is a field that will normally say "Editable" meaning that Roles and Responsibilities can be added, edited, deleted but there if the user is working in a Project Architecture but hasn't yet included an area in the project they will see "Locked" for any of the Roles and Responsibilities in that area.

## R&Rs Q&As

Here are some tips on how to understand and use the R&Rs Tab:
1. In the regional view what does the "In Project" check box mean?
    "In Project" is checked when one or more projects include the R&R. The reason for showing the regional architect this information is they may want to know that the edits that they are making to an R&R will impact one or more projects. A possible point of confusion is that the "In Project" checkboxes are checked whenever the R&R is included in a project, even if that R&R is included in a project as part of an R&R Area that is different from the R&R Area that is currently being edited. It works this way because edits to the R&R will change the R&R everywhere that it occurs - in all projects and in all R&R Areas. If you want to make a change to an R&R that does not impact other areas/projects and "In Project" is checked, then you should make a copy of the R&R and make your edits in the copy.
2. Do the checks in the "Include" column mean that these R&Rs are included for the regional architecture?
    Yes, almost. The Include checkboxes by the R&Rs mean that these R&Rs are included for that stakeholder in that area. Technically, they are not in the architecture until you actually include the R&R Area in the architecture by checking the checkbox next to the R&R Area on the left-hand side. When you include the R&R Area in the regional architecture, you get all the stakeholders and R&Rs associated with that Area, including the two in question.
3. In the project view what does the "In Region" check box mean?
    The "In Region" column works just like the "In Project" column discussed above. The "In Region" column is checked whenever an R&R is included in the regional architecture, even if that R&R is included in the regional architecture as part of another R&R Area. The user can edit any R&Rs where "In Region" is checked so care should be taken if they are meant to be unique to the project. The checkboxes provide a visual cue about why the user is prevented from making any edits to these R&Rs.
4. In both of the views why are the same R&Rs checked under "Include" column?
    "Include" is checked to include an R&R in an R&R Area. The same R&Rs are included in the R&R Area, regardless of the architecture that is selected. This is why the R&R Include column is the same, whether the project or region is selected. As stated above, you can choose to include the R&R Area in one or more architectures using the checkboxes next to each R&R Area on the left hand side of the tab.

Think of the R&Rs tab like the Services tab in that the left side of the screen lists the Areas – the big things – while the right side lists the individual R&Rs – the smaller pieces. Similarly, on the Services tab you have the Service Packages on the left (the big things) and then the Elements on the right that belong to each Service Package. On the R&Rs tab you are using the check boxes on the right to check whether the R&R is included in an Area, not in an architecture. To include or exclude something from the architecture use the left side to include or exclude the area first.

# Functions Tab

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 8th tab – the Functions tab.

## Functions – General Information

The "Functions" tab supports the development of a description of the tasks or activities (the "functions") that are performed by each system in the inventory. Selecting the functional objects provides a high-level way of documenting the share of the work that each system is required to do to provide the ITS services for a region or project. System functional requirements are one of the required components of a regional ITS architecture as identified in FHWA CFR 940.9(d)5 and FTA Architecture Policy section 5.d.5.

GUIDELINE: Before writing the first functional requirement, determine the appropriate level of detail for your region or project. Requirements should follow directly from the ITS service decisions, operational concept and interface choices. Identify which systems need to have functional requirements defined – for instance, systems on the boundary of ITS (e.g., financial institutions) do not have to be functionally defined.

> TIP: As regional architectures are typically too high level and too far looking in terms of their time horizon, it is recommended to keep the functional definition at a high-level in the regional architecture. Once a project has been scoped out use SET-IT to select and further customize the functional requirements for the system elements in a project.

## Functions Tab - Elements View

The Functions tab identifies the areas of functionality or functional objects for each element.

The left side of the screen on the tab shows the list of elements from the inventory. The list includes all elements when a regional architecture is selected or only project elements when a project architecture is selected. Elements can fall into one of 3 categories which are represented with the small icons to the left of the element names.

1.  The beige rectangle means that no functions have been assigned to the element.

2.  The box with the "*f*" means that functional objects have been selected for this element.

3.  The box with the "*f*" and a magnifying glass means that functional requirements have been defined for this element.

This may vary between regional and project architectures in the same file. For example, functions may not be specified for an Event Parking System in one project architecture, but they may be specified in another project architecture in the same file. The same element could have three different status values in three different architectures. Highlighting one of the elements will cause an enlarged status icon to be displayed at the top right side of the screen.

The checkbox beside "Specify Functionality" allows you to make a simple yes/no decision on whether functionality will be specified, allowing basic scope to be established. Checking the "Specify Functionality" box will cause the Related Functional objects to be populated based on the inventory element's mapping to ARC-IT Physical Objects.

Functional Objects represent a group of processes within an element that contribute to the delivery of a particular ITS service. For instance, in order to implement the Infrastructure Based Traffic Surveillance service package, the ITS Roadway Equipment subsystem must include the Roadway Basic Surveillance functional object. In RAD-IT, think of these functional objects as building blocks to help you take into account all of the functions that an element of your inventory will need to support.

On right side the screen a list of "*Related Functional Objects*", only functional objects that can be associated with the element based on its physical object mapping, are shown. The list of functional objects is sorted alphabetically with the areas that have already been selected at the top. The check boxes allow the user to include/exclude the functional objects with the element. The choices only affect the currently selected architecture.
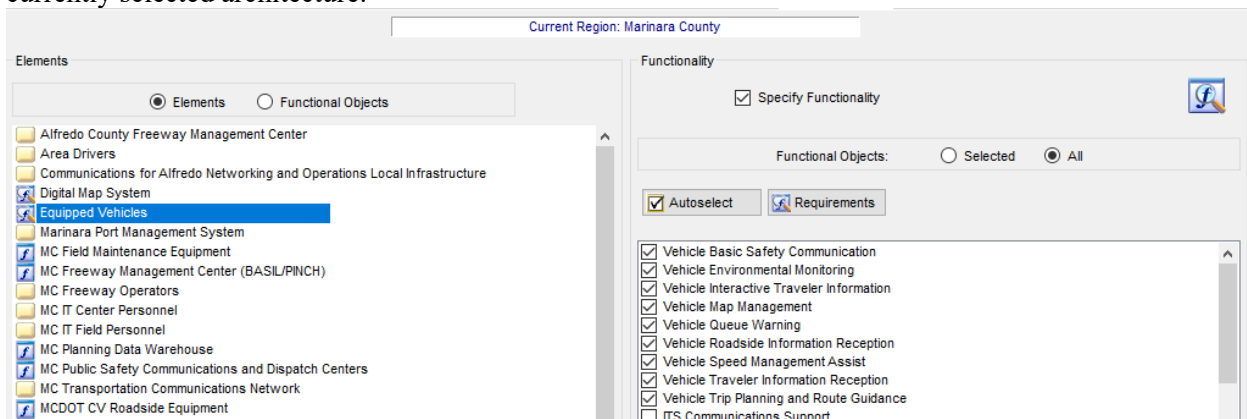


Highlighting one of the functional objects will show a brief description of what is included in that area, the mapping of that element to ARC-IT, and the type - "ARC-IT", or "User Defined". These fields may not be edited.

## Autoselect Functionality

The "**Autoselect**" button will cause another window to appear that selects the functional objects and/or requirements to be included for each element based on the service package mapping. Options on the Autoselect window allow you to either run the Autoselect for the current element or for the entire architecture. You can also decide whether to add and/or remove functional objects. You can also decide whether to add and/or remove requirements that are based on the User Needs.
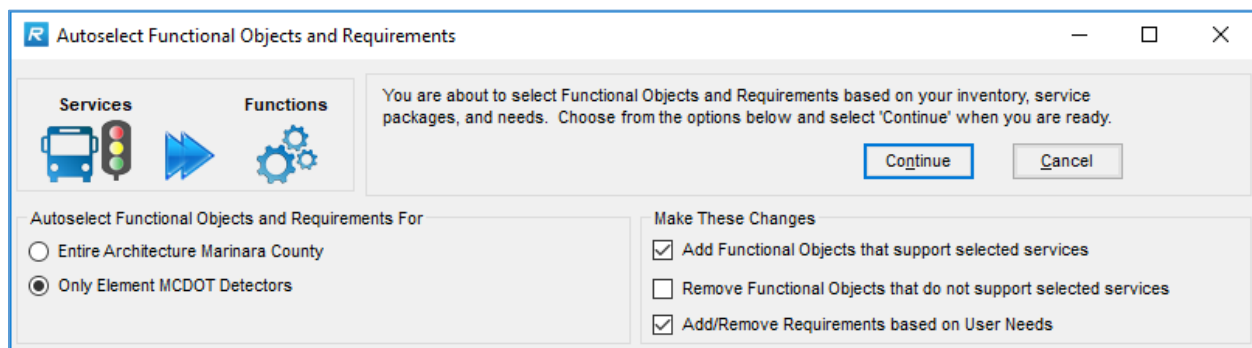
Selecting "Continue" will bring up the Autoselect results showing all of the recommended changes to your functional objects and gives you the chance decide whether or not RAD-IT should reflect the changes on the Functions tab.

> **NOTE:** Autoselect on the Functions tab will not automatically assign functional objects to a related element that is an element from a related architecture or adjacent region. You can still map functional objects to that element manually.

Selecting "Continue" will first bring up the Autoselect results showing all of the recommended changes to your functional objects (Add or Remove) and gives you the chance decide whether or not RAD-IT should reflect the changes on the Functions tab.

| Change | Element | Functional Object |
|---|---|---|
| Add | Equipped Vehicles | Vehicle Speed Management Assist |
| Add | Equipped Vehicles | Vehicle Environmental Monitoring |
| Add | Equipped Vehicles | Vehicle Basic Safety Communication |
| Add | Equipped Vehicles | Vehicle Queue Warning |
| Add | Equipped Vehicles | Vehicle Interactive Traveler Information |
| Add | Equipped Vehicles | Vehicle Map Management |
| Add | Equipped Vehicles | ITS Management Support |
| Add | Equipped Vehicles | ITS Security Support |
| Remove | Equipped Vehicles | Vehicle Platoon Operations |
| Remove | Equipped Vehicles | Vehicle System Monitoring and Diagnostics |
| Remove | Equipped Vehicles | Vehicle Data Subscription Management |

Saying No will effectively end the process. Saying Yes will take you to the next stage, Requirements.
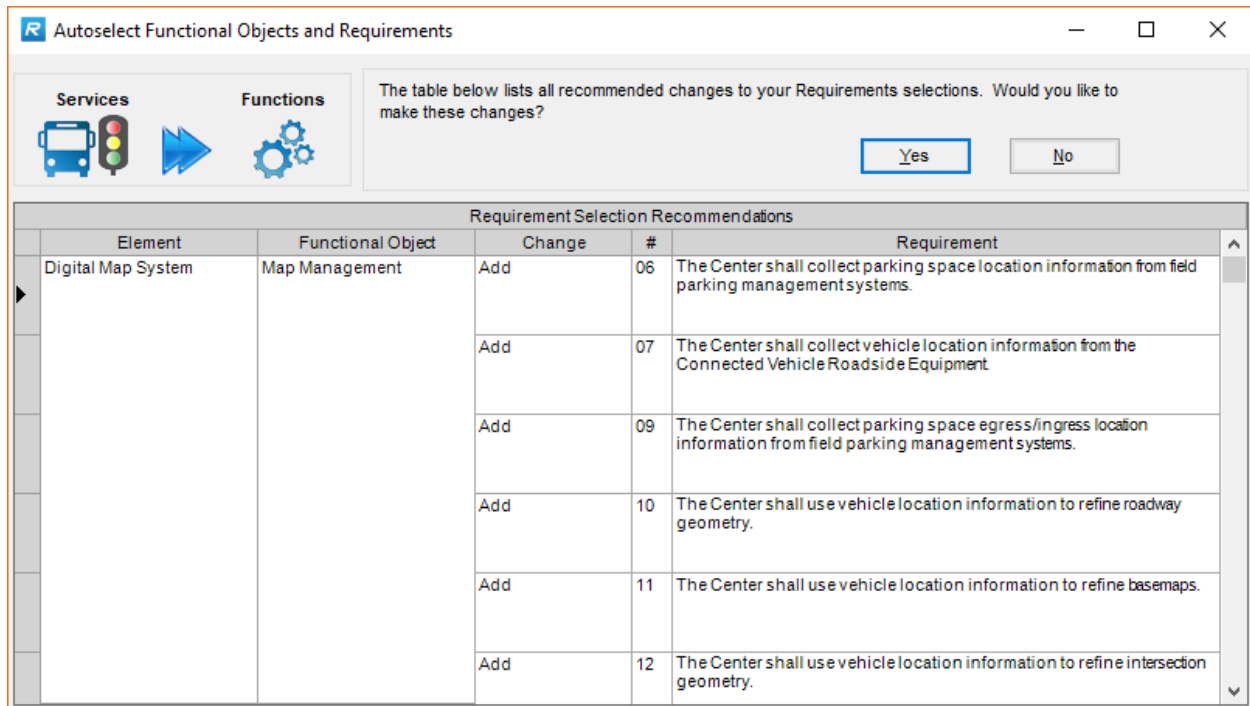


More about the Requirements below but the Autoselect screen here preselects the functional requirements to be added to the architecture based on the Needs and the functional objects in the architecture that are supporting the selected set of Service Packages.


## Functions Tab – Functional Objects View

From within the "Functions" Tab window you can select the "Functional objects" button on the left side of the screen and get an indented list of functional objects for each Physical Object in your architecture. Only functional objects that make sense based on your inventory to Physical Object mapping in the architecture are shown; e.g. if an architecture doesn't have anything mapped to a Commercial Vehicle Administration Center (CVAC) then functional objects for CVAC won't be shown. As in the Elements view, the list of functional objects is architecture specific.

Icons show the functional objects that have been included in the architecture. Clicking on the Physical Object name will cause the list of functional objects underneath to expand or collapse. Highlighting one of the functional objects will bring up the description, architecture mapping, and element mapping on the right side of the screen.
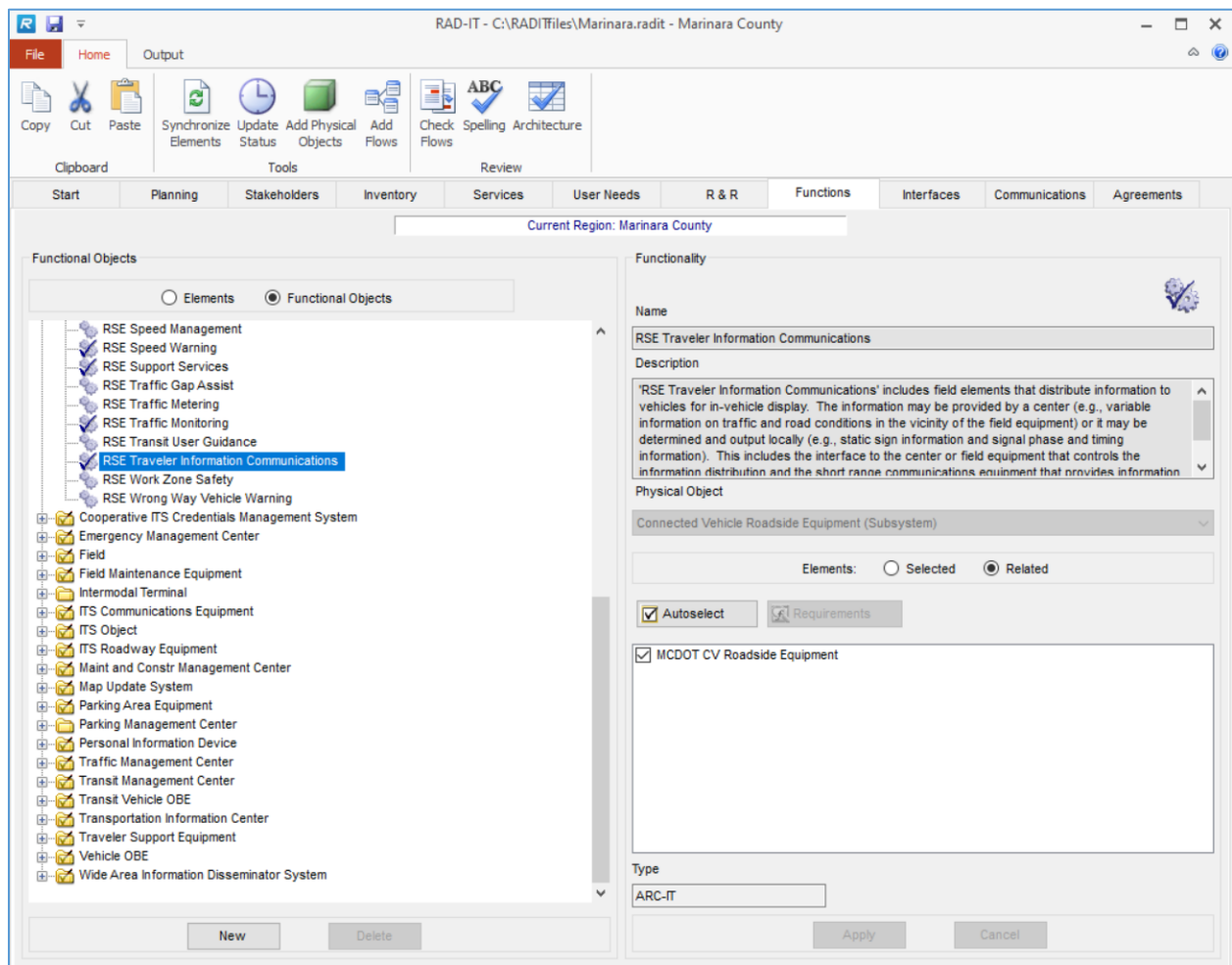
In the "Functional Objects" mode, you can click on "New" at the bottom of the screen to create your own functional object. Then you can write a description and map it to a Physical Object. You can also "Delete" the user defined functional objects.

You can add a user defined functional object to one of ARC-IT's terminators – physical objects that do not have functionality in ITS.  This may be important to your region if you are expanding the scope of your ITS architecture to include the capabilities that lie in something like a DMV or Enforcement Center, currently outside the scope of ITS. Behind the scenes RAD-IT will effectively turn it into a subsystem for the purposes of mapping other functions within your region/project architecture.

The Related Elements shows only those functional objects that can be associated with the element based on the Physical Object mapping.

The Autoselect button on this Functional Object view works the same as it does from the Elements view - It brings up a window to direct RAD-IT to automatically select functional objects based on the service package mapping and requirements based on the User Needs either for the element in question or for the entire architecture.

## Requirements Details Form

From either the "Elements" View or the "Functional Objects" view of the Functions tab, clicking the "**Requirements**" button will bring up the "Functional Requirements Selection" screen shown in the figure below.





*RAD-IT Requirements Overview*

These functional requirements have been developed for each functional object in the National ITS Architecture (ARC-IT) to capture the main functions and interface support that is defined in the process

specifications and data flow definitions of the national ITS reference architecture. These requirements provide a good start for the generation of functional requirements for Regional and Project ITS Architectures.

The user interface allows the user to create their own requirements or to customize the wording of the provided requirements to suit their own needs. The user may utilize a single requirement for more than one element. The user may assign user-defined requirements to ARC-IT functional objects as well as user defined functional objects.

An inventory element may be designated to have no defined functional requirements. For example, functional requirements would typically not be specified for elements at the boundary of the Regional Architecture (e.g., National Weather Service or an adjacent state's TMC) per the guidance document process. This type of element can be distinguished in the output diagrams from elements having defined functional requirements.

## Notes about the Requirements Window

The top left of the requirements window shows the **element** in question. The user can use the pull-down to select from any element in the architecture that has been assigned functional objects (which causes the table to be regenerated for that element).

The other pull-down at the top of the screen displays the **functional object**. The user can use the pull-down to select from any functional object that has been assigned to the current element. The user can also select "All" which causes all functional objects and their requirements to be displayed with an additional column in the table for the functional objects.

The "**Limit**", "**Details**", "**Sort**", and "**Present**" buttons work just as they do on the Interfaces tab.

The "Needs" button is to manage the mapping between the User Needs and the functional requirements. *This is a future capability.*

The columns in the table are described as follows:

- Functional Object:  Only visible when the pull-down is set to "All". This is a read-only column.

- Number:  Unique number for each requirement within a functional area. Read only but see the "Tailor" button below.

- Requirement:  Text of the requirement. Read only but can be tailored (see below).

- Status:  Pull-down menu similar to the Interfaces tab. Default status is automatically selected when the user clicks on "Include".

- In Region: When viewing a project architecture this indicates whether this requirement is being used by the regional architecture in the same file.

- Include:  Check box to include the requirement, similar to the Interfaces tab.

- User Defined:  Indicates whether the requirement has been created or modified by the user (i.e., user-defined). Not directly editable.

Click the **Details** button to pop up a screen just for that one highlighted row to see the text of the requirement, its functional object, any comments made about it, and how it traces back to the user needs.

If no requirements have been selected or defined yet for an element then the Details button will be greyed out.



Back on the Requirements window, the "**New**" button at the bottom allows the user to create a custom (user defined) requirement. Also, if the user selects the "**Tailor**" button when an ARC-IT requirement is selected, RAD-IT makes a copy of the requirement for tailoring, and the "Type" becomes "User Defined". "**Delete**" is only available when a tailored, user-defined, requirement is selected. The user is warned before the requirement is deleted.

Tailoring or creating a new requirement will bring up another window in which the user can edit the requirement text.



In the "Tailored Functional Requirement" window, the requirement number is automatically selected by RAD-IT to be the next number in sequence. The user can change this, but the number must be unique.

The "Functional Object" is also preselected by RAD-IT based on where the user was in the "Requirements" window. The user may change this to any other functional object that is associated with the element.

The "Requirement" text can be anything that the user types. The "Regional ITS Architecture Guidance Document" and the Architecture Use section of the http://www.arc-it.net/ website has some tips on how to write good functional requirements for ITS architectures. Feel free to make use of the "Tailoring" option to edit the default requirements to make them match your needs – take out the phrases that will not apply to your situation, modify the text so that your stakeholders can better understand some of the terms.

The "Applies To" choices allow the user to decide whether this tailored requirement will show up on the lists for other elements. This allows the user to reuse general requirements without cluttering up lists with specific requirements that only apply to a single element.

The Needs area of the Tailored Functional Requirement window is for reviewing and editing the mapping of the requirement to the user needs that were defined and edited on the User Needs tab. The Needs listed are the needs for the functional object(s) to which the element is mapped that support a set of services on

the service packages tab. Here you can Included or Exclude a mapping between a Need and a Requirement. There is a Review Your Architecture table that you can generate to make sure all User Needs are covered by at least one requirement and that all Requirements are mapped to at least one User Need.

The user hits the "Apply" or "Cancel" button when they are done and ready to go back to the "Requirements" window.

> **NOTE:** RAD-IT will display a message to the right of the screen when tailoring the text of an ARC-IT requirement to indicate that it has created a copy of the ARC-IT requirement that you can tailor and include in your architecture.

# Interfaces Tab

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 9th tab – the Interface tab.

## Interfaces Tab General Information

The Interfaces tab allows the user to define the interfaces between the transportation system elements in the region or project. The two major controls on this tab are:
  (1)   The *toolbar*, which runs across the top of the tab and includes tools that can be used to control the interface information that is displayed on the tab, and
  (2)   The *interfaces table* that makes up the bulk of the tab and allows the user to review and edit transportation system interfaces for the region or project.

These two basic features, along with the command buttons at the bottom of the tab, are all the tools that are required to define interfaces for the region or project.

The figure below shows the tab when it is first opened, before any interfaces have been added for the region or project. The various views and customization options are described later in this section.
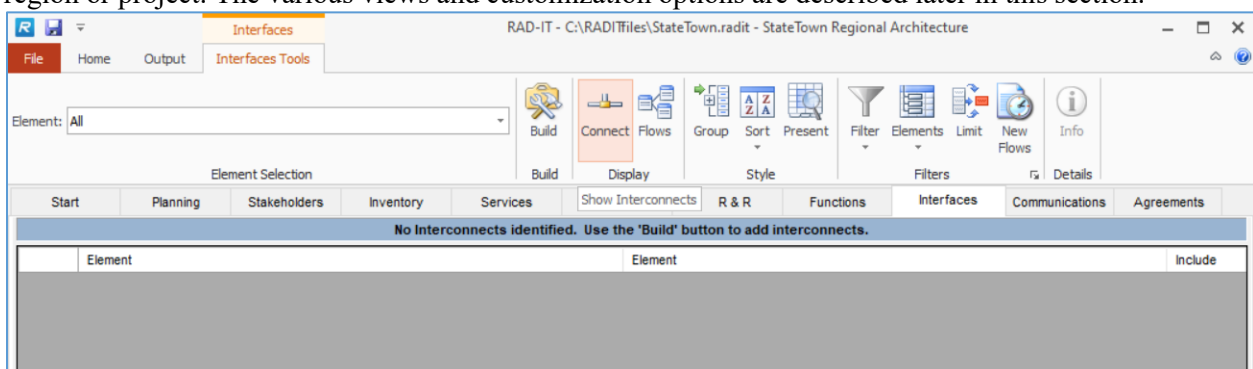


**NOTE:**  ARC-IT includes physical objects, service packages and flows from regions outside the United States, such as Australia, Canada, and the European Union. When building the interfaces RAD-IT will only include flows based on the regions selected on the Options / General menu.
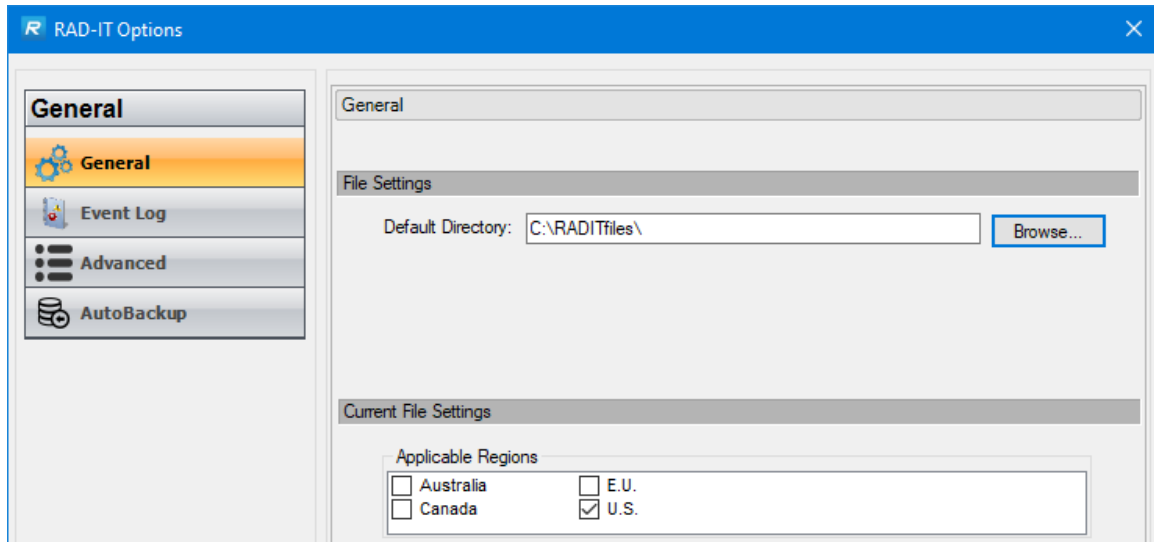
## Uncustomized Architecture

### Adding Interfaces (Building the Architecture)

When the user first enters the Interfaces tab, no rows will be displayed in the interfaces table. *A "build" must be performed to add interfaces to the tab.* The "Build" button (the leftmost button on the toolbar) initiates the build function.

The user may build the architecture if the architecture includes, at a minimum, a set of Inventory elements and Services.

The "Architecture" that is created by the "Build" function is a set of source elements, destination elements, and the information flows between them. The tool contains logic to create an initial set of interconnections and corresponding information flows based on the service packages selected on the Services tab and their assignment to elements from the Inventory. In all cases, the set of interconnections and information flows that this logic selects will need to be reviewed and customized by the user. The "Build" logic in RAD-IT is fairly inclusive. After all, the idea of creating an architecture is to identify opportunities for integration. This step is necessary in order to populate the database with the initial selections prior to actual customization. The step of building an uncustomized architecture is described in more detail in the following sections.

GUIDELINE:  The user should repeat the "Build" step whenever additions are made to the inventory or changes are made to the service package selections after the initial architecture build. Subsequent architecture builds will make additional flows available for customization on the Interfaces tab.

GUIDELINE:  If a "Build" is done after some customization has taken place, the customization is not undone by the new "Build". In order to remove undesired interconnects or flows (for example, if a service package has been removed), the user must uncheck the "Include" box for each interconnect or flow on the Interfaces tab.

## *How to Build an Uncustomized Architecture*

To build the architecture:

1. Select the "Build" button at the top of the Interfaces tab.
2. Click "Yes" or "No" to view a report comparing the Inventory and Service Package selections before building the architecture (this output table is also available on the list of standard RAD-IT tables on the "Output" pulldown menu, even before a "Build" is done). Generating this table may take **several minutes** for a large architecture. The "Build Settings" option also allows you to compare the number of flows that will be added to the Interfaces tab for selection and/or actually added to the architecture using the various settings, before committing them to the architecture.
3. If the output table was generated in the preceding step, click "Exit", or the "x" in the upper right-hand corner of the window, to close the Excel file. Back in RAD-IT you will be asked if you would like to continue with the "Update to the Interfaces tab", i.e., the "Build". Click "Yes" or "No".
   a. When the table is displayed, if nothing new has been added to the architecture in the "Inventory" or Services tabs, then the "Build" operation will not display any new flows to be added to the architecture. However, if a user defined flow or new element (or new service package association) has been created, and no other changes or additions have been made, the "Build" will pick up this (these) flow(s).
   b. The first time that a "Build" is done the entire architecture will be listed in this table.
   c. Making a change and running "Build" again to build the architecture will only display a shorter list of flows and interfaces in the table for the additions made to the architecture. **NOTE** again that no flows will be deleted from the architecture, and customized flows will not be touched.
4. The table on the "Build Interfaces" screen is now populated with source element, information flow, destination element, and status columns. The first column states what the suggested *action* will be when the user selects the "Yes" button to build the architecture. The possible actions are "Add to Architecture" or "Add to Interfaces Tab". These actions are described later in this section.
5. This "preview and accept" step on the "Build Interfaces" screen is important since an architecture build can add thousands of flows to the user's database with the push of a button. There are ways to minimize the number of flows that are actually generated by the "Build" step. By reviewing this screen, the user may identify major problems during the preview and abort the architecture "Build".
6. Click the "Yes" button to actually add the flows to the Interfaces tab and/or the architecture, or "No" to cancel the uncustomized architecture generation. If you are testing how many flows will be selected with each "Build Setting", you may wish to build with each setting, then select "No" to not save the changes till you are ready, and have decided which "Build Setting" will work best.

In the simplest scenario, the user completes the Inventory and Service Package choices and then invokes the "Build" for the first time. The tool also supports more complex scenarios in which the "Build" is invoked more than once for the same architecture. This is necessary, for instance, when new items are added to the inventory after an architecture has already been built and customized. The user will have to invoke the "Build" step again to make the flows that connect the new Inventory items available on the Interfaces tab. The "Build" logic is careful not to impact or modify areas that the user has already customized when subsequent architecture builds are performed.

## When to Generate Your Architecture

The Build command may be used as soon as you have defined at least two elements that should be interfaced, but you may want to spend the time to define more of your inventory and identify the ITS services to be included in the architecture before doing your first build.

After the initial "Build, if you have made no changes in the "Inventory" or "Services" tabs, zero rows will be generated by a subsequent "Build". You should view (and perhaps modify) the "Inventory" and "Services" tabs before entering the "Interfaces" tab to build or customize the architecture. If a user defined flow is created, and no other changes or additions have been made, the "Build" step will pick up this flow.

Although it wouldn't hurt to generate an uncustomized architecture for every architecture in a file, it is not absolutely necessary. For instance, consider the case where there is an existing Regional Architecture and you want to build a Project Architecture that is a subset of the Regional Architecture. You could go directly into the "Interfaces" tab (with the Project Architecture selected), and begin to manually select the interconnects and flows for the project. (The only minimum requirement is that in the Regional Architecture, you have identified at least the element(s) and services that are associated with the project. This information is used to determine the set of flows that might apply to the project on the "Interfaces" tab.)

If you chose instead to assign one or more service packages to the project, and then do an architecture build, a preliminary set of flows would already be selected for the project. If the RAD-IT Architect has tailored the Project Architecture on the "Interfaces" tab, a "Build" in the Regional Architecture will not regain consistency between the Regional and Project Architectures. The Project must be merged into the Regional Architecture again to regain consistency.

## Initial View of the Build Step
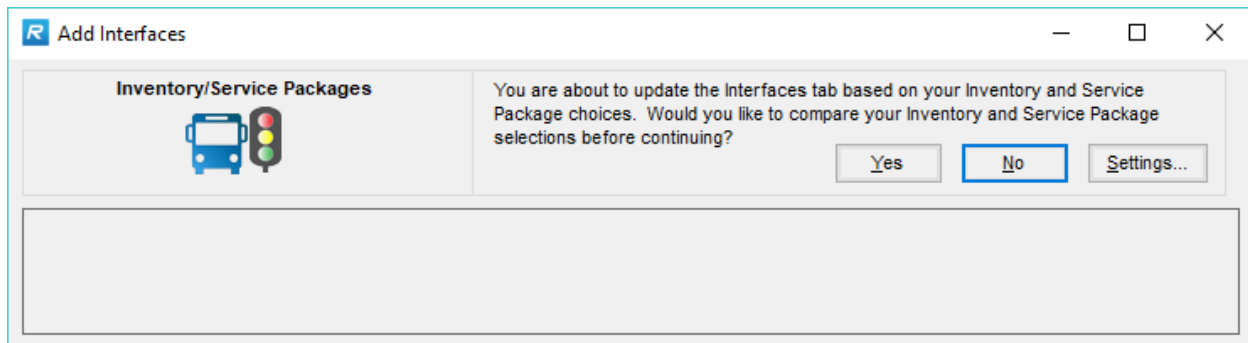


In the "Build" option on the Interfaces tab, the user steps through the process of generating, reviewing, and approving, an uncustomized architecture. You will notice that the "Build" step is a little different from the other tabs and windows since it does not allow the user to do any data entry.
When the "Build" option is first selected, the tab is blank and the user is presented with the Add Interfaces window and a couple of options. First, he may select a setting level, discussed in the next section. Next, the RAD-IT architect should select the option to review the reconciliation report that crosschecks the Inventory and Service Package selections (the title of the report is "Inventory to Service Package Comparison"). This explicit recommendation is made because it is easier to fix Inventory and Service Package selection problems before an uncustomized architecture is generated. If the user selects "Yes", the reconciliation report is displayed. If he selects "No", the report is not displayed and the architecture may be built next.

The Inventory to Service Package Comparison report opens in a separate Microsoft Word window. It will highlight several issues:

- The element does not participate in any Service Package
- No element is defined for the Physical Object(s)
- The element is not selected in the Service Package

You can use the results of this report to decide to go back to the Inventory tab and add elements for certain physical objects or go back to the Service Package tab and add elements to the service package. You can also review the report and decide that your architecture is the way you want it and can continue with Build process.

## *"Build" Settings*

The Build Settings window is displayed when the user chooses the "Settings…" button on the Add Interfaces window. It contains two slider bars to select from different settings that govern how many interfaces should be included on the Interfaces tab and how many RAD-IT should go ahead and select as being included in the current architecture. Those settings will be described next. There is also an "Override" option that will also be explained. Together these choices control the number of flows selected by the "Build" algorithm, thus allowing the user to control the type of "Build" that is performed.



The settings for the first slider, Include on the Interfaces Tab, control how many flows to include on the Interfaces tab and, going from left to right, include the following:

- **Only Selected Flows**, where flows will only show up on the tab if they have been selected to be included (given a status of something other than Not Applicable) in the current architecture. All unselected flows will be removed from the display. This is useful to present as clean an Interfaces tab as possible - just show me what I have. On large regional architectures this may help sort out exactly what you are starting with and can then edit out what you don't need.
- **Related Flows**, where all the flows that are somehow associated with the selected service packages will be shown on the interfaces tab. This may result in some extra Not Applicable flows

being displayed which presents some additional options to consider. The clutter is minimized in that these extra flows are at least traceable to a service you have already selected.

- **All Possible Flows**, where the most information flows will be added to the tab - this goes to ARC-IT and pulls out any and all flows that go to or from your elements based on how they are mapped to ARC-IT Physical Objects. This may be useful for smaller architectures where you aren't exactly sure what services you need and just what to see all the possibilities. This is not recommended for a large inventory as it could reach into the tens of thousands of possible flows.

The next slider bar, Flow Selection, governs what flows to actually select to be including in your architecture and has the following settings:

- **Conservative**, where fewer information flows will be selected for the architecture and the Interfaces tab. This setting adds flows to the list on the Interfaces tab if they are included in a service package in the current architecture, but they are not actually included in the architecture, i.e. the status is "not applicable". If this setting is selected, the "Override Previous Builds" option is unavailable.
- **Moderate**, where a medium number of information flows will be selected for the architecture and the Interfaces tab. This selects a flow if BOTH the source and destination elements are mapped to a service package that includes the flow. The differences between "Moderate" and "Aggressive" are not always easy to see, depending on how extensive the service package to element mapping is.
- **Aggressive**, where the most information flows will be selected for the architecture and the Interfaces tab. This selects a flow if EITHER the source OR destination element is mapped to a service package that includes the flow.

Do a "Conservative Build" after an "Import", where the project has been customized and flows deleted. The user would not want to see these deleted flows re-introduced after "Import", which is possible with an "Aggressive Build" on the imported architecture. The "Conservative" or "Moderate Build" can be used after the initial "Build", when an "Aggressive Build" would add too many flows to the semi-customized architecture.

The RAD-IT build algorithm at the moderate or aggressive build setting automatically includes information flows in the current architecture only if the flows are included in a selected service package and the flows connect elements that are included in the same **service package instance**.

The "**Override Previous Builds**" check box is only for *regional* architectures - it will be grayed-out for *project* architectures. If this option is turned **off**, then an Aggressive or Moderate build performed after a Conservative build will ONLY add in the flows associated with the new element or service package and not add in all flows ignored by the initial Conservative build. The "off" setting will also not change flows already on the Interfaces tab. This is the DEFAULT. If the "Override" option is turned **on**, then ALL corresponding flows for all elements and service packages will be added by a Moderate or Aggressive build. In addition, the "on" setting may change flows already on the Interfaces tab from "not applicable" to another status value).

> **NOTE** that the "Override" option WILL NOT override the settings of any flows that have been manually tailored.

For example, if you do a Conservative build, add no new elements or service package associations, then perform an:

- Aggressive build without "Override" - Nothing new will be selected by default.

- Aggressive build with "Override" - New flows will be selected for inclusion as if the Conservative build was never performed. New flows added for an unselected interconnect will be "Not Applicable".

**NOTE** that user tailoring is NEVER overridden by the "Build", regardless of the option selected. Subsequent more aggressive builds will only affect changes on the Interfaces tab that are associated with new inventory, service package choices, and user defined extensions. Every flow associated with an interconnect is marked by the software when the interconnect is deselected. This prevents interconnects from being added back in when a more Aggressive build is done after interconnects are tailored.

The "Build Settings" window also includes "OK", "Cancel", and "Apply" options. While changes are pending on the Build Settings tab, the "Yes" and "No" commands on the "Add Interfaces" window are disabled so that builds cannot be initiated until a settings change is applied or canceled. The header on the preview window will indicate the "Build Setting" as a reminder, e.g. "Chicago Architecture Aggressive Build Results - 132 Flows Added".

To help the user be consistent with their "Build" strategy, the "last build setting" in the RAD-IT Database will be saved and will be used the next time the user does a "Build". **NOTE** that this approach means that the "default" build strategy can change when the user opens a different RAD-IT database. The settings should always be reviewed before starting a "Build".

## *Completing the Build Process*

Once the "Recommended Interface Updates" build screen is populated with flows, the uncustomized architecture "Build" preview step is complete. All changes that will be made to the "Interfaces" tab or added to the architecture are presented. You may want to cancel out of the "Build" process by selecting "No" if you see something you do not like (e.g., RAD-IT wants to add in 10,000 new flows because too many service packages and/or element to subsystem associations have been identified).

## *Stakeholder Bound Interfaces*

The "Build" process takes the stakeholder assignments for elements into account to minimize some of the combinations of interfaces selected. If the State DOT owns TMC-A and some A-Devices in the field and the City owns TMC-B and some B-Devices in the field then the Build process will identify all of the possible combinations of flows but it will only recommend including the flows between TMC-A to the A-Devices and between the TMC-B and the B-Devices.

Note that in order for RAD-IT to take stakeholders into account you must make sure stakeholders are, in fact, assigned to those elements. Otherwise, RAD-IT will treat a null stakeholder like a wildcard and it may still try to connect that element with other elements you don't want.

## *Build Results Screen*

On the final "Build" window, the flows are presented in two groups:

1. Those flows that RAD-IT thinks are the best fit for the architecture. These flows will be included in the uncustomized architecture if you select "Yes" to complete the "Build" step. The status of these flows will be either "existing" or "planned" or a local status value.
2. Other valid information flows that you may also want to consider. The second category of flows will be made available on the "Interfaces" tab, but will not be included in the architecture that is

built by the "Build" step by default. These flows initially appear as "Not Applicable" on the "Interfaces" tab. You can change the status of these flows from "Not Applicable" to "Existing" or "Planned" (or a local status value) on the "Interfaces" tab, and the "Include" box may be checked (to include a flow in the current Project or Regional Architecture) and added to the architecture there.

3. A third group of "Remove from the Interfaces Tab" may be shown if Only Selected Flows was chosen on the upper slider bar or if there were invalid flows in the existing file. This may happen with an older file or whenever mappings have changed for an element to physical objects or service packages. Every build does a complete validity check on all information flow triples on the Interfaces tab, regardless of the architecture that is being built.

If you select "Yes" to complete the "Build" step, the flows are loaded into the "Interfaces" tab and a message is displayed directing you to the "Interfaces" tab to do architecture tailoring. If you select "No", the "Add Interfaces" window exits and the "Interfaces" tab is again visible. No new flows or interconnects have been added to the architecture or to the "Interfaces" tab.

## Customized Architecture

### Customizing the Architecture

The "Interfaces" tab allows you to make information flow by information flow (or interconnect by interconnect) changes to Regional and Project Architectures. In the typical scenario, this is where you would go after building the architecture via the "Build" button on the "Interfaces" tab. At this point, after generating an element inventory and making service package selections, you should obtain stakeholder input into the process and determine the interconnects and flows that should be selected or deselected on the "Interfaces" tab.

### Introduction to Customizing Your Architecture

Once the uncustomized architecture has been created, the next step in the creation of an architecture is to customize it. By this we mean adding or deleting source element / information flow / destination element "triplets" from the architecture. This step is done on the "Interfaces" tab. This tab allows you to view your architecture either as a set of interconnects (a list of the elements that interface with each other) or as a set of information flows (exactly what information is exchanged between two elements). For a large architecture it is usually easier to begin your customization by looking at the interconnects and deciding which ones belong and which do not. For this reason, the default view shown when you first enter the "Interfaces" tab for an architecture is the Interconnect, or "Connect", view. Within the same RAD-IT session, however, if the view is changed to the "Flows" view, then this will be the default view if another architecture or file is opened. Customization may involve changes beyond the "Interfaces" tab. It may also mean adding, modifying, or deleting elements or information flow definitions themselves. For example, you may want to add an information flow (which is not currently defined) between element A and element B. This is done via the "Tools" pulldown (to create user defined physical objects and flows) on the menubar.

When defining a Project Architecture from an existing Regional Architecture, regional flows may be selected or deselected for the project. A comment can be entered on the "Interfaces" tab using the "Info" button concerning the reason for selecting or deselecting certain flows.

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Input to customization includes the initial element and stakeholder inventory in terms of ARC-IT physical objects (subsystems and terminators) and user defined physical objects, as well as, ARC-IT service packages related to the initial projects and services. From the "Build" step, the source element, information flow, and destination element are included on the "Interfaces" tab as described below. The tool indirectly allows you to modify the subsystems, terminators, and information flows for the region or project based on the initial subsystem, terminator, and service package characterizations by selecting or deselecting a flow.

The "Interfaces" tab includes two views: "Connect" (showing the interconnections between elements) and architecture "Flows". Initially, the window will be displayed in "Connect" mode by default. You may move from interconnect to flow or from flow to interconnect views during the customization process.

GUIDELINE: Once the user enters the Interfaces tab and begins to customize the architecture, he may return to the Inventory or Services tabs to change element/stakeholder mappings and service package selections. Note again that a new "Build" will only add new interconnects and flows from the selections made on these tabs.

## Interfaces Tab Display Options

On the "Interfaces" tab window, the toolbar at the top allows you to control what is displayed in the main table on the form. You select and deselect flows in the table using check boxes at the far right or by using a pulldown menu that allows changing the status of each row between "existing", "planned", "not applicable", and local status values. Working from left to right across the toolbar, the following options are available:

- Element Selection box
- Build Option - see previous section on building the uncustomized architecture
- "Connect" and "Flows" Display buttons
- Style Options: Group, Sort, Present buttons
- Filters Options: Filter, Elements, Limit, and New Flows buttons
- Information Details Option

## Element Selection Combo Box

This pull-down acts like a filter for the grid. You can either view all elements or view the interconnects and flows for a single element using this selection box.

## Flows and Connects Buttons

These buttons allow you to switch between the "Connect" (interconnects) and information "Flows" views. In interconnect view, no information flow information is provided and each check box in the table adds or deletes an entire interconnect (including ALL its flows) for the current architecture. You cannot switch between these two views when changes are pending (changes have been made to the table, but "Apply" or "Cancel" have not been selected). Pending changes must either be applied or canceled. Then, all options and rows are again available.

## Group Option

This is a toggle that lets you view the displayed list with only one element name listed when an element is used multiple times and sorted alphabetically. The "Group" button combines adjacent cells that have the

same values in the source and destination columns which simplifies the display, but makes no other changes (e.g., the number of rows in the table stays the same.)

## Sort Option

This option allows the user to select the order in which the columns will be sorted.

Sort Options available on Connects View:
- Include, Elements
- Elements, Include
- Column Sort

Sort Options available on Flows View:
- Include, Source, Destination
- Source, Destination, Flow Name
- Flow Name, Source, Destination
- Destination, Source, Flow Name
- Interconnect Sort
- Column Sort

It may be used to see all instances of a flow, or to list common or similar information flows. When the user has selected a single element from the pulldown list at the top left of the window, there is an additional sort option for "**Interconnect**" sort. This option will sort all flows for an individual interconnect. For example, flows for Element A to Element B will immediately be followed by flows for Element B to Element A. In addition, the user may use **"Column Sort"** to control sorting and sort based on any of the columns displayed. After the user defined sort is applied, the remaining columns are sorted in the order they are displayed, from left to right.

## Present Option

This toggle option enables the "Interfaces" tab to be more visible to group presentations, such as during a training class or stakeholder Workshop. This option could also be used to illustrate to the stakeholders the customization that has been done, or is planned, for a region, or to tailor interconnects in front of a group. The "Present" option increases the visible font size by 50%.

## Filter Option

This option allows you to display the list of interconnects or information flows using the same filters selected on the "Output => Filtering" menubar pulldown menu. This option enables the output filters so that flows that would be filtered from the diagrams and output tables are filtered in this table. This allows you to ignore human interfaces, for instance. Right-click the "Filter" option to display the filter settings window.

## Elements Option

This option allows you to control the display of interconnects or information flows using the same Element selections on the "Output => Filtering" menubar pulldown menu.
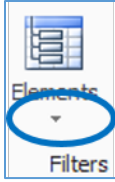
Click the little arrowhead under the icon to bring up the element selection window.

This option limits the displayed list of information flows to only the elements listed on the "Element Selection" window. This includes the "Project Elements" and "Show All" options on that window. To control the number of elements displayed on the diagrams, set the **element selection** for a diagram/list of interfaces.



The elements and their interconnections that appear on the "Interconnect" and "Flow" views of the Interfaces tab may be customized in the following manner:
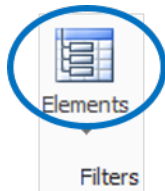
1. To see all elements and all connections between them in the entire architecture, make sure all element boxes are checked on the "Element Selection" window. The "**Select All**" option on this window may be used to easily select all elements. Select "OK" when finished then click the main part of the Elements button itself on the Interfaces tab to see the results.

2. To see only the connections between selected elements, bring up the "Element Selection" window again (click the arrowhead under the Elements button) then make the appropriate element choices. If many elements need to be removed from the list, the "**Clear All**" option is available. Then select the required elements. Select "OK" when finished then click the main part of the Elements button itself on the Interfaces tab to see the results. For instance, using the StateTown example, to produce a diagram showing just the flows that go between the TMC and the Transit Dispatch, then …
   a. Open the "Element Selection" window.
   b. Select "Clear All".
   c. Select "StateTown TMC" and "StateTown Transit Dispatch".
   d. Uncheck, if necessary, the "Show Communications Elements".
   e. Select OK.
3. To see *all* of the connections into or out of selected elements, bring up the "Element Selection" window again (click the arrowhead under the Elements button) then make the appropriate element choices. If many elements need to be removed from the list, the "**Clear All**" option is available. Then select the required elements. Select "OK" when finished then click the main part of the Elements button itself on the Interfaces tab to see the results. This is the equivalent of a Context Diagram you can generate from the outputs section. Using the StateTown example, to produce a diagram showing just the flows that go into or out of the TMC, then …
   f. Open the "Element Selection" window.
   g. Select "Clear All".
   h. Select "StateTown TMC".
   i. Check the "Show All Interfaces" box.
   j. Uncheck, if necessary, the "Show Communications Elements".
   k. Select OK.

**NOTE** about the Show All option: If you are only interested in viewing the connections between selected elements, turn off the "Show All" option. If "Show All" is selected, all flows associated with the selected elements are included, even if the flows begin or end at an element that is not selected. This option applies to reports, diagrams, and the Interfaces tab.

Examples of the "Show All" option:
   a. You select one element and "Show All". The interfaces tab and diagram will display all connections to and from this element. These are sometimes called "Context Diagrams" and can be very useful to show an individual stakeholder how their systems relate to the region. If you turn off "Show All", the tab will be blank. On the diagram generator, a popup appears saying that the diagram is blank – nothing is displayed.
   b. If you select two or more elements and "Show All", the diagram will display all connections between these elements *and* to and from these elements to other elements in the architecture. If you turn off "Show All", only the connections between the selected elements are displayed.

## Limit Option
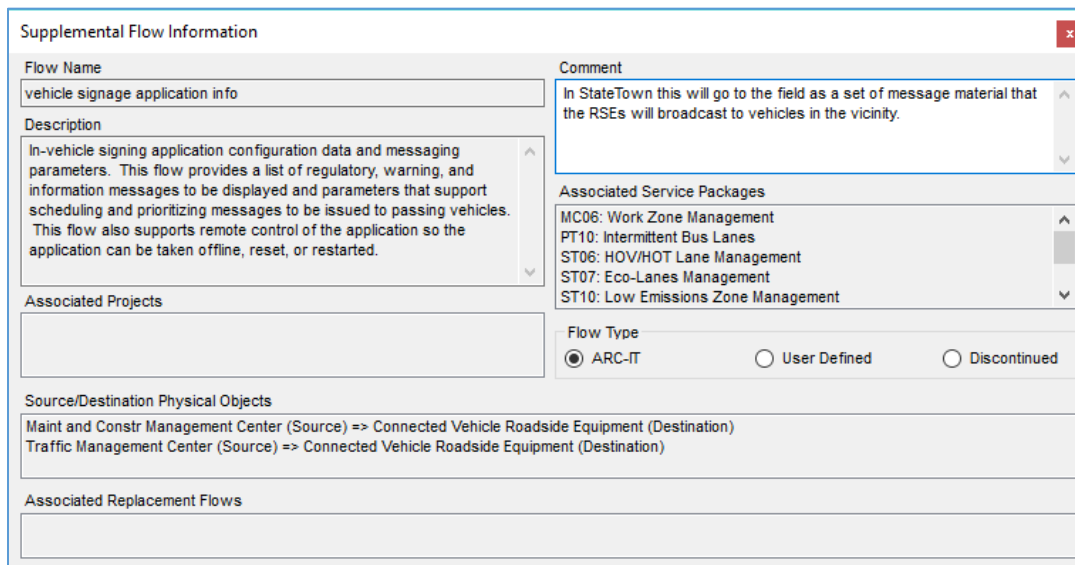
On the Interfaces Tab the *Limit* option acts like a filter to cut the displayed list of information flows to only the interconnections or flows that are present in the current architecture, i.e., the rows selected in the "Include" column. After initial customization, you can use this mode to avoid being bothered by other "valid" flows that do not apply to the architecture.

## New Option

This option lists all new interconnects and information flows that have been added to the architecture by the last "Build", or by the conversion process from a previous version of RAD-IT. The information on this screen may change based on new information - if a new "Build" has been done that added a few flows, then these flows will appear replacing the data from a previous "Build" or from converting this architecture. Previous data will then be available only on the main lists of interconnections and flows (with the "New" option turned off).

## Info Option

This option, available in the "Flows" view only, displays a form that gives you more information about the selected information flow. The only field that you may edit is the "Comment" field. The information flow name, description, associated projects, and whether this flow is in the ARC-IT, is a user defined Physical Object, or is a discontinued flow (based on the current version of ARC-IT) are also displayed on this window. You may add a comment about this flow, why it is planned or not, the flow's characteristics, or other pertinent information.



A project is listed in the "Associated Projects" field if the flow is found on the "Interfaces" tab for a project. When looking at the Regional Architecture, this field is also filled in for the projects that the flow is associated with. This has nothing to do with whether or not the source and destination elements are associated with the project.

## Interconnects View

The default "Connect" view (showing the interconnections between elements) includes all interconnections (source and destination elements) in the architecture that is currently being customized. The interconnections were generated during the "Build" step.

In addition to the data filters available on the "Output => Filtering" pulldown (these are also available on the "Interfaces" tab), you can select an element in the selection box in the upper left-hand corner of the window. This will limit the interconnects displayed to include only those associated with the selected element. The table illustrates element to element rather than source/destination ARC-IT Physical Objects associated with the element). The "Connect" view illustrates the elements in a directionless manner, unlike the "Flows" view, where direction is shown. You will notice that the header row in the "Interfaces" table is different between the two views of the architecture.

The "Connect" view omits the information flow column with a corresponding reduction in the number of rows displayed. Both views are closely related. Making a change to included flows in the "Flows" view will change the corresponding interconnect in the "Connect" view, if no other flows are involved in the interconnection between the two elements. The reverse is also true - deselecting an interconnect is reflected in the "Flows" view.

## Communications / DDS

The Communications column allows you to select the communications element that is assigned to the interconnect. This includes objects that have been created for your architecture that are of the Communications Physical Object type from ARC-IT that are specific to communications:

- ITS Communications Equipment
- Wide Area Information Disseminator System
- Roadside Communications Units (Field class)
- Remote Access Device (Human Interfaces to Centers or Support elements)

| Element | Element | Communications |
|---|---|---|
| MCDOT CV Roadside Equipment | MCDOT Detectors | Not Identified |
| MCDOT CV Roadside Equipment | MCDOT Dynamic Message Signs | Not Identified |
| MCDOT CV Roadside Equipment | MCDOT Environmental Sensors | Not Identified / Communications for Alfredo Networking and Operations Local Infrastructure |
| MCDOT CV Roadside Equipment | MCDOT Speed Monitoring | MC Connected Roadside Unit |
| MCDOT CV Roadside Equipment | MCDPW GARLIC Information System | MC Transportation Communications Network |

The DDS column allows you to select a Data Distribution System (DDS) element will act as a pass through for the information. DDS' collect, aggregate, and distribute or publish data to subscribed destinations. There are numerous technologies in the market for data distribution depending on the needs of the project.

**NOTE:** With the Communications and DDS columns you will notice that not every flow has a Comm or DDS option. This is because there are some rules that determine the eligibility of what can go through Communications equipment and what can go through a data distribution system. For instance, Roadside Communications Units are field class objects and as such are not eligible for center-to-center interfaces. Wide Area Information Disseminator System is for the *broadcast* of information over a wide area so information flows containing interactive data such as requests or time-sensitive controls cannot use a WAIDS. Remote Access Devices (RAD) are available for human interfaces between a human operator and a Center or Support class subsystem.

This may be an area that won't be known during the development of a regional architecture and that's OK. It can and will be decided during the project development.

## Selecting/Deselecting Interconnects

When you select or deselect an architecture interconnect or, optionally, select an associated communications element, and then hit "Apply" to save changes to the architecture, the architecture is updated in the following ways:

1. Regional Architecture:
   a. Select a new interconnect that was not part of the architecture: All valid information flows associated with that interconnect (in both directions) are selected as part of the architecture.
   b. Deselect an interconnect: All information flows associated with that interconnect (again, in both directions) are deselected.
   c. Deselect, then select an interconnect before clicking "Apply": No change is made to the underlying database. This preserves any information flow level tailoring that has already been done on the interconnect. **NOTE** that if you deselect an interconnect and click "Apply", and then select the same interconnect and click "Apply", any flow level tailoring will be lost and all flows for that interconnect will be selected.
2. Project Architecture:
   a. Select a new interconnect: If there are information flows on the interconnect that are part of the Regional Architecture, then only those flows are selected as part of the project. If there are not any Regional Information flows on the interconnect, all valid flows on the interconnect are selected as part of the project.
   b. Deselect an interconnect: All associated information flows are deleted from the project (analogous to Regional Architecture operation above).
   c. Deselect, then select an interconnect before clicking "Apply": No change is made to the underlying database.

## Selecting Part of an Interconnect

If in an architecture (either regional or project), you only want a portion of an interconnect to be selected, i.e., only certain flows from an interconnect are required in this architecture. Review the ARC-IT website for information on the flows associated with an interconnect (subsystem to subsystem or terminator).

*Correct* way to accomplish this:
   a. Enter the "Interfaces" tab, "Connect" button.
   b. Deselect the interconnect, since not all flows are required. This deselects ALL the flows associated with this interconnect.
   c. Click the "Flows" button.
   d. Select only the flows that are required in the architecture for this interconnect, and assign their status of "existing", "planned", or a local status value, if not already correct. By selecting a flow associated with an interconnect, the interconnect is again selected ("included") on the "Connect" screen.
   e. Do not go back and deselect or reselect the interconnect as this will deselect or reselect ALL flows associated with it.

*Wrong* way:
   a. Enter the "Interfaces" tab, "Flows" button.
   b. Deselect the flows not required for this interconnect. Leave the others as "existing", "planned", or a local status value.
   c. Click on the "Connect" button.

d.  Deselect the interconnect. This deselects ALL the flows associated with this interconnect, even the ones that had not yet been deselected. This is NOT what you intended.

e.  This may also occur if you deselect a flow, deselect the interconnect, then reselect the interconnect - ALL its flows are again selected. You need to be aware of this type of synchronization issue between interconnects and their associated information flows.

## Customize Flows

The Flows view for the Interfaces tab displays a table that illustrates the Regional and Project Architecture associations. As in the "Connect" (interconnects) view, in the box on the upper left-hand side of the screen a pulldown list of all the elements currently defined in the architecture is displayed. This is either the list of the project elements for the Project Architecture that is open, or all elements in the Regional Architecture. Select one element or the "ALL" option. A table is then created with all the information flows into (or out of) the element selected (or with all flows listed).

The Source Element, Information flow, Destination Element, In Region (for Project Architecture only), Status, and Include, will appear in the table.

> **NOTE:** that some flows may appear with an asterisk after the flow name. This indicates that these are discontinued flows from the conversion.

The default sort for these columns is set based on the following order:  Include, In Region, Source Element, Destination Element, Information flow, and lastly, Status. The sort order may be changed by selecting the "Sort" button at the top of the window.

When looking at a Regional Architecture, "Included" flows are either "Existing", "Planned", or a local status value. Conversely, "Not Included" flows are "Not Applicable". When looking at a Project Architecture, "Included" flows must also be either "Existing", "Planned", or a local status value. However, "Not Included" flows can be any state since the flows may be part of another architecture in the file. If the "Include" box is not checked, the status of this flow defaults to "Not Applicable".

The flow status on the Interfaces tab in the Regional or Project Architecture is set equal to the flow status that is displayed in the "Build" step (i.e., the "Build" option on the Interfaces tab). There is one EXCEPTION to this. The flow status in the architecture will not be changed if the flow already exists on the Interfaces tab, and the software determines that some customization work has already been done on the flow. This exception prevents user customizations from being lost during subsequent builds.

When the "Include" box is checked, the status is changed from "Not Applicable" to either:
- The default status if the status has never been manually changed for the current flow, or
- The last status selected in cases where the default status was overwritten before the flow was deselected.

In either case, click on the status field and change it. If you change it to "Not Applicable", the "Include" box is automatically deselected. The last actual deployment status is stored in the database for all flows. When a flow is selected, this last actual status is displayed on the Interfaces tab. This means that you can accidentally toggle the "Include" box on a flow without inadvertently changing the deployment status.

NOTE that the columns on the Interfaces tab may be moved or the column width stretched. For instance, you may wish to move the "Include" column next to the "Flow Name" column when trying to decide whether or not to deselect a flow.

**NOTE** that for a Project Architecture, additional flows that are not part of the project will be included on the "Flows" view of the Interfaces tab. These additional valid flows are included so that the user can select additional flows for the project. This may include flows associated with other projects (or the Regional Architecture) to present all valid flows, giving the broadest set of choices. The "Limit" filter is also available to selectively limit the Interfaces tab to the flows that are selected or "directly applicable" to the project.

GUIDELINE:  A project may apply to more than one service package or to parts of different service packages. This is accomplished in the customize "Flows" view of the Interfaces tab by selecting or deselecting information flows connected to this project and element.

# Communications Tab

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 10th tab – the Communications tab.

## Communications Tab General Information

ITS Standards address interfaces between ITS elements. When stakeholders have reached consensus on the interfaces (information flows) between each pair of elements in the Regional or Project ITS Architecture, then a set of standards can be identified for many of these flows. A report identifying ITS Standards supporting regional and national interoperability is a required component of the Regional ITS Architecture as identified in FHWA CFR 940.9(d)7 and FTA National ITS Architecture Policy Section 5.d.7. The "Regional ITS Architecture Guidance Document" includes recommendations on how to approach this topic as it pertains to a Regional Architecture.

ARC-IT maintains a mapping of information flows to ITS standards development activities. Refer to the Communications View pages of the ARC-IT website for the latest mapping between ARC-IT and the ITS communications standards. RAD-IT accesses this mapping information and makes it available for customization and tailored standards activity tables.

Not every region will use every applicable standard and often local "standards" will be identified where no national standard is yet available. To address these needs, you can now select the standards (tailor the list of standards) that actually will be used in the region so that the "Standards Activities" report will more accurately reflect the intent of the region and/or projects. Editing can be done for a region or project on a standard-by-standard or interface-by-interface basis. Also, you are able to add user-defined standards to the list and link the user-defined standards to information flows that will be included in the standards report.

GUIDELINE:  Get your architecture to the point where you already have a good understanding of your services and interfaces, i.e. customize the flows first. When you get to this point, gather the key stakeholders together to make ITS Standards choices that will apply to any architecture in the region.

## Communications Tab Entry

The "Communications" tab in RAD-IT provides the opportunity to decide which of the Communications Solutions and their Standards activities best applies to your situation.

Communications Solutions represent the newest addition to the regional architecture toolkit with version 9.0 of ARC-IT and the RAD-IT/SET-IT software suite. You may be wondering, "What's a Solution?" This is all based on the information that makes up the Communications View of ARC-IT.

According to the http://www.arc-it.net/ website:

> The Communications Viewpoint provides a framework for identifying the protocols necessary to implement an information flow between Physical Objects (as defined in the Physical View or in RAD-IT's case – on the Interfaces tab). These protocols need to meet interoperability, performance, functional, security, and environmental requirements, as well as address operational challenges and relevant policies (such as an assurance of pseudonymity for mandatory data provision).
>
> The Communications Viewpoint enables the project systems engineer to answer questions such as:
> - What is the set of communications protocols that provides a complete interface solution that meets mission needs?
> - Are there any issues with using a given protocol for a given triple? How serious are those issues?
> - If multiple protocols exist to satisfy an interface, how do we choose between them?
> - Are there gaps in data usage and definitions, communications functionality, security, or management?
> - What protocols address critical system-wide security issues, such as the provision for protection of data confidentiality, protection of message integrity, defense against in-transit manipulation?
> - What organizations are responsible for the maintenance of data, communications, security and management standards and specifications?

The result is a really detailed set of analysis organized into Communications Solutions that a project system engineer can use to know what standards to focus on for a given interface as well as what questions to ask and what other information will be needed to fill in the gaps.

The key word is "*Solution*" which is the combination of the Data *profile* and the Communications *profile* needed to fully define an interface. The data profile includes the ITS application information layer standards to define the data – data dictionary, message set, etc. The communications profile is what is needed to communicate at all the layers of the Open System Interconnect (OSI) model along with the management and security standards needed.

Once you have 'built' and customized (selected/deselected) the interfaces for your architecture on the Interfaces tab, click the Communications tab to see which communications solutions and the standards they include are associated with the interfaces in your architecture.
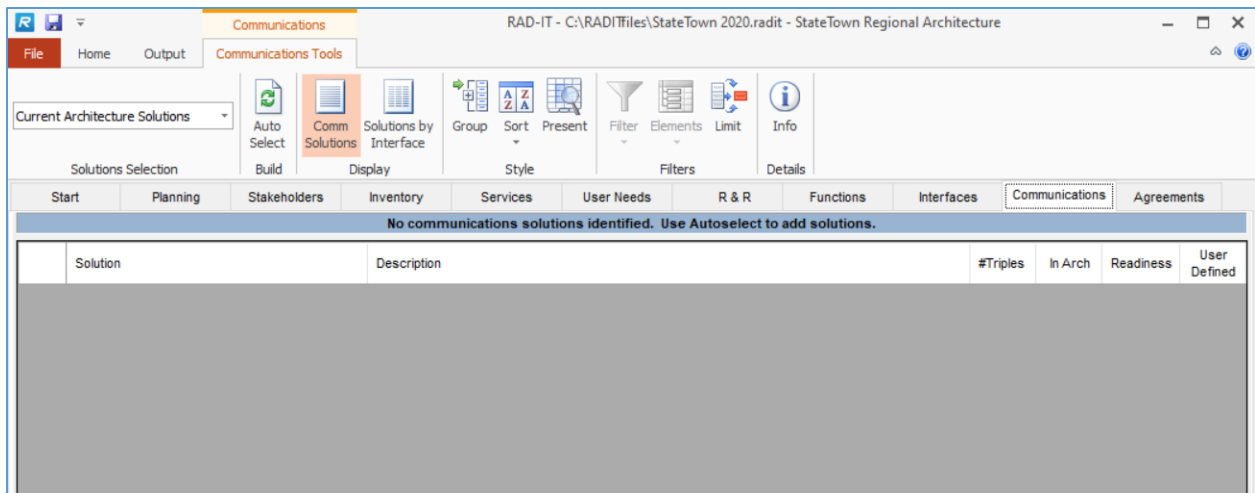
The Communications tab is arranged like the Interfaces with a menubar at the top to change how the information is presented and to see more details on a row.

The default layout of the Standards tab shows the "Current Architecture Solutions" but will appear blank for the first time through a new architecture. You will first need to do a "Build" as with the Interfaces tab.

Either the first time through the architecture or anytime you have made significant changes to the architecture's interfaces you should click the "AutoSelect" button in the Build area of the menubar.
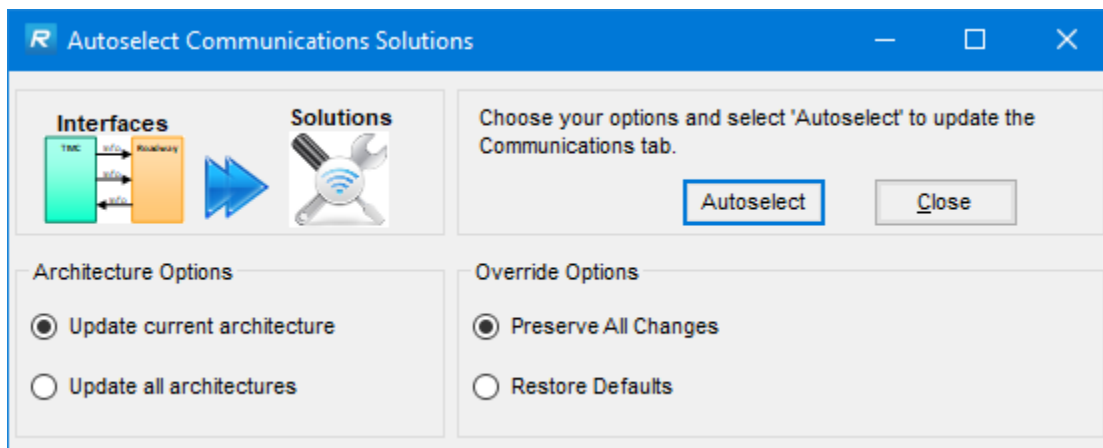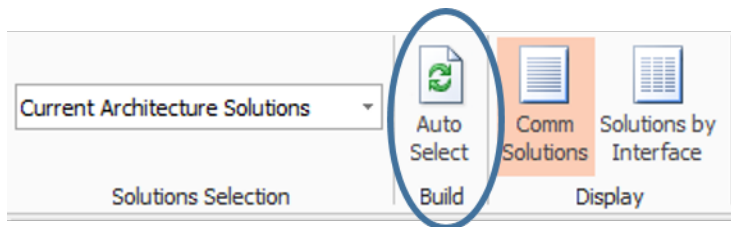




The Autoselect Communications Solutions window comes up to let you decide how the selection should work. Do you want it to just focus on the current architecture (the one you selected on the Start tab) or all architectures in the file – the regional and any project architectures?  You can also use the Override Options to preserve all changes that have been made previously – any solutions that have been purposely

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deselected before won't be selected again and vice versa. Or you can tell it to restore all defaults based on the information from the ARC-IT model.

Click the Autoselect button and a number of queries will run to determine which set of communications solutions are the most viable for your region/project architecture.



You can also use the "Solutions Selection" pull-down in the top left of the window to choose to show a listing of "All Solutions" in the ARC-IT communications view database as shown below.

The columns on the Communications tab include:
- Solution name
- Description of the communications solution
- # of Triples that have been mapped to that solution. Recall that a 'triple' is a combination of the source and destination elements and the flow between them.
- In Arch to indicate that it has been included in the selected architecture
- Readiness (more on that below)
- User Defined to indicate that a user defined solution has been selected.

**NOTE:** Currently with RAD-IT you are not able to create a user defined Solution but if you import a project architecture from SET-IT you may see user defined Solutions created in that tool.

The user can change the display of the Communications window using the buttons at the top of the screen:

- Display: These buttons include the "Comm Solutions" button or the "Solutions by Interface" button.
  - The default is the "Comm Solutions" display as shown above.
  - "Solutions By Interface" shows the selected solution mapping by source element-information flow-destination element triple based on the inventory of elements and interfaces in the current regional or project architecture.



Solutions by Interface lets you change the selected Solution if an alternative is available. Use the pull-down in the Solution column. If an alternative solution is available and you pick it then you will see a checkbox appear in the "Override" column. As you make changes to the Solutions you will see the Apply and Cancel buttons activated.

- Group: Works like it does on the Interfaces tab, groups cells of the table together that have identical contiguous content.

- Sort: The sort options available on the Communications tab varies by the Solutions Selection choice
  - For Comm Solutions, the Sort options are:
    - In Arch, Solution (default)
    - Solution; Readiness
    - In Arch, Solution
    - #Triples, Solution
    - User Defined, Solution
    - Column Sort
  - For Solutions by Interface, the Sort options are:
    - Source, Destination, Flow(default)
    - Override, Source, Destination, Flow
    - Readiness, Source, Destination, Flow
    - Flow, Source, Destination
    - Readiness, Flow, Source, Destination

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▪ Column Sort.
  o As on the Interfaces tab, with Column Sort just click on any column header and the screen will sort by that column. OR, if in any other sort mode, click on a column header and the "Column Sort" option is activated.

- Present: Makes the characters 50% bigger to make it suitable for engaging in a group discussion by projecting the Communications screen at a stakeholder meeting.

- Filter: Works when in the "Solutions by Interface" display mode. It works the same as the Filter screen on the Interfaces tab and Outputs menu.

- Elements: Works when in the "Solutions by Interface" display mode. It works the same as the Filter screen on the Interfaces tab and Outputs menu.

- Limit: As on the Interfaces tab, this will limit the display to just the Solutions that have been included. This only works in "Comm Solutions" display mode.

- Info: With one of the Comm Solutions or Solutions by Interface highlighted, clicking the "Info" button will display information describing the communications solution. An example is shown in the figure below.

In the lower part of the Solution Details screen there are 2 sets of tabs. The upper 3 tabs – Standards, Issues, and Information Flow Triples – govern what is shown below.

- The default is to highlight the Standards and then the lower set of tabs include the selected standards for each protocol layer.
- Clicking the Issues tab displays a list of issues or gaps that have been identified by the ARC-IT communications team regarding the solution or standards within the solution and their severity. The issues are available as a resource to the regional or project architect to see how viable a given solution may be or how ready it might be for deployment.
- Clicking "Information Flow Triples" displays the list of interfaces assigned to this triple

**NOTE:** The details window is currently READ-ONLY in RAD-IT.

## *Customizing the Communications View*

The Communications View for an architecture is more relevant to a project architecture – deciding which communications solution are best for a given set of interfaces, seeing their mapping to individual interfaces, etc. These are questions that will make more sense and need to be factored in once decisions are being made for the project.

SET-IT is the better tool to customize the communications solutions for a project so once a project is ready to be defined out of the regional architecture use the steps to define a project from the regional architecture, see "", then import that project into SET-IT to customize the communications solutions in more detail.

That said, there may be times at even the regional architecture stage when certain things are known about what types of communications are going to work in a region and some that won't. In this case, select "Solutions by Interface" display mode and use the solution pull-down for a given information flow triple and change the solution, if there is a choice. As you make the change you will see the checkbox in the Override column checked.

As you make changes to the Solutions you will see the Apply and Cancel buttons activated.

## *Solution Readiness*

The Solution Readiness column on the Communications tab is an indicator of the overall readiness of this solution to be deployed and reflects the issues that have been identified for the collection of standards that make up the solution.

The Readiness values are shown in the table below in terms of their readiness or suitability to deploy:

| Readiness Level | Readiness or Suitability Description |
|---|---|
| Highest | Suitable for wide-scale deployment when applied to the triples it supports. |
| High | A small number of minor issues. For existing deployments, consider addressing issues as needed as part of maintenance or upgrade activities. For new deployments, the solution is likely suitable for wide-scale deployment when applied to the triples it supports, though the noted issues should be considered and a path to addressing them developed, if needed, either as part of design or subsequent maintenance or upgrade activities. |

| Readiness Level | Readiness or Suitability Description |
|---|---|
| High-Moderate | One significant or possibly a couple minor issues. For existing deployments, the chosen solution likely has identified security or management issues not addressed by the communications solution. Deployers should consider additional security measures, such as communications link and physical security as part of these solutions. They should also review the management issues to see if they are relevant to their deployment and would require mitigation. For new deployments, the deployment efforts should consider a path to addressing these issues as a part of their design activities. The solution does not by itself provide a fully secure implementation without additional work. |
| Moderate | Two significant or one significant and several minor issues. For existing deployments, the chosen solution is likely deficient in security or management capabilities and the issues should be reviewed and upgrades developed as needed. For new deployments, the solution may be viable for pilots when applied to the triples it supports; such pilot deployments should consider a path to addressing these issues as a part of their design activities. The solution does not provide sufficient interoperability, management, and security to enable proper, full-scale deployment without additional work. |
| Moderate-Low | Multiple significant and minor issues. For existing deployments, the chosen solution is likely deficient in security or management capabilities, and the issues should be reviewed and upgrades developed as needed. Some solutions in this category may also be becoming obsolete from an interoperability perspective and if this is the case, then upgrades should be planned as soon as possible. For new deployments, the solution may be viable for pilots when applied to the triples it supports; such pilot deployments should consider a path to addressing these issues as a part of their design activities. The solution does not provide sufficient interoperability, management, and security to enable proper, full-scale deployment without additional work. |
| Low | One serious or several significant issues. This category often includes proprietary or partial solutions. The communications solution may fail to provide even a base level of interoperability and security. Consider alternative solutions or define specific revisions or upgrades that would provide a level of interoperability or security that are needed for the deployment. |
| Lowest | Many serious issues. This category includes solutions that have not been standardized, or do not have a basic level of interoperability or security. Consider selecting a different communications solution or if this is not possible (e.g., a pilot of a new application that has not been standardized), take additional measures to provide an acceptable level of security or interoperability. |

## *Data Distribution Solutions*

If an interface is eligible to us a data distribution system then you may notice a solution, either selected as the default or as a choice for the information flow triple that involves a data distribution system. Recall from the discussion on the Interfaces tab that not every flow is eligible depending on the type of data included in the interface or the type of communications involved – broadcast vs control vs interactive communications. If the flow had a data distribution system element selected in the DDS column on the Interfaces tab then a DDS solution will be shown in the Communications Solutions. If it did not have a data distribution system element selected then you may still see it as choice if you use the Solution pull-down on the Communications tab.

The Solution Details form will show whether the solution applies to interfaces with or without a DDS as an intermediary or if they can use DDS at all. This can be accessed from the "Solutions by Interface" view on the Comm Tab and selecting the "Info" button for a particular interface.

*What's a Standards Bundle?*

The Communications tab includes Communications Solutions that are defined by a set of standards – either for the data/message or for the communications protocols. In the list of standards for a given Solution you may notice the term "Bundle". In the ARC-IT Communications view a "Bundle is a group of Standards. A group of Standards is used when there are more than one standard that are needed to define how best to implement an interface. See the ARC-IT website (http://www.arc-it.net/) for more information.

## Thoughts on Communications Tab Usage

GUIDELINE:  Use the Communications Tab in RAD-IT to see the full list of communications solutions that are part of the architecture and to generate outputs for your regional or project architecture when you are required to list the ITS standards being considered for the region's or project's interfaces. But use SET-IT to be able to see and customize the full interface protocols and communications solutions associated with each interface.

GUIDELNE: When you are developing a project architecture *use SET-IT* to build the physical view (e.g. customized service package diagram with elements and flows) and then use the Communications View to review the ARC-IT defined communications standards for each layer of the relevant communications solutions.

## I Just Need a List of Standards for My Region/Project

If you are required to produce a list of standards, perhaps to fulfill requirement 23CFR940.9 d.7 – "Identification of ITS standards supporting regional and national interoperability," then you can generate a table from the Outputs menu.

Go to the Outputs menu, select Tables, click to expand the Interfaces & Standards section, and select "Communication Solution Details".  In the list of fields on the lower left box select the following fields:

- Standard
- Standard Number
- Standard Title
- Standard Version



The results can be exported to Word or Excel where they can be reformatted for your final reports.
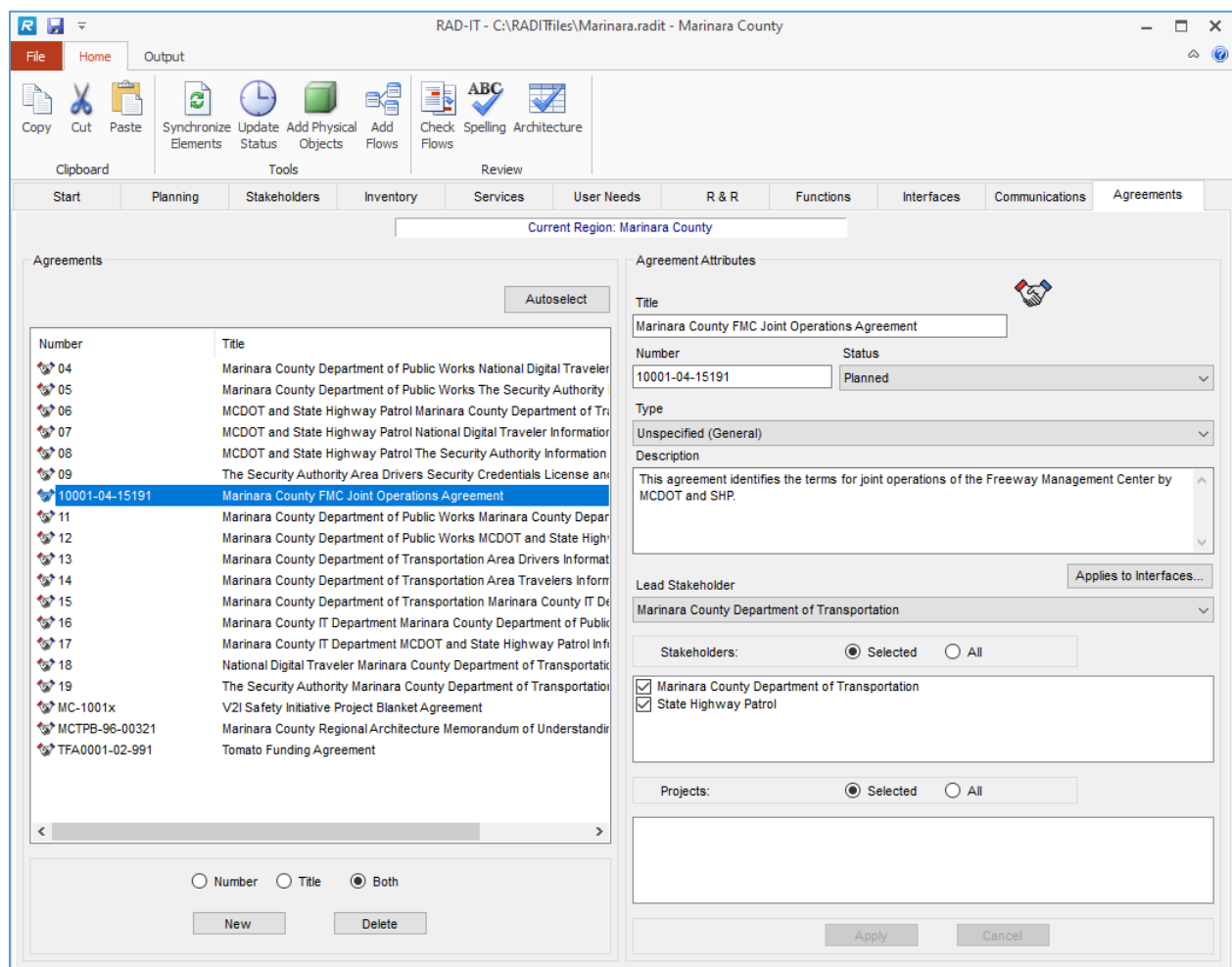
# Agreements Tab

Looking at the RAD-IT screen we continue working our way from left to right across the tabs at the top. This section discusses the 11th tab – the Agreements tab.

## Agreements Tab General Information

Agreements among different stakeholder agencies and organizations are required to realize the integration shown in the regional or project architecture, and to provide project interoperability. The stakeholder/agency in charge of the architecture development should ensure that all stakeholders are aware of the required agreements and their status.

Using the Agreements tab in RAD-IT, a list of the required agreements can be compiled, either agreements already in place or new agreements that are needed. Each agreement will have a user-supplied number, name, type, description, and status and be related to two or more stakeholders that are identified in the architecture. RAD-IT output tables will show the list of agreements and (optionally) the specific relationship of each agreement to the architecture.

Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the Regional ITS Architecture, are required in FHWA CFR 940.9(d)4 and FTA National ITS Architecture Policy Section 5.d.4.

Each connection between systems in the Regional ITS Architecture represents cooperation between stakeholders and a potential requirement for an agreement. Of course, this does not mean that hundreds of connections in the architecture will require hundreds of new agreements. One agreement may accomplish what is necessary to support many (or possibly even all) of the interfaces identified in the architecture. More on that in the "*Agreements by Project or Interface*" section below.

The Agreements tab for a Regional architecture, as shown in the figure above, lists all the agreements in the file. They are all listed on the left and an area at the bottom right of the screen shows with which projects they are associated.

With a project architecture you can use the 2 radio buttons at the top of the left side to choose between "Project" and "All".

With "All Agreements" selected, you can select "New" or "Delete" at the bottom of the window to create a new agreement or delete one of the existing agreements. If you are working with a project architecture, use the checkboxes on the extreme left of the screen to quickly associate an agreement with the project.

The left side shows the agreement "Number" and "Title" and there are buttons at the bottom to choose which columns will be shown: "Number", "Title", or "Both". You may hide either the name or number

column for the displayed agreements. By clicking on the top of each column the window can be sorted by that column, in either ascending or descending order.

Highlighting one of the agreements will populate the right side of the screen with the information for that agreement. These attributes may be modified, then "Apply" or "Cancel" selected. Clicking the "New" button will allow you to start from scratch and fill-in any of the information on the right.

The "Status" field allows you to pull-down and select from any of the status values that are valid for the selected architecture.



The "Type" field is another pull-down that allows you to select from one of the Types that have already been defined. Agreement types include general and interface/architecture specific. General agreements typically apply to a group of stakeholders in a region or on a project, like an MOU or Blanket Agreement for the project. Specific agreements are more about 2 stakeholders needing to agree on a specific interface in order for a service to work.

General Agreement Types include:
- Funding Agreement
- Handshake Agreement
- Interagency Agreement
- Master Agreement
- Memorandum of Understanding
- Project Blanket Agreement
- Shared Operations Agreement

Specific Agreement Types include:
- Information Exchange Agreement
- Information Exchange and Action Agreement

- Information Provision Agreement
- Security Credentials License and Usage Agreement
- System Maintenance Agreement
- System Usage Agreement
- Warranty

**NOTE:** Unspecified is also selectable as a type of agreement to be used early on when you may not be sure what type of agreement will be needed.

**NOTE:** For Older Architectures, previous versions of Turbo Architecture and RAD-IT allowed users to enter their own agreement type. Now RAD-IT is based on ARC-IT's Enterprise view with a predefined set of agreement types. If you converted an older architecture into RAD-IT then you will see those previous custom types changed to "Unspecified". You should go and change those to one of the ARC-IT supported types to ensure compatibility with other RAD-IT architectures and SET-IT projects.

See the "Regional ITS Architecture Guidance Document" and the http://www.arc-it.net/ website for more information. Agreements take a long time to execute. Build consensus early with simple agreements such as MOU's, while final agreements are being developed.

The "Description" field can include any text to describe the nature of the agreement, who is likely to be involved, over what time period it is effective, or any other pertinent information.

The "Lead Stakeholder" (agency) is a pull-down to select from the list of Stakeholders defined on the Stakeholders tab. There can only be one selected - if more than one is really the lead then go back and use the Stakeholders tab to create a Stakeholder Group. Below the "Lead Stakeholder" a series of check boxes provides a way for other stakeholders to be identified.
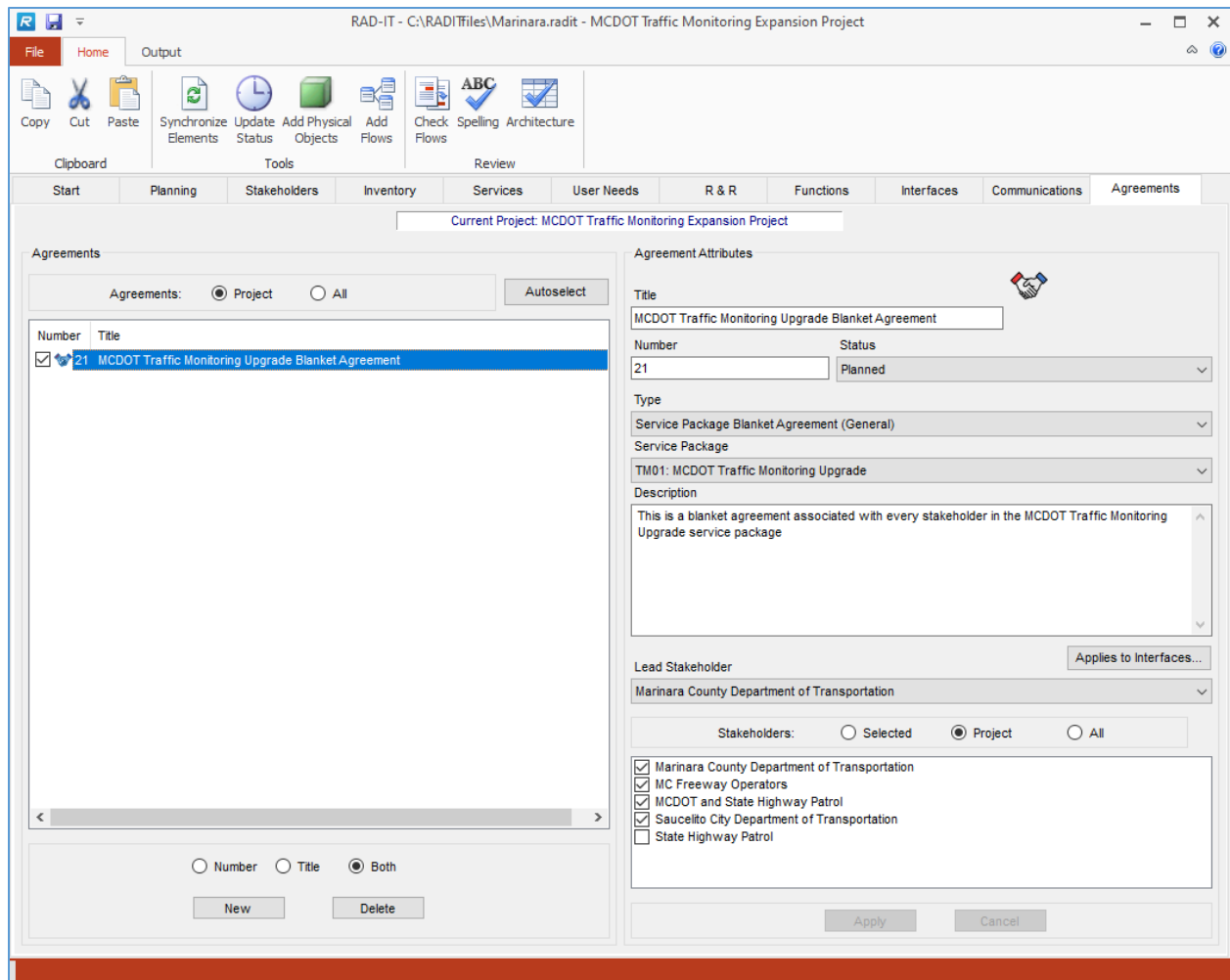
As shown above, the Stakeholders area has 3 buttons to help see just the "Selected" stakeholders, the stakeholders that are part of the selected architecture, or "All" of the stakeholders in the database.

Finally, when you are editing the regional architecture the Agreement can be associated with one or more projects that have been defined in this RAD-IT database. Right clicking in the "Projects" area will expand the list to allow the user to view more projects. Right clicking in the "Stakeholders" area works the same. Right click a second time to return the list to the smaller size. (This works in the same way as on other tabs.)
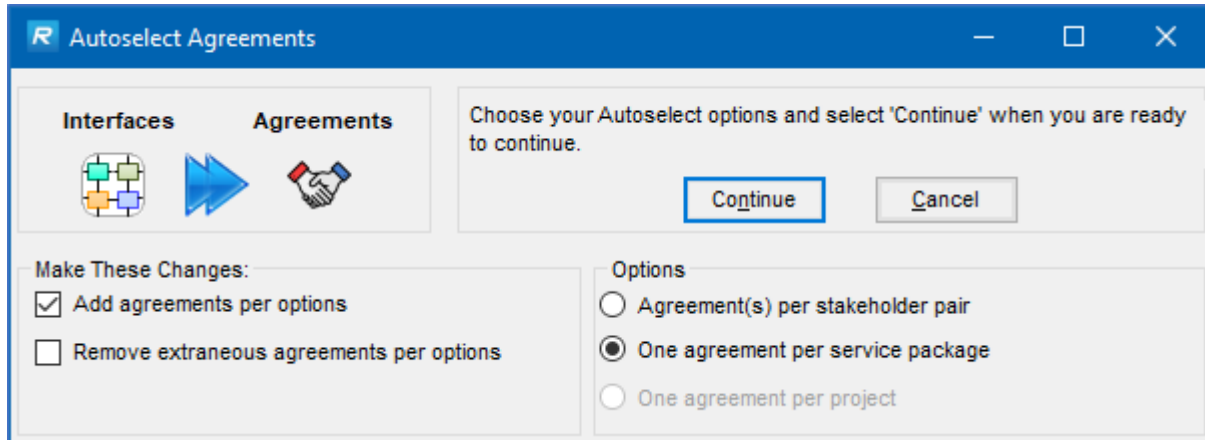
This information can be output using the "Agreements" table that provides a number of sorting and include option settings.

## Agreements by Project or Interface

You can now associate an agreement with a specific service package or interface. There is also an Autoselect feature to let RAD-IT create agreements for you based on your architecture.

## Autoselecting Agreements

This feature, available as a button at the top of the agreements tab allows you to let RAD-IT look at your architecture and come up with a starting set of agreements – either based on the service packages or interfaces.



Pressing the Autoselect button on the Agreements tab brings up a window with several options. On the left side you can check whether to add agreements that are supported by flows (the information flows listed on the Interfaces tab) or if you want to remove extraneous agreements.

## AutoSelect – Add
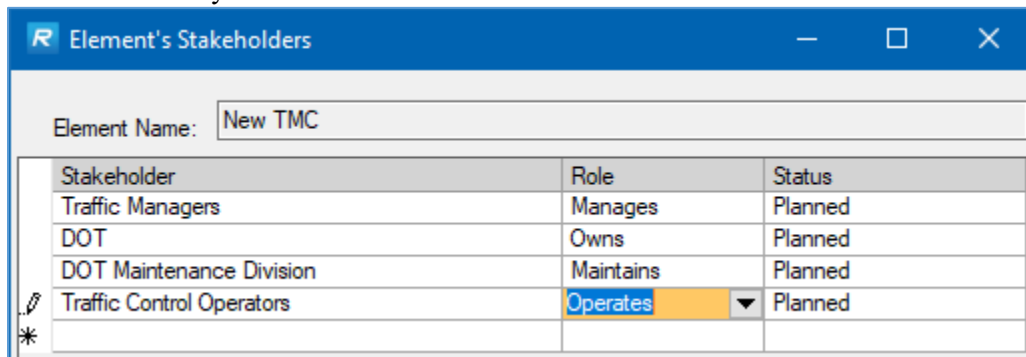
If you have checked "Add agreements per options" left side of the AutoSelect screen then on the right side you can click Options to tell it whether it should …
   a) Create agreement(s) per stakeholder pair.
   b) Create 1 agreement per service package.
   c) Create 1 agreement for the entire project (blanked out if the regional architecture is selected).

How does it do this?  This goes all the way back to the Inventory tab when you associated a stakeholder as the 'owner' of an element. RAD-IT now uses that information to see which stakeholders are involved in an interface or service package.

It also uses the other roles related to an element in order to create additional agreements like a Maintenance or an Operations agreement.

So, for a new TMC we may have several stakeholders involved as shown below:

The TMC with separate stakeholders identified for who Manages, Owns, Maintains, and Operates the center will result in 3 separate agreements when you select "One agreement per stakeholder pair:

- A system Maintenance Agreement between the owner and the maintainer,
- An Operations Agreement between the owner and managers,
- And a System Usage agreement between the manager and operators.



Once they are created and added to the Agreements tab you can customize and edit the title and description to better reflect how your region would describe these. Autogenerate will also add a generic description for the new agreements.

For interface related agreements it looks at the stakeholders who 'own' elements on both sides of each interface in the architecture. If they are the same, then no agreement is necessary, such as when the State DOT is sending configuration data from its center down to its field equipment. On the other hand an agreement is needed if the State DOT is sharing control with another DOT center. The agreement types and the generic text are from ARC-IT's Enterprise View. The Enterprise View in ARC-IT describes the relationships between organizations and the roles those organizations play within the transportation environment. Some agreement are needed for one organization to provide information to another; some agreements need to be defined in such a way that not only is information provided but an action is expected to take place with the information. These are among the agreements that ARC-IT will define and will show up when Autoselect Agreements is run.

The 'Agreement(s) per stakeholder pair' option also adds agreements that are based on elements such as a Joint Operations agreement or a common element where multiple stakeholders have different roles with respect to a single element. Another type of agreement is a Joint agreement where it is a Group of Stakeholders that owns, operates, etc. a particular element. These agreements will show up with a single stakeholder – the name for the group.

For Service Package related agreements (second button above), RAD-IT looks again at the stakeholder to element assignments to see what stakeholders are involved in each service package and creates a Blanket Agreement for that service package.
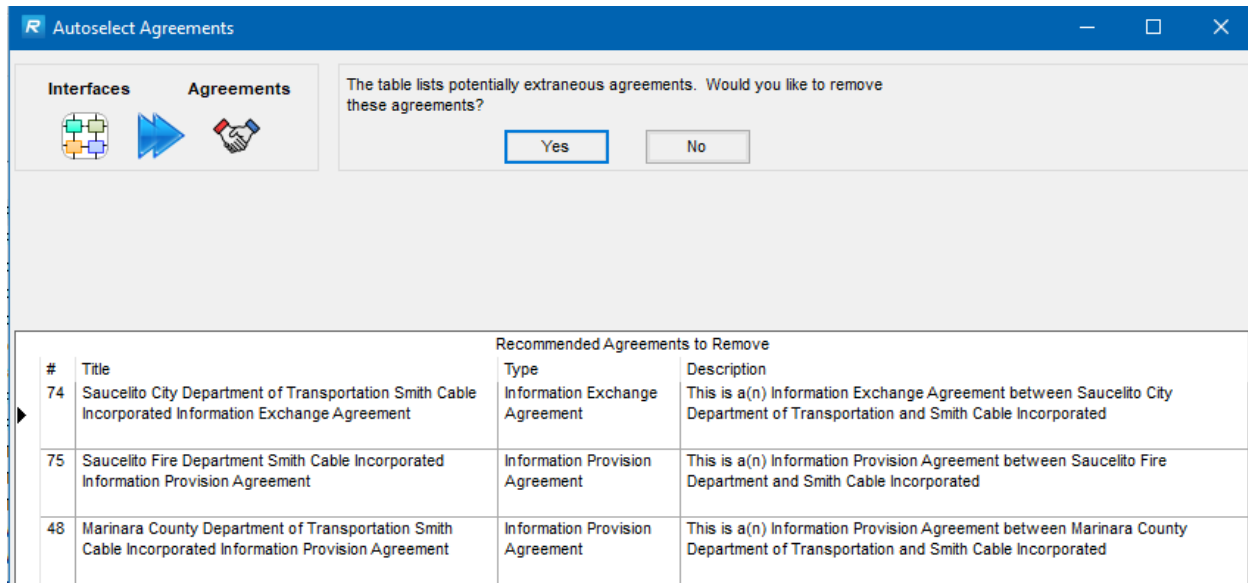
Once the agreements tab is populated you will see that the names, description, type, and stakeholders have all been populated. You can use the Lead Stakeholder pull-down to decide which stakeholder will take the lead in developing each agreement.

> **TIP:** Once autoselect has added agreements to the Agreements tab you will probably want to edit both the numbers and names of the agreement because they will be fairly generic. The numbering scheme is really simple: 1, 2, 3, etc. for each agreement by type in the file. The naming of the

Autogenerated agreements can be fairly long and hard to recognize at first. Customize them based on the stakeholders involved and your regional needs.

### *AutoSelect - Removal*

AutoSelect also lets you Remove agreements that are no longer necessary. After the new agreements have been identified and added the next screen will list any agreements that it recommends removing.



In the example above several agreements are listed as 'potentially extraneous', probably because interfaces between elements owned by these stakeholders were removed from the Interfaces tab. Click Yes or No and the listing in the Agreements tab will change.

## Service Package Agreement



## Interfaces Based Agreement



For the Interfaces related agreements you can also press the "Applies to Interfaces…" button and see a new form pop-up that shows which information flows are associated with that agreement.

Use the radio buttons at the top of the form to view the interfaces or information flows for just the currently selected agreement or click All Agreements to see all the agreements and which flows are included. This allows you to control which specific information flows are 'on the table' when it comes time to negotiate an agreement.

How do I use this? You may decide that certain interfaces need to be hashed out at the individual information exchange agreement level between 2 parties but decide that other information flows can be left as part of a blanket MOU for the project.

## *Elements Based Agreement*

In the screenshot below a Joint Management agreement is highlighted.



In the Joint Management Agreement above the Lead Stakeholder and the Selected Stakeholder is the stakeholder group that was assigned the role of 'Manages' on the Inventory tab.

Notice that for agreements like this that pertain to an element rather than an interface the button changed from 'Applies to Interfaces…' to 'Applies to Elements…'.

Click the 'Applies to Elements…' button to show the list of elements with which this stakeholder group is associated:
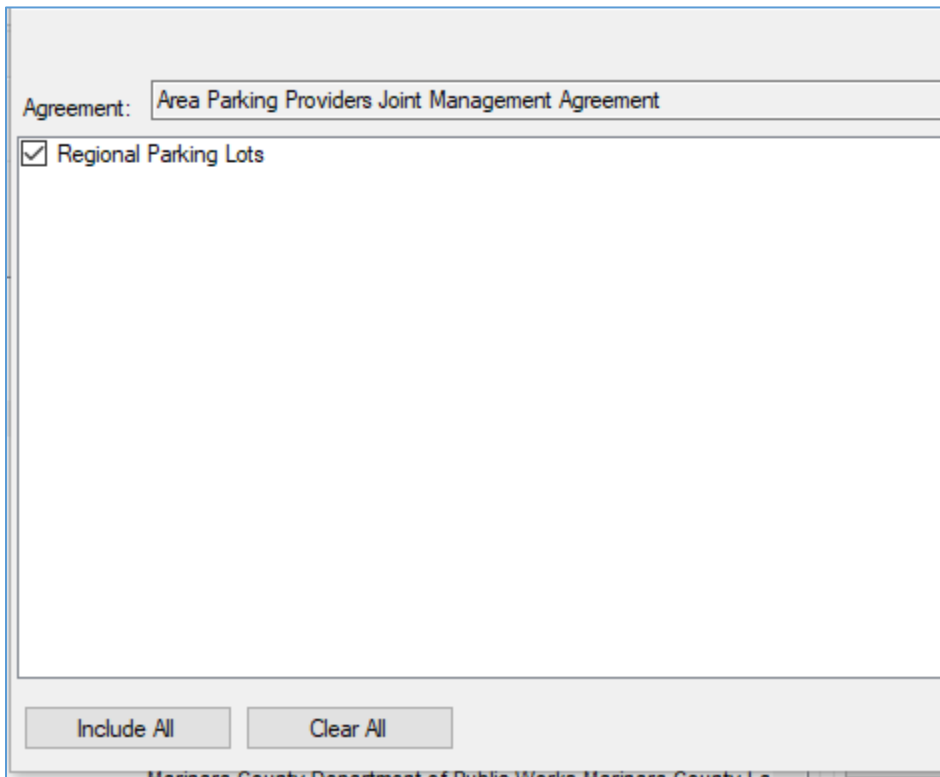


The Agreements listing shows the elements that apply to the agreement selected on the Agreements tab. It shows the list with checkboxes beside each element with Include All and Clear All buttons at the bottom.

Another group of agreements related to elements rather than interfaces would be the Common Element agreements where multiple stakeholders have different roles with a single or common element. A System Usage agreement is shown below:
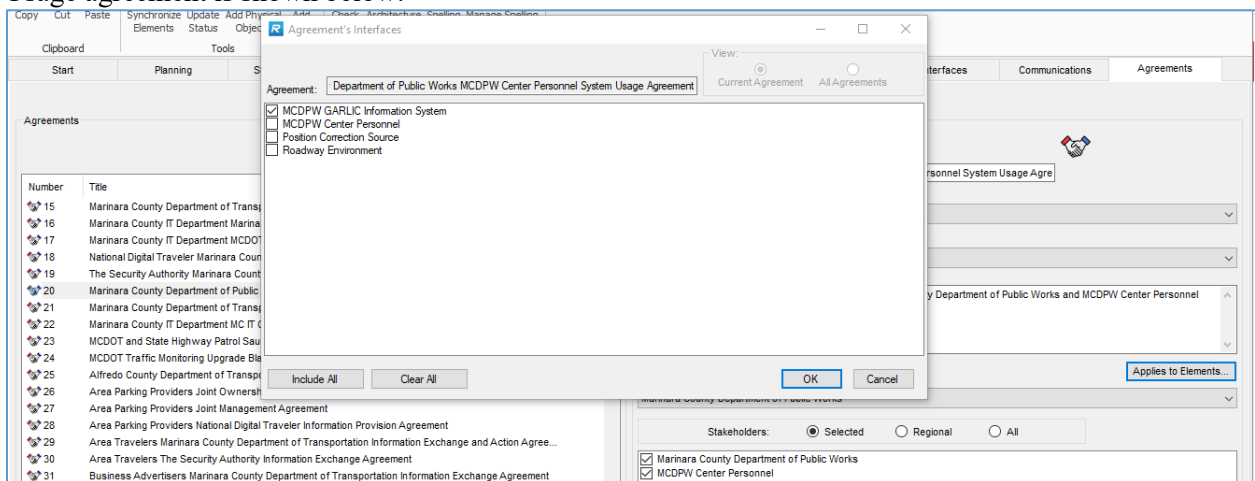


The example above is a System Usage Agreement that was driven by the owner and the operators for the Department of Public Works' (DPW) GARLIC information system.

# Toolbar Features

Now looking above the tabs of the RAD-IT screen we'll look at the other features available at the top of the screen from the "Home" menubar.

Several tools are available to review and check your architecture as well as extend the basic set of ITS physical objects and flows provided by ARC-IT to support your unique needs.
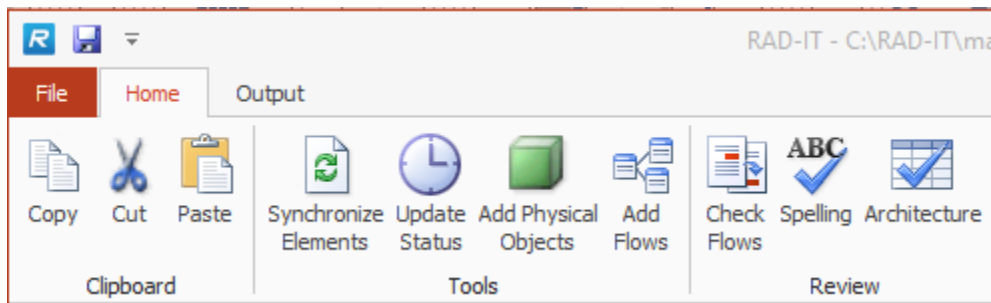


## Clipboard Tools

Now looking above the tabs of the RAD-IT screen we'll look at the other features available, starting with the Clipboard at the top left of the screen from the "Home" menubar.
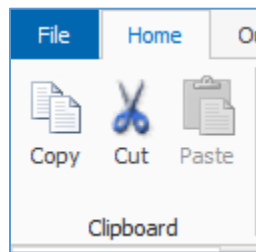


These options work as in other tools:
1. Select a word or phrase (for instance, in the description of an element).
2. Click "Cut" (to delete the phrase from the selected field and copy it to the clipboard) or "Copy" (to copy the phrase elsewhere).
3. Select another element, stakeholder, or similar item that allows a description or comment.
4. Click "Paste" to insert the phrase in a user editable field.

Keyboard shortcuts also work for these options, similar to other Microsoft tools as does Right-Click from a text box:
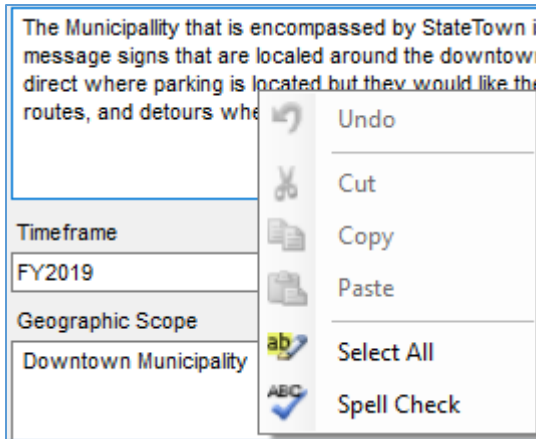
**NOTE:** These options on the "Edit" pulldown only work for window fields that may be edited. You may not select a portion of a report using "Edit => Copy" to insert into another document. You must save the entire report to a file, then open and manipulate it in the selected editor.

## Architecture Tools

RAD-IT provides several tools to help you keep elements in sync, to add customized status values, extend the architecture model in terms of physical objects as well as physical information flows.

### Synchronizing Parent and Child Elements

The Synchronize Elements tool is used to match up the functional objects and service package mappings between an inventory parent element and any element instances. The Inventory tab where element instances are created included an option for the new instance to inherit the attributes of the parent but that was only the attributes that are available on the Inventory tab.
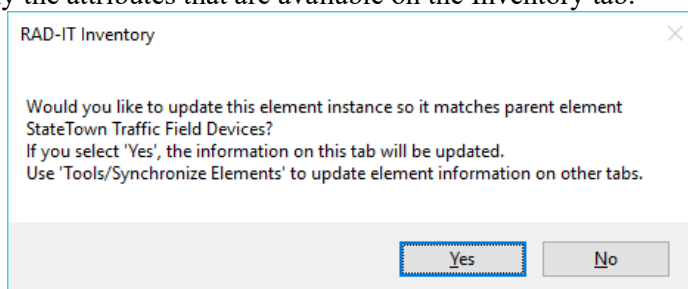


Once other aspects of the architecture have been captured like the services and functions then it may be a good idea to sync the parent and child elements. It may also be useful This window is accessed by selecting "Tools => Synchronize Elements" from the menu bar.

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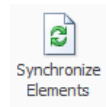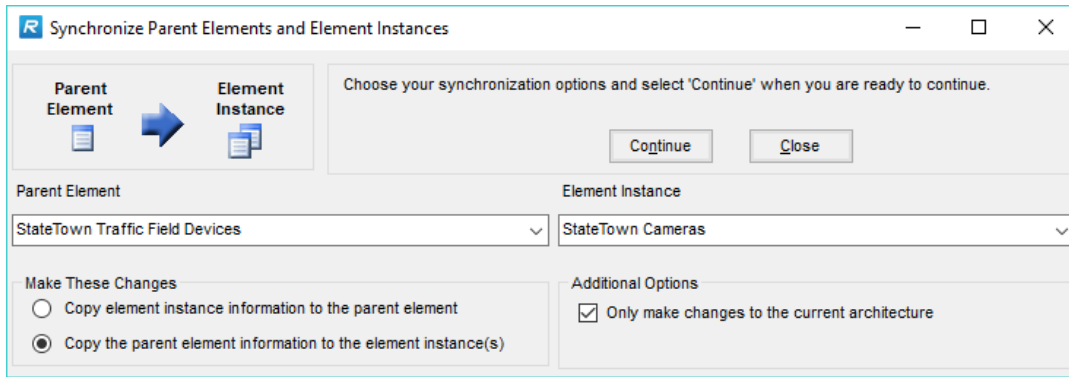
Select the elements to be synchronized: a Parent on the left side and an Element Instance using the pull-down list on the right. Then decide which direction to synchronize the information with the radio buttons on the bottom-left of the window: either to copy from the instance up to the parent or the other way around, to copy the parent's attributes down to the instance.

You can also decide if these changes should apply to just the current architecture or to all architectures in the file.

> NOTE: about the scope of Synchronization. Certain mappings are already file-wide, like service package mappings and Physical Object-to-Element assignments. This means that depending on the type of changes clicking or unclicking the "Only make changes to the current architecture" may have no apparent differences. Checking the "Limit" checkbox does impact the Service Package to Element assignments, as long as there are different parent element/element instances associated with different architectures. For instance, a region that has the parent element and 2 projects that each have an instance of the parent.

Once you have made the selections of what to synchronize and selected "Continue", RAD-IT will look at the following areas to see what, if any, changes are needed:

- Physical Objects
- Service Packages
- Functional Objects

At each step if there are changes to be made, RAD-IT will show what changes are recommended and ask whether to make the changes.

If you select "Yes" RAD-IT will confirm that the changes were incorporated and give an opportunity to continue to the next area of synchronization or to close the operation and return to the Synchronize Elements window.

Once RAD-IT has completed synchronizing the service packages and functional objects it will return to the original Synchronize Elements window where another pair can be selected or select "Close" to return to the main RAD-IT screens.


## Customizing Status Values

The window to add, modify, or delete a status value allows you to generate your own locally defined values as attributes for the timeframe of deployment for various parts of the architecture. Bring up this RAD-IT feature from the Tools area of the Home ribbon by clicking on the "Update Status" button. This option allows a region to define up to 7 local status values that will be available when creating or modifying an architecture or inventory element or center, mapping a service package to an element, or

customizing information flows for the open architecture. Status values are global to all architectures in the file, so the list will be available when working with any of the architectures.

The initial status values that come with the RAD-IT tool are "existing", "planned" (default), and "not applicable". The names and descriptions of these values may be changed, but "not applicable" must remain last even if its name has been changed (the tool will not let this value be reordered). The others may be reordered by selecting the value, such as "planned", then clicking on the "re-order" up or down arrow on the left. The default value may also be changed by checking or unchecking the "Make this the default Status value" checkbox on the right.



To work with local status values:

1. There are four buttons on this form:
   a. New - Create a new local status name.
   b. Delete - Delete a status name from the RAD-IT database. If this status value has been assigned to an architecture, element, service package, or information flow, then a window will popup stating how many items have been assigned to this status, and that he must reassign them before being able to delete this status value.
   c. Apply -- Save the changes made to the selected status value - save the new status value to the database.
   d. Cancel - Cancel the action. This option toggles with "Close" to close the window when no actions are pending.
2. To create a new status value, select "New". Enter the name and description of the new status value on the right-hand side of this screen, select the "default" checkbox if applicable, then click "Apply". If you wish to cancel this change, select the "Cancel" button.
3. To delete an existing status value, select the name of the status value from the list on the left, then click "Delete". A verification screen appears asking if you wish to delete the status. Click on "Yes" or "No" to delete or cancel the operation. If this status value has been assigned to an architecture item, a different popup window appears asking you to reassign those items to another status value before the selected status may be deleted. Click "OK" on this window to return to the "Status" window.
4. To modify an existing status value, select the name on the left, then enter the new name or (modify the) description on the right. The default status may also be changed. Click "Apply". If you wish to cancel this change, select the "Cancel" button.

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When you are on the "Inventory" tab and edit status values on the "Status" window, modifications, additions, or deletions that are made on this form, then saved (by selecting "Apply"), are immediately reflected in the status list box on the "Inventory" tab (and all other tabs and windows where available).

## Add Physical Objects

In order to create a new user defined physical object, i.e., extend the architecture to add a subsystem- or terminator-like object.
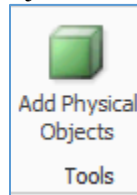


1. On the menubar, select "Add Physical Objects" from the Tools group of buttons
2. Click the "New" button.
3. After selecting "New" to create a new user defined Physical Object, enter the name and description of the user defined Physical Object. The Physical Object may be associated with existing elements in the architecture.
4. Next, select the "Class" and "Type" of Physical Object that is being defined.
5. Finally, click "Apply" to create the new user defined object, or "Cancel" to cancel the object creation. After "Applying" the change, the "Cancel" button again switches to "Close".
6. Click "Close" to exit from the window, or "New" or "Delete" to continue creating or deleting user defined physical objects.
7. Now use the Inventory tab to associate this new Physical Object with new or existing elements. They will appear at the bottom of the list.

**TIP:**  It is important to provide a good description for user defined physical objects since these are unique to your architecture. That way others that review the architecture or future maintainers of the architecture will know what this is.

**NOTE:** You may notice that when selecting "New", the elements button switches to the "All Elements" button. The reason that you cannot switch back to the "Related Elements" button is that there is a change to the related elements that is pending. This change must be applied before the other button can be selected. Both buttons are again available when the change is "Applied", i.e., the new object is saved. This behavior is consistent throughout RAD-IT among all windows that include the All/Related buttons.

## Modifying User Defined Physical Objects

If there are user defined physical objects already listed, they may be modified on the User Defined Physical Objects  window by selecting the object on the left, and changing the appropriate information on the right. There is also a "Delete" option to delete an existing user defined object.

The "Kind" field in the "Physical Objects Attributes" section has two values:
   a. When creating a new user defined Physical Object, the "Kind" is set to "User Defined" and cannot be changed.
   b. After converting a RAD-IT file from a previous release version, certain Physical Objects (subsystems and terminators) in ARC-IT may have been discontinued between versions of the architecture. These are represented as "Discontinued". You can choose to modify a

discontinued Physical Object. The result is a "User Defined" Physical Object (the "Kind" switches from "Discontinued" to "User Defined" when the Physical Object is modified). The User Defined Physical Object CANNOT be changed back to "Discontinued". The additional category for user defined flows, "ARC-IT", does not appear on the "User Defined Physical Objects" window. All discontinued Physical Objects from the conversion that you wish to keep are also loaded into the "User Defined Physical Objects" window. This gives you a convenient way to review and manage all extended physical objects using the same tool.

## *Add Information Flows*

In order to create a new user defined flow, i.e., extend the architecture to add an interface that is not part of ARC-IT you enter the flow name and description as well as the directionality between subsystems, terminators, and user defined physical objects.
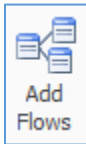


Definition of the user defined flow also requires explicitly defining the type of source and destination physical object that is tied to the flow. This is required on the "Add Flows" window.



The "Flow Kind" field in the "Flow Attributes" has three values:
1. When creating a new user defined flow, the "Flow Kind" is set to "**User Defined**" and cannot be changed.
2. After converting a RAD-IT file from a previous release version, certain flows in ARC-IT may have been discontinued between versions of the architecture. These are represented by a "Flow Kind" called "**Discontinued**". You can choose to modify a discontinued flow. The "Flow Kind" switches from "Discontinued" to "User Defined" when the flow is modified. All discontinued flows from the conversion that you wish to keep are also loaded onto the "User Defined Flows"

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form. This gives you a convenient way to review and manage all extended flows using the same tool.

3. The third type of "Flow Kind" is called "ARC-IT". See the notes below for more explanation.

The "Build" logic will ignore "Discontinued" flows and "ARC-IT" information on the "User Defined Flows" window. Only user defined flows will be added to the "Interfaces" tab when you build the architecture following conversion. "Not applicable" unsupported flows will be removed from the "Interfaces" tab list during a "Build" (discontinued Physical Objects and flows will not be removed). We do not want to propagate discontinued flows or non-standard applications of ARC-IT flows on the "Interfaces" tab.

To create a user defined flow:

1. On the menubar, click "Add Flows".
2. To create a new user defined flow, click "New" and enter the name and description of the flow. Notice that the "Flow Kind" is now set to "User Defined", as expected.
3. Next, map the user defined flow between architecture physical objects. The screen asks for source and destination Physical Object. These must be selected from the available list - they may not be typed into the fields. A user defined flow can connect two user defined Physical Objects, a user defined Physical Object with an ARC-IT Physical Object, or two ARC-IT Physical Objects. On the "Inventory" tab, the architecture Physical Objects are associated with architecture elements, so the new user defined flow is indirectly associated with these elements. These are shown later on the "Interfaces" screen.
4. Next, decide if you want your user defined flow to *replace* an existing ARC-IT flow. After selecting a source and destination click the "Replaces" pull-down and choose from one of the flows that are currently defined between those physical objects.
   > **NOTE:** You can create more than one user defined flow to replace the same ARC-IT flow. When you do a build you will see both flows between the applicable source and destination pairs. This may be useful if you want to split a complex flow into multiple parts, e.g., basic data and advanced data.
5. Click "Apply" to create the new user defined flow, or "Cancel" to cancel the flow creation. Then, click "Close" to exit from the window, or "New" or "Delete" to continue creating or deleting user defined (and discontinued) flows. After "Applying" this change, the "Cancel" button switches back to "Close".
6. Build the architecture again on the "Interfaces" tab to add the new user defined flow and its source and destination elements to the architecture and to the "Interfaces" tab. The new user defined flow will appear with the status of the elements to which it is connected, usually "existing", "planned", or a local status value. If the user defined flow appears as "not applicable", then one or both of the elements to which it is connected may be associated with a service package that is "not applicable". A "Conservative Build" may also result in the user defined flow being "not applicable".
7. Visit the "Interfaces" tab to review/modify the connections around the new user defined flow. Use the "Flows" view of the "Interfaces" tab to select or deselect the new user defined flows associated with source and destination elements (these may be indirectly mapped to a new user defined Physical Object).

The element to Physical Object mapping provides a level of abstraction above the user defined flow to Physical Object mapping. For instance, the Clatsop County Roadside Equipment element could map to both the ARC-IT ITS Roadway Equipment subsystem and a new user defined Physical Object called "Flood Monitoring System". Both user defined flows associated with the Flood Monitoring System and

ARC-IT standard flows associated with the ITS Roadway Equipment would be available on the "Interfaces" screen.

> **NOTE:** Concerning the ARC-IT "Flow Kind", in certain rare cases, you may have defined a user defined Physical Object or the associated flow in a previous release version of RAD-IT that now has the exact same name in RAD-IT as a new ARC-IT flow or Physical Object. During the conversion, the user defined flow with the duplicate name is converted to the ARC-IT flow, which works fine as long as the user defined flow is associated with the same source/destination entity pair as in the current ARC-IT. When this is not the case, the source/destination information for the ARC-IT flow is retained on the "User Defined Flows" form.

When an "ARC-IT" flow is selected on the "User Defined Flows" form, you have very few options. You cannot convert the flow to "User Defined" and cannot alter any other attributes. Also note that the "Delete" command button changes to "Remove", signifying that this button works differently with "ARC-IT" flows than with the other flows on this form. When you "remove" a flow, the flow is only removed from the "User Defined Flows" form, the national flow is still defined in the database and still included on the "Interfaces" tab unless you specifically tailor the flow out. In contrast, when you delete a "User Defined" or "Discontinued" flow, it is completely removed from the database. One way to resolve these identically named flows that are marked with "Flow Kind" of "ARC-IT" after the conversion is to simply recreate the flow in the converted architecture using a different name, on the "User Defined Flows" form. Then remove the original flow on this form.

## Review Tools

RAD-IT provides several ways to review and check your architecture from the Review section of the Home toolbar.
- – Check Flows
- – Check Spelling
- – Review the Architecture
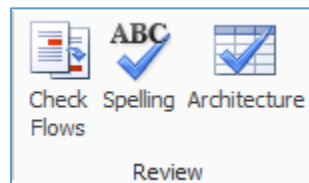


### *Checking Flows*

Available from the "Review section of the Home menubar, the "Check Flows" button on the Home menu, the window illustrates inconsistencies between related information flows in the current architecture.

Flows can usually be associated with a particular information flow in the following ways –
- Depends on (where one flow depends on the existence of another flow),
- Interactive (where one side will expect feedback based on information provided)
- Request/Response (typical control flow where a request triggers a response)

The Check Flows tool allows you to view a list of inconsistencies between flows and information flows that are included in an architecture and allow RAD-IT to automatically reconcile issues with either the Interactive or the request/control flows and to remove identified discrepancies.

On the "Related Flows" area at the top of the screen:
1. Lists the flows that should be included in your architecture but aren't (based on the defined Interactive or Request/Response relationships in the database)
2. The "Include" and "Include All" options will add flows to the current architecture that may be necessary to support the included information flows.

On the "Flows Included" section at the bottom, just the opposite happens:
1. The "Remove" and "Remove All" options will remove information flows that are included in the current architecture but are supported by their related flows (listed above).

Another way to use RAD-IT is to use the Filters on the "Output => Filtering" window. The autoselect feature automatically selects all request/control flows associated with information flows that are included in the architecture. This will possibly save 20% of the time that is normally spent on the "Interfaces" tab selecting and customizing information flows.

*Spell Checking your Architecture*

A Regional or Project ITS Architecture is to be used by many stakeholders. It is important that as that architecture becomes circulated among a broad and diverse audience it must provide an overall level of quality that gives the readers confidence that the architecture is their architecture. The Spell Check feature provides a mechanism to review the cells within a tab that contain text and verify whether they are spelled correctly.

Spell checking of the current tab may be initiated by selecting Spell Check from the Review menu. RAD-IT displays a "Spelling" window very similar to that provided by Microsoft Word. Each cell on the tab is spell checked in turn and the user is given the opportunity to select from spelling suggestions or provide their own corrections. The spell check continues until all text on the tab has been spell checked or the user cancels the operation. User corrections may be added to a custom dictionary for future use. Individual text boxes may also be spell checked by right-clicking the text that appears to have a red squiggly line under it.

You can also get to Spell Check by Right-clicking in a text box and selecting Spell Check
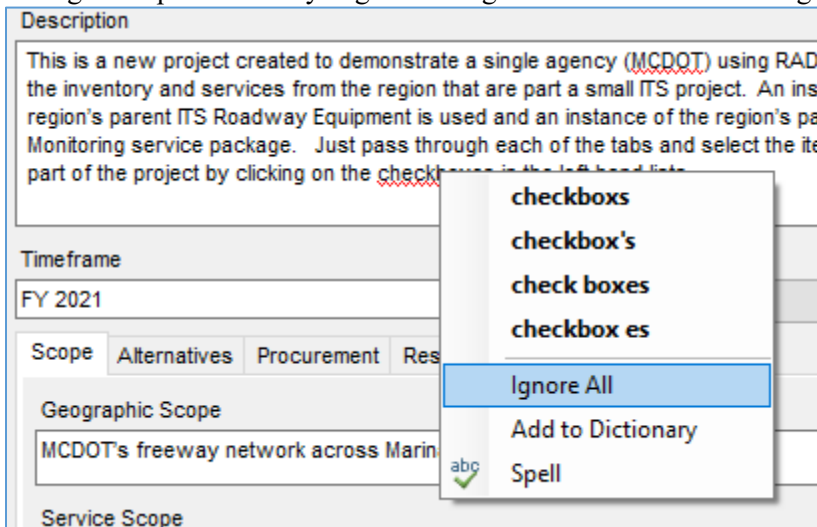


If you click "Spell" that will bring up the Spelling dialog box that will give you more suggestions and give you the options to change the word to one of those or to something else.
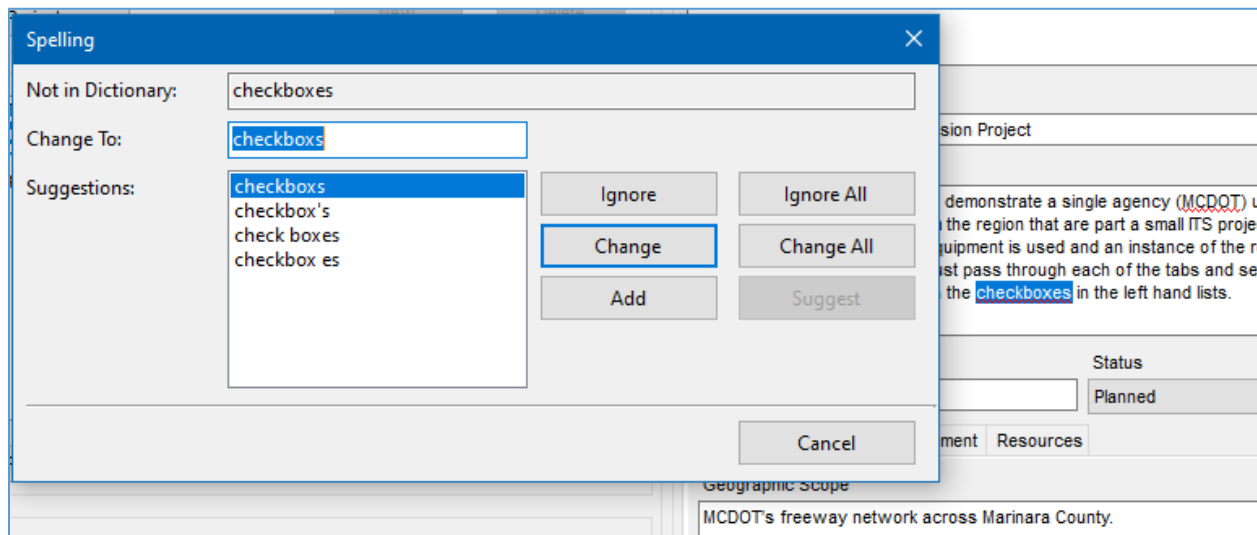


This allows you to quickly review the architecture as you go.

*Local and Global Spell Check*

Another option is to check all of the spelling across the entire architecture.  At the top of the RAD-IT screen click the caret under the Spelling icon and choose "Global Spell Check".
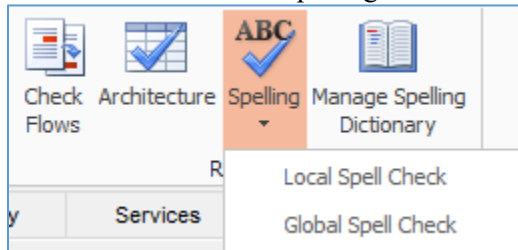


That will check all of the text on all of the tabs at once.

## Dictionary Manager

Lastly, you can add and remove words from your custom dictionary by clicking the "Manage Spelling Dictionary" icon at the top of the RAD-IT screen.  This will bring up a new window called the Dictionary Manager.
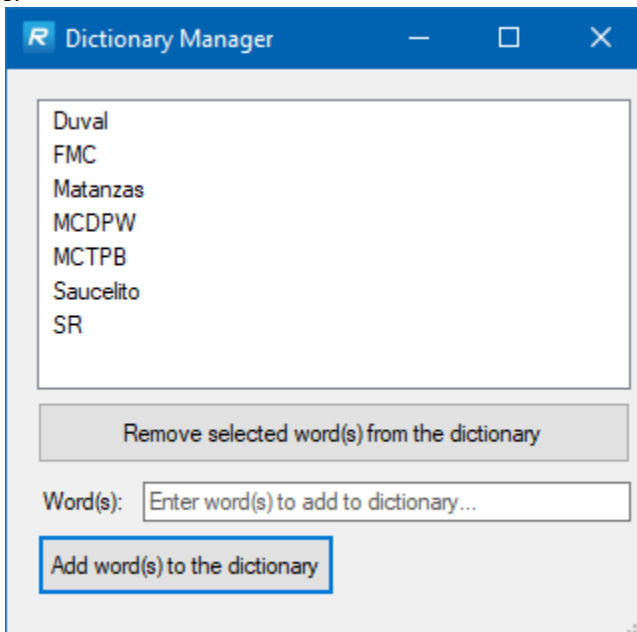


Here you see the custom words that have been added previously and remove them or you can add words to your custom dictionary by typing them into the space provided and clicking the Add button.

> **NOTE:** if you have both RAD-IT and SET-IT installed on your computer then this custom dictionary will be available to both tools. Words added to the dictionary in one tool will be available to the other tool.  Also, words removed from the dictionary in one tool will not be shown in the other tool.

## Architecture Checking / Review Tables
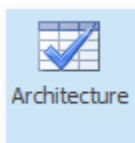


There is a series of Tables that can be generated using the same process as other Output/Tables that are all about Reviewing Your Architecture.

RAD-IT software lets the user have as much flexibility as possible and does not try to prevent the user from creating the architecture the way they want. However, as you work on one part of the architecture (say, adding or deleting flows) you could be introducing inconsistencies with other parts of the architecture (inventory or services). The Review section of the menubar has a shortcut to those tables.

There are 2 categories of reports – "Check Your Architecture" and "Region to Project Comparison" as shown below.

This screen works just as the Output Tables screen. Select the type of Check you want to run, select the Columns you want to include, and either save it to a file or open the Office application. Each of the reports has a hint or hovertext that will display to show you what the report does.

See "*Check Your Architecture Tables*" below for a listing and description of the tables you can generate to help you debug issues with your architecture.

# Generating Outputs

This section describes ways to use RAD-IT to generate outputs from your regional or project architecture, including diagrams, tables, documents, and web pages.
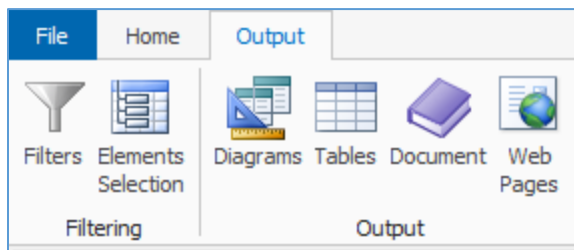


## Introduction to Outputs

Once you have customized your architecture the development process is really complete. However, it is important to create outputs that represent the architecture and can serve as vehicles for transferring information to the stakeholders. The "Output" toolbar allows creation of diagrams, tables, web pages, and documents pertaining to the architecture created.

From this menu you are able to produce these outputs for a completed or partially defined Regional or Project Architecture. Settings are available that control the data to be output and the format of each output.

## Data Filtering

You may choose to filter the data that is output in selected diagrams, tables, and documents. The same filters also impact the Interfaces tab so that the impact of interface filtering can be previewed. These data filters will limit the types of interfaces to be considered, and should be used for large tables and diagrams. The filtered data will not appear on the outputs, but is still included in the architecture. The filters may include such types of data as human interfaces, acknowledgment or request flows, etc.

The filters are identical for output tables, diagrams, and the "Interfaces" tab. There are four types of filtering:  "Physical Objects", "Interconnects", "Flows", and "Service Packages", and a fifth tab, "Summary", that indicates if any of the filters are selected.
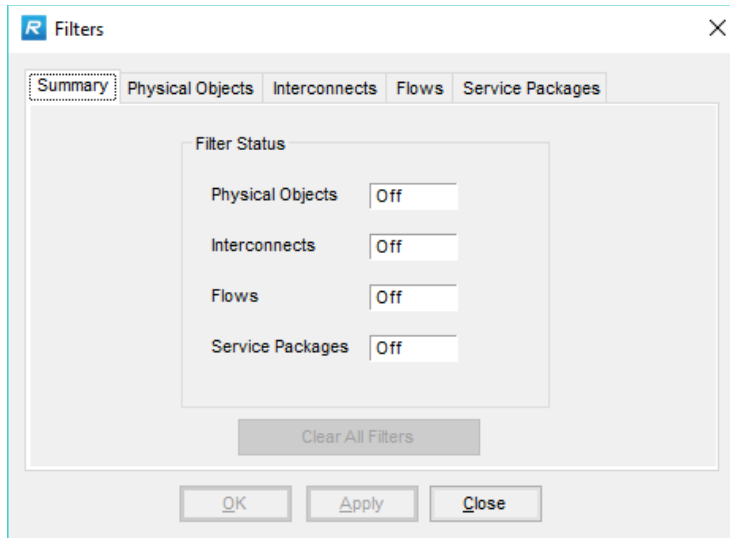
The four types of filters are:

1. *Physical Objects*:  Sets filters that control the elements displayed in output tables, diagrams, and on the "Interfaces" tab. "Class" indicates subsystems and "Type" indicates Human, System, and the "Other System" type of objects which represent additional peer systems that usually lie on the periphery of a regional architecture.

2. *Interconnects*:  Sets filters that control the types of interconnects that are displayed, including permutations of center, field, traveler, and vehicle interconnections. The RAD-IT interconnect filters are based on Source and Destination class because that is information that is available for all RAD-IT triples, including user defined triples.

3. *Flows*:  Sets filters that control the information flows displayed in output tables, diagrams, and on the "Interfaces" tab. Deployment status (existing, planned, etc.) and type of flow (information vs. request flow) may be selected.

4. *Service Packages*:  Sets a filter that limits output tables and diagrams to a single service package or service package instance, or all service packages may be displayed.

The "Filters" window may be displayed in a variety of ways, from the "Output" menubar pulldown, the "Diagrams" and "Tables" windows, and by clicking the little arrow at the bottom of the Filter button on the "Filter" option on the "Interfaces" tab. Then to activate the filters just click the main part of the Filter button. These methods result in the same filters being applied to the tables or diagrams and on the "Interfaces" tab. A change to a filter in one place also changes it in the other windows.

Checking the boxes on the Filters window will result in the physical objects, flows, or interconnects being selected. If the box is not checked, the items of that type will be deselected. Both "Apply" and "OK" save your filter settings to the database. "Apply" leaves the window open; "OK" closes the window. "Cancel" allows you to cancel out of the window without committing any filter changes to the database.

Where multiple filters apply to a single Physical Object or flow, the software will filter pessimistically. That is, if any filter that you have selected (by leaving the box unchecked) applies to a Physical Object or flow, then this Physical Object or flow will be deselected on the "Interfaces" tab, or not appear on a report or diagram.

**NOTE:** This may result in zero flows being displayed on the "Interfaces" tab, output tables, and diagrams.

## Physical Object Filters

The Physical Objects tab of the Filters screen lets you select or deselect the different Classes of physical objects as defined in ARC-IT: Center, Field, Personal, Support, Vehicle, and the 'super-class' known as ITS. You can also select and deselect the Types of physical objects to display: Human, Other System, and System. This could be useful to unclutter your diagrams to not include human interfaces.
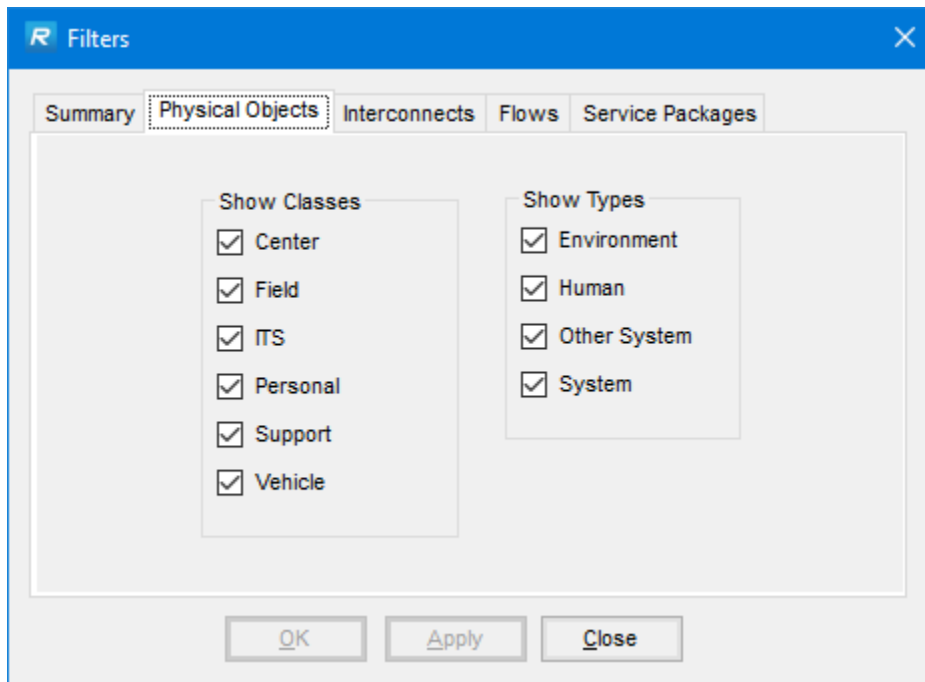
## Interconnect Filters

The interconnect tab on the filters screen lets you select and unselect the interfaces to be shown on the interfaces tab or the outputs based on the class of the source and destination.
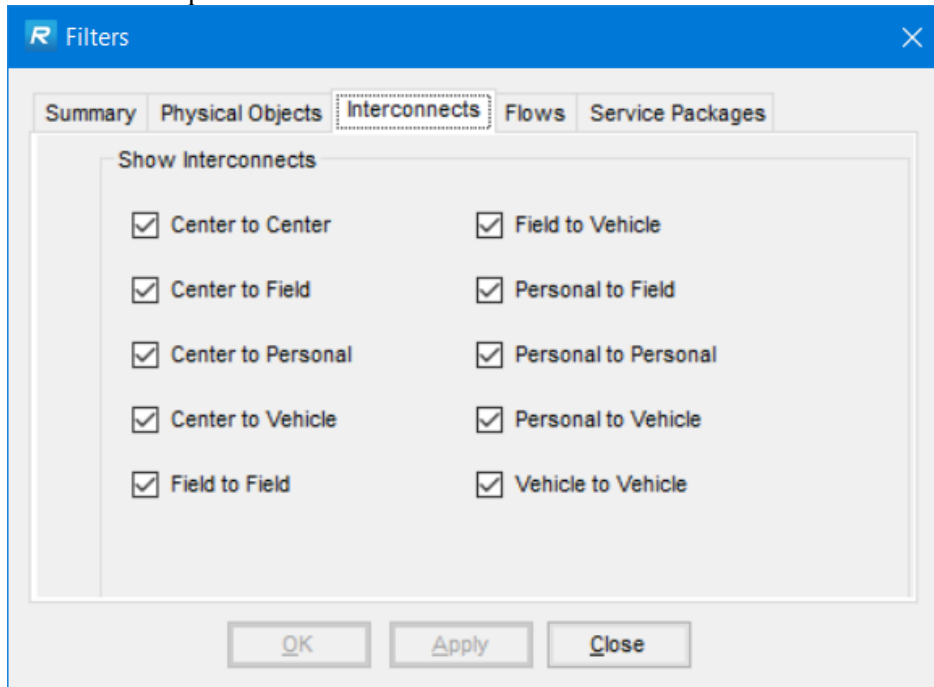


## Flows Filters

The Flows tab of the Flows screen lets you choose whether to show just the Information flows or both the Information and the Request flows and filter by type of flow – system, human, or from an environmental terminator. This tab is also where you can narrow down to show the interfaces by their deployment status – existing, planned, etc.
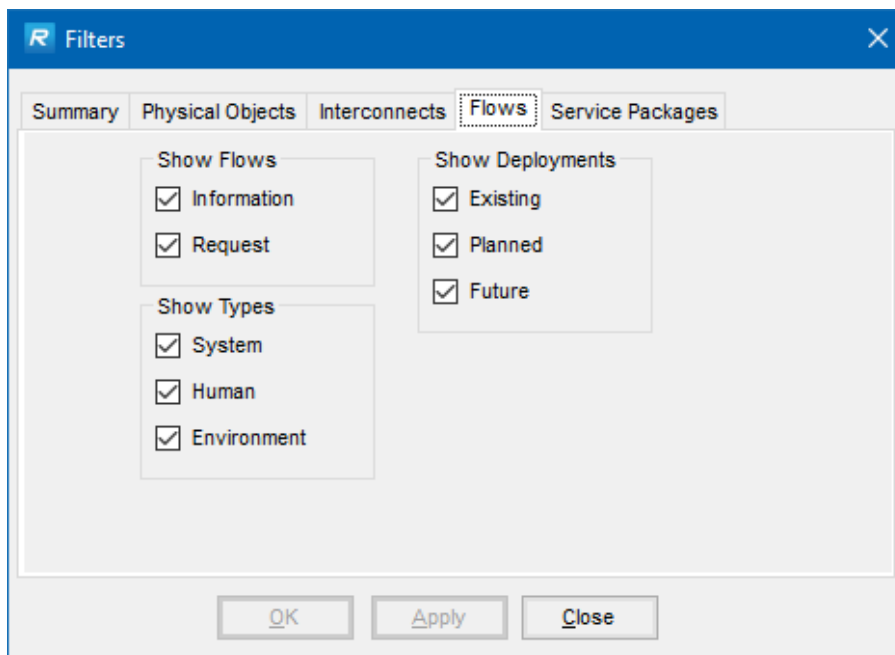
The Service Packages tab on the Filters screen lets you down-select and display the flows based on a single service package.
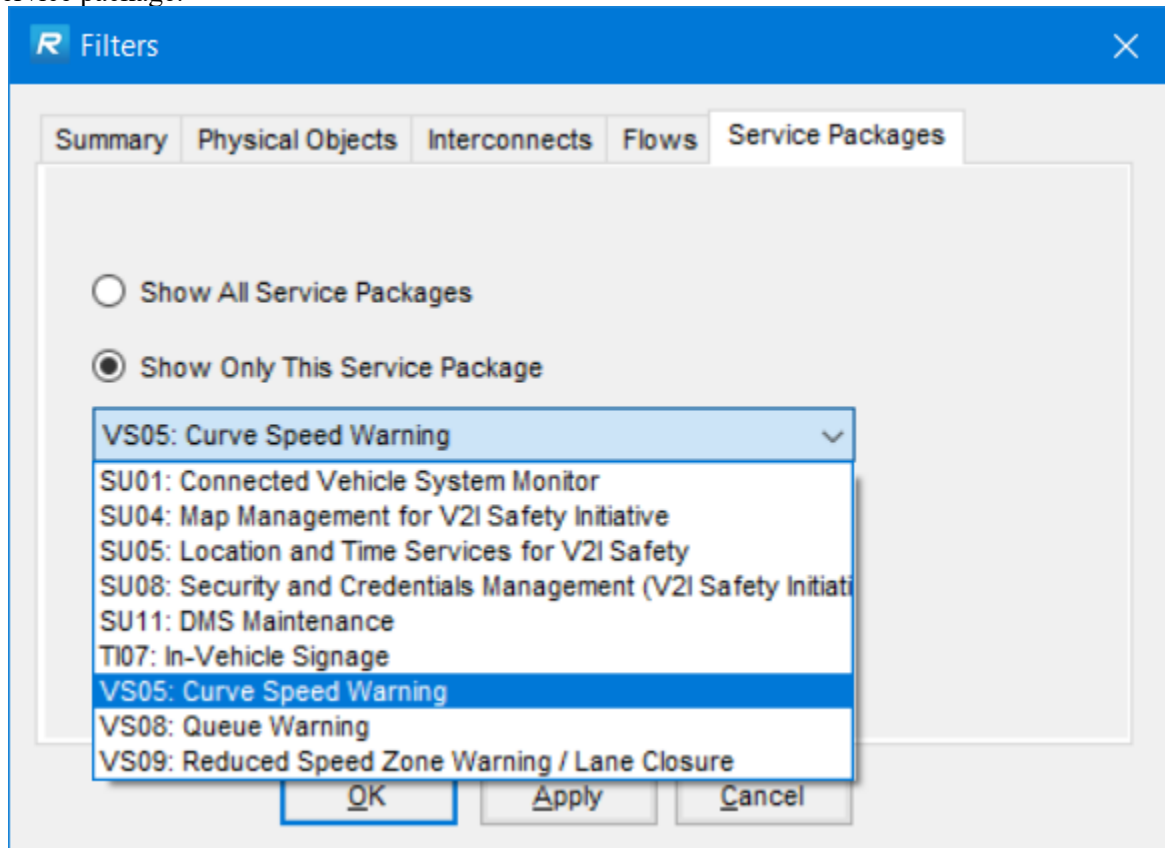


As noted before selecting multiple filters may result in no flows being shown in either the Interfaces tab or the outputs. Check the Filters to see if something should be unchecked.


## Element Selection

To control the number of elements displayed on the diagrams, set the **element selection** for a diagram. The element selections are identical for output tables, diagrams, and the "Interfaces" tab. This option is available in a variety of ways.

- On the menubar, select "Output => Element Selection…".
- On certain output tables and diagram windows, and on the "Interfaces" tab, there is an "Elements" button that provides this option.

The elements and their interconnections that appear on the "Interconnect" and "Flow" Diagrams may be customized in the following manner:

1. To see all elements and all connections between them in the entire architecture, make sure all element boxes are checked on the "Output => Element Selection" window. The "Select All" option on this window may be used to easily select all elements. Select "OK" when finished then select "Preview" on the diagrams window to view the output.

2. To see only the connections between selected elements, select the "Elements" button on the diagrams window then make the appropriate element choices. If many elements need to be removed from the list, the "Clear All" option is available. Then select the required elements. Select "OK" when finished then select "Preview" on the diagrams window to view the output.
3. When working with a Project Architecture, the "Project Elements" option is available. This will show only the elements that are in the project inventory when a particular project architecture is selected. For large architectures, it is difficult to tailor project unique elements when all elements are listed. This option applies to output tables, diagrams, and the "Interfaces" tab. This is not a toggle. If many elements have already been selected for a diagram or report, be careful not to select the "Project Elements" option, because it is not possible to return to the previous list except by using the "Select/Clear All" buttons and selecting the required elements.
4. To see all connections in and out of certain selected elements, as well as the elements that they are connected to, use the "Show All" option on the "Elements Selection" window. Then, select the desired elements. "Preview" the diagram. If you are only interested in viewing the connections between selected elements, turn off the "Show All" option. If "Show All" is selected, all flows associated with the selected elements are included, even if the flows begin or end at an element that is not selected. This option applies to tables, diagrams, and the "Interfaces" tab.
5. To see Communications Elements in your outputs, select the "Show Communications Elements" checkbox. New rows are added for the communications elements and a new column is added to distinguish between the Transportation elements and the Communications elements.

# Diagrams

## *List of Diagrams*

Once you select "Output => Diagrams…" from the menubar, a main diagram dialog menu is displayed. From this dialog, one of the available RAD-IT diagrams can be selected.

**NOTE:** If you are using a cloud-based or network based storage system like OneDrive or Drop Box that try to synchronize your local files over a network then you may get a message that you have a "Locked File Selected" and "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file." If this happens, you can still close RAD-IT and your information is still stored. To avoid this message go into the settings for the file sharing program, e.g. Drop Box, and pause synchronization until you are done generating the diagrams.

There are three types of diagrams that may be displayed or printed by the RAD-IT tool:
1. **Subsystem**: The "Subsystem" (Communications) Diagram for a region or project illustrates the methods that are used to communicate between the subsystems selected for that region or project. These include fixed-point to fixed-point, wide area wireless, dedicated short range, and vehicle-to-vehicle communications. Only the ARC-IT subsystems and communications methods appear on this diagram. Terminators do not appear.
2. **Interconnect**: The "Interconnect" Diagram for a region or project illustrates the interconnections between element/stakeholder pairs selected for that region or project. This diagram captures the physical object interfaces with a single "direction-less" line.
3. **Flow**: The Information "Flow" Diagram for the region or project illustrates the flow of data between the element/stakeholder pairs selected for the region or project. The flow of data appears as physical information flows (one or many) connecting the elements to each other. The direction of the flow of data also appears between the information flows and the elements.

Three different types of diagrams are available for the "Interconnect" and "Flow" diagrams:

- Full Information Flow or Interconnect Diagram for the region or project.
- An Information Flow or Interconnect Diagram that illustrates the connections surrounding a single element/stakeholder. Also called a "context" diagram.
- An Information Flow or Interconnect Diagram that illustrates the connections between multiple (user selected) element/stakeholder pairs.

## *Diagram Options and Buttons*
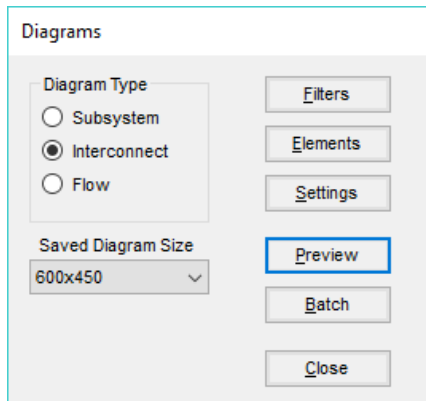


The "Interconnect" and information "Flow" diagrams include a feature to display or print a subset of the architecture, either the interfaces to a single element, or to multiple elements.

Displaying thousands of connections may cause problems, both in the generation of the connections and in the display.

Use the Filters and Elements buttons to control what is shown in the diagrams. See Data Filtering and Element Selection above for more information.

The various options on the "Preview" diagram pulldown menus include:
1. The diagrams may be displayed by selecting on the menubar:  Output => Diagrams… => <diagram name> => Preview.
2. The diagrams being "Previewed" ("Subsystem", "Interconnect", and "Flow") may be saved to a file by selecting on the "Preview" menu: File => Save. A popup window asks for the directory and file name where you want to place the diagram. The file can be saved in EMF, GIF, JPG, PNG, TIF, and BMP formats that may be input to any tool that reads this format (Visio, PowerPoint, etc.).
3. The display of the "Interconnect" and "Flow" Diagrams may be zoomed in or out by using the "Zoom" option on the menubar of these "Preview" diagram windows. Several zoom options are available, from 50% to 400%.
4. The diagrams may be printed to a connected printer by using the "Start => Settings => Printers" option to select or set up the printer on your machine. To print the diagram, select "File => Print" from any "Preview" diagram window.
5. The "Preview" diagrams may be closed by using the "File => Close" option on these windows, or by selecting the "x" in the upper right-hand corner of the display window.

## Information in Diagram Boxes

On the "Subsystem" Diagram, you may click on a subsystem and see a list of all related elements for this subsystem in the region or project.
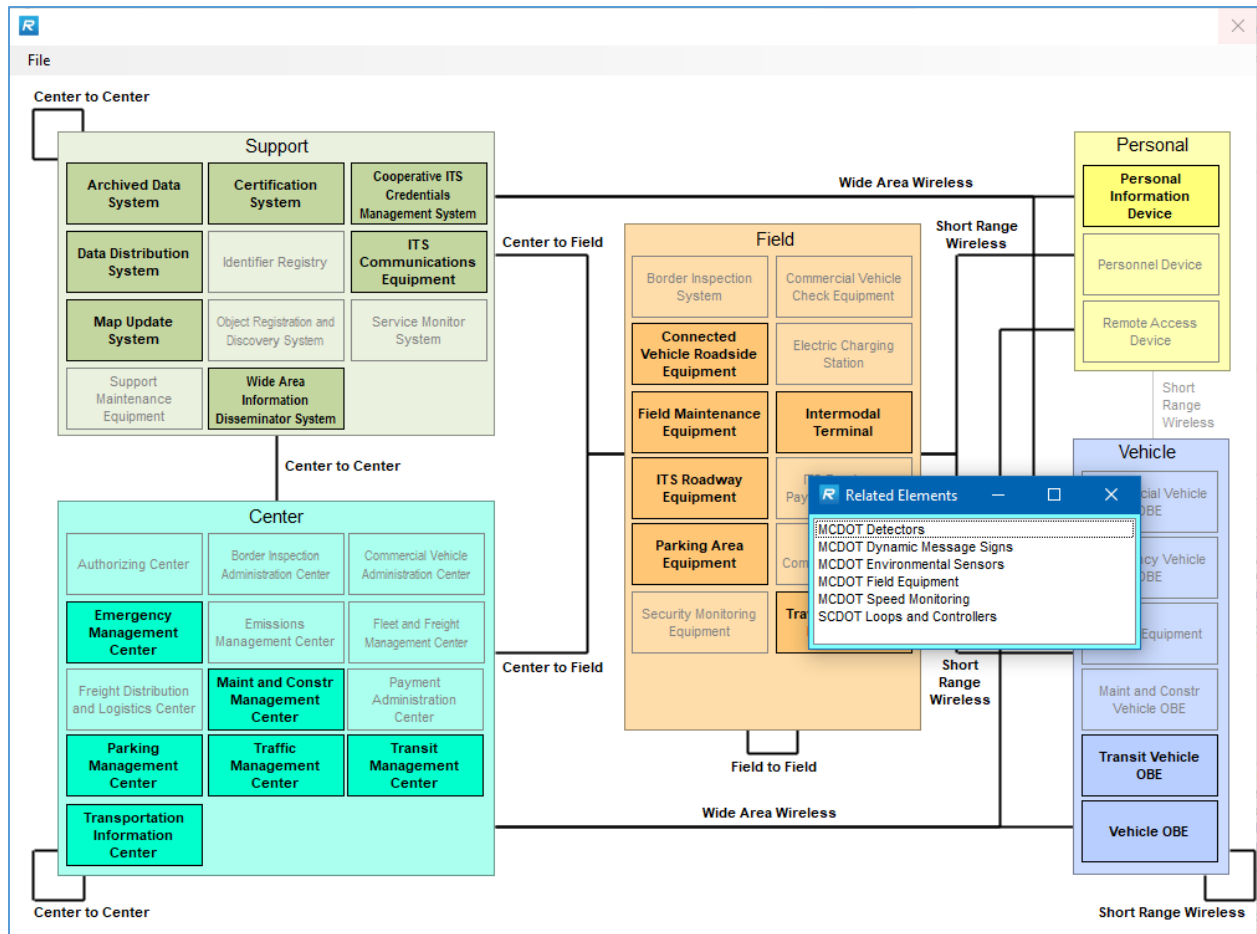


The boxes on the "Interconnect" and Information "Flow" Diagrams contain the element and stakeholder names. For "Interconnect" diagrams, the lines are codified (e.g., solid/dashed and different colors) to distinguish between "Existing", "Planned", and local status value interconnections. Where an interconnect supports information flows with different status values, the interconnect is identified as the status value that is of higher priority, or nearer term. "Flow" diagrams include directed information flows and are also codified to distinguish between different status values.

The placement of boxes on the "Interconnect" and "Flow" Diagrams: The diagram layout algorithm positions the most connected block in the middle and then positions blocks in decreasing numbers of connections, spiraling outward. This algorithm reduces the number of crossed flows that would be plotted with an "alphabetical order" or other ordered diagram layout algorithm.

## Customize Diagrams

You may choose to customize the information presented on the "Interconnect" and "Flow" Diagrams. Physical Objects and flows may be filtered or specific elements selected for the diagrams for the Regional or Project Architecture. The filters are the same for the "Interfaces" tab, diagrams, and tables. The shape

and color of the diagram boxes and the line style and color may be changed via the Diagram "Settings" option. The "Subsystem Diagram" cannot be customized.

## Filtering Diagrams

For the "Interconnect" and "Flow" Diagrams:
1. To set the *filters* for a diagram, select on the menubar: "Output => Filters." This may also be done directly on the "Diagrams" window for the "Interconnect" and "Flow" Diagrams: Output => Diagrams… => <Interconnect or Flow> => Filters  (button on the window).
2. To set the *Element selection* for a diagram, select on the menubar: Output => Element Selection…. This may also be done directly on the "Diagrams" window for the "Interconnect" and "Flow" Diagrams: Output => Diagrams… => <Interconnect or Flow> => Elements (button on the window).

The elements and their interconnections that appear on the "Interconnect" and "Flow" Diagrams may be customized in the following manner:

1. To see all elements and all connections between them in the entire architecture, make sure all element boxes are checked on the "Output => Elements Selection" window. The "Select All" option on this window may be used to easily select all elements. This window is also available under:  Output => Diagrams… => <diagram name> => Elements. Then preview the diagram: Output => Diagrams… => <diagram name> => Preview.
2. To see only the connections between selected elements, select the "Elements" button on the diagrams window then make the appropriate element choices. If many elements need to be removed from the list, the "Clear All" option is available. Then select the required elements. Select "OK" when finished then select "Preview" on the diagrams window to view the output.
3. To see all connections in and out of certain selected elements, as well as the elements that they are connected to, use the "Show All" option on the "Output => Diagrams…" window. Then, select the desired elements on the "Output => Diagrams… => <diagram name> => Elements" window. The elements may also be selected first on the "Output => Element Selection" window, then "Show All" selected on the diagram window. Preview the diagram. If you are only interested in viewing the connections between selected elements, turn off the "Show All" option.

CAUTION – Filters can be set so that your outputs may end up blank or empty. If you are trying to generate an Inventory table and it is blank it could be because you have a filter set to filter out all objects that are in your architecture.

## Diagram Settings

For the shapes and lines in the "Interconnect" and "Flow" diagrams, you may change the appearance of element boxes and the lines representing the status values.

To change the *shape* of an element box in either the "Interconnect" or "Flow" diagram:
1. Select the type of diagram: "Interconnect" or "Flow" on the "Diagrams" window.

2.  Select the "Settings" option.
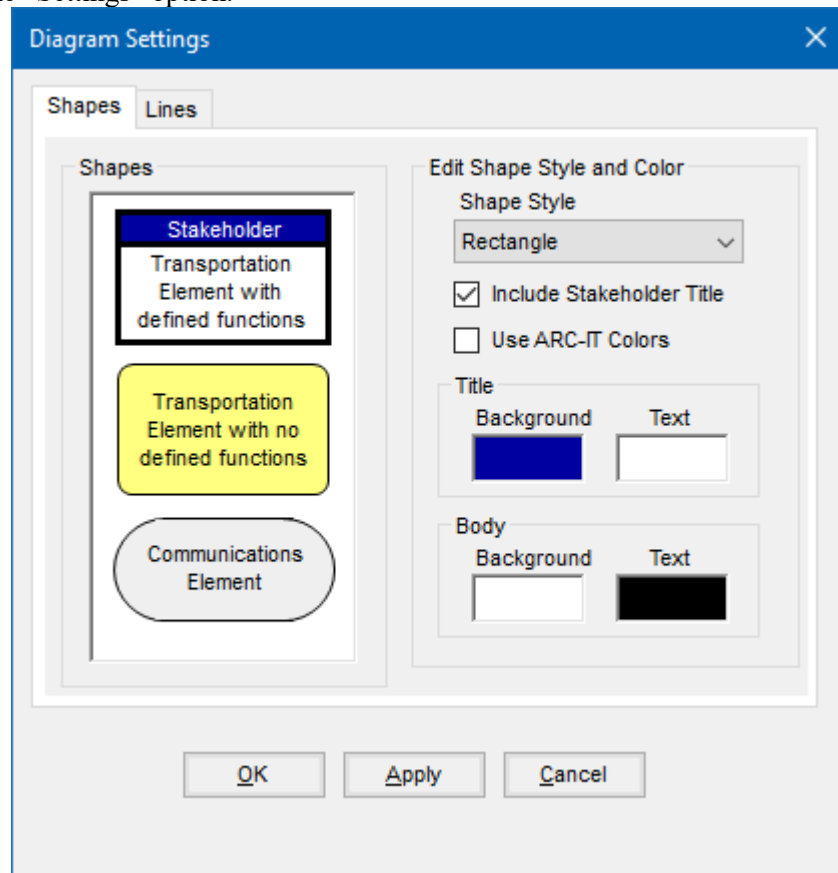


3.  When changes are made to the right-hand side attributes for a shape, they are immediately displayed in the shapes on the left but are not saved until "Apply" or "OK" is selected.
4.  On the Shapes tab, the default for Transportation elements with defined functions is a rectangle with blue title bar while the default for Transportation elements with no defined functions is a rounded yellow rectangle with rounded corners. The default for Communications elements is a oval-type shape, known as a sausage. These can be changed by clicking the radio button for the box on the left and select from the "Shape Style" list box on the right.
5.  The "Include Stakeholder Title" checkbox is checked by default for subsystems (elements with defined functions). If the stakeholder name is not required at the top of the element boxes in the diagrams, uncheck this box. However, it will then not be possible to recognize the stakeholder names in the diagrams. It is recommended to leave this box checked.
6.  The colors selected for the background and text of the "Title" and "Body" of the element boxes in the diagrams may be changed. Click on the colored box and change the color from the palette that appears. These colors may be changed separately for elements with and without defined functions. Select each box on the left and change the colors on the right.
7.  You can also click "Use ARC-IT Colors" and the boxes will be colored based on the class of the element to closely match the colors used in the service package diagrams used on the http://www.arc-it.net/ website. Orange for Field, Green for Centers, etc.  If you click that then you can't customize the colors for the Title or Body.
8.  Click "OK" or "Apply" to accept the change, or "Cancel" to abort the change. NOTE that you may make changes to both shapes and lines before selecting "Apply". "Close" toggles to "Cancel" once editing begins.

To change the *line style* in either the "Interconnect" or "Flow" diagram:

1. Select the type of diagram: "Interconnect" or "Flow" on the "Diagrams" window.
2. Select the "Settings" option.
3. On the "Lines" tab, all status values are listed on the left with a default line style and color on the right.
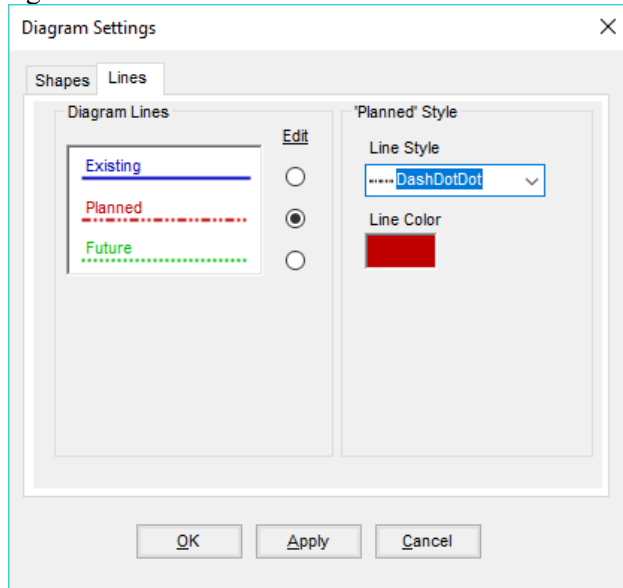


4. To change a line style and color:
   a. Select the status value on the left ("Existing", "Planned", or a local status value created via the "Tools => Update Status" option on the menubar). Each status value is represented by a different line style.
   b. Select a line style from the list box on the right.
   c. Click on the "Line Color" box on the right and select a color from the color palette that appears.
5. Click "OK" or "Apply" to accept the change, or "Cancel" to abort the change.


## Batch Generation of Diagrams

The "Batch" feature of the "Diagrams" window allows you to generate many diagrams with a single command. For example, all interface diagrams or context diagrams for every element may be generated in batch mode based on user specified parameters. All Service Package diagrams can also be printed in batch mode.

1. Select the type of diagram to be batch generated: "Interconnect" or "Flow" on the "Diagrams" window.

2. Select the "Batch" option.
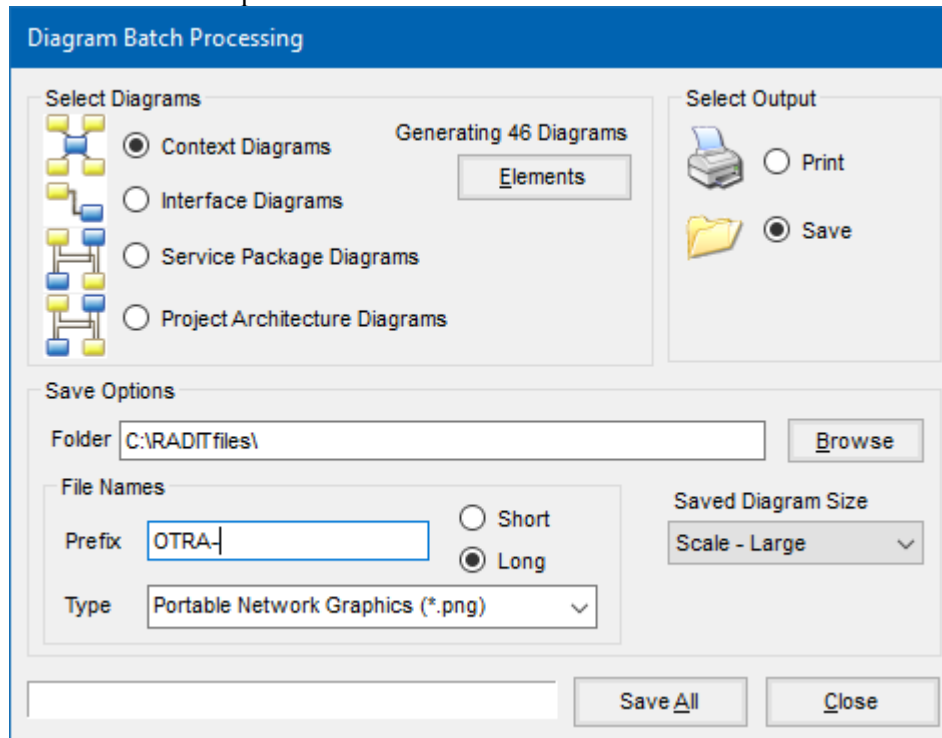


NOTE: it will display the number of diagrams to be generated just above the Elements button. To reduce the number of diagrams you my use the Elements window to down-select some of them or go back and use the Filters.

3. To select the inventory elements to be included in the diagrams to be batch generated, select the "Elements" button, choose the elements, click "OK". These will be the elements that define the context or interface diagrams that are to be printed. If all elements are selected, then there will be a diagram printed for each.

4. Specify whether context diagrams or interface diagrams are to be batch generated.
   a. "Context Diagrams" show the interfaces between one element and all other elements.
   b. "Interface Diagrams" show the interface between a single pair of elements.
   c. "Service Package Diagrams" show the interfaces pertaining to a particular service package.
   d. "Project Architecture Diagrams" show all of the interfaces pertaining to each project architecture in the file.

5. Select "Print" to print the diagrams.
   a. Select the "Print All" option.
   b. The "Print" option will display a "Print" dialog box listing available printers and initiate batch printing of all diagrams of the selected type.

6. Select "Save" to save the diagrams to a file.
   a. The "Save" option allows you to select a directory where the diagrams are to be stored.
   b. A "Short" or "Long" name style may be selected for the file names of the saved files, or a "Prefix" to the long or short names may be entered.
   c. The short names are typically a number, while the long names represent the inventory element names in the architecture.
   d. All name styles identify whether the file contains a context or interface diagram.
   e. Select the "Save All" option.
   f. The files are saved in ".emf" (Enhanced Metafile), GIF, JPG, PNG, TIF, or BMP format.

g. If a file already exists, you are given the option to replace or not replace the existing file.
7. "Close" closes the "Diagram Batch Processing" window.

**TIP:** Use the Saved Diagram Size pull-down and change to "Scale – Medium" or "Scale – Large" when generating large complex diagrams. This will create more legible outputs when importing them into a Word document or presentation.

## Tabular Output

RAD-IT includes tools to let you generate reports or outputs in tabular form that you can use to generate documents or presentations about your project. These Output Tables provide a means to output the content from the main tabs into tabular formats that can be imported into other Microsoft Office automation products.

**NOTE:** If you are using a cloud-based or network based storage system like OneDrive or Drop Box that try to synchronize your local files over a network then you may get a message that you have a "Locked File Selected" and "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file." If this happens, you can still close RAD-IT and your information is still stored. To avoid this message, go into the settings for the file sharing program, e.g. Drop Box, and pause synchronization until you are done generating the tables.

### *Output Tables Window*

From the Outputs tool bar, click **Tables** to bring up the **Output Tables** window.

Click the 1st pull-down to **Select Table**. You can traverse through the categories to find the report you want.

In the 2nd area select from the **Available Columns** which will vary depending on the table selected in the first step.

Use the left arrow to select individual columns to include (they will then move to the Selected Columns table). You can also use the double left arrow to include all the columns.

The **Filters** and **Elements** buttons work exactly as they do on the "Interfaces" tab and the Diagrams screen. They are only activated for tables for which they would apply, e.g. inventory, interfaces, etc.

The Output Tables window has a pull-down to select the type of table to be generated. Once the selection is made, the left side of the screen is populated with the fields that can be included in that table. The user can select the arrow or multi-arrow buttons in the middle of the window to move fields to be included in the output. The user can also use the lower two arrow buttons to remove fields that aren't desired for the table.

The next step is to decide whether to save the output to a file or to open the application. You must have the application (e.g. Word, Excel) installed on your computer to create output for Word or Excel. The final step is to press one of the buttons to create the output either to Word, Excel, or a text based comma separated variable (CSV) output.

The checkbox to "Roll up multiple rows into a single row" is used to combine cells together such as combining all Elements together that are mapped to the same Physical Object. This can save space and help tell the story easier. You can decide what's best for what you are trying to do.

If there is nothing to display for a particular table then a message will appear in the left area of the Tables screen saying there is nothing to display.

For example, if I have not done anything on the Planning Tab to create Objectives or Strategies when I select the Planning table the message in the Available Columns area will say, "The planning tab includes no defined items for the current architecture."

> CAUTION – "*What if my tables are blank?*" Filters and Element Selection can be set so that your outputs may end up blank or empty. If you are trying to generate an Inventory table and it is blank it could be because you have a filter set to filter out all objects that are in your architecture. Click the Filters and Elements buttons to see what is set and make adjustments.

## List of Output Tables

The tabular reports included on the "Tables" screen consist of the following:

## Summary / File Info Tables

Summary information about the regional and project architectures contained in this file.

- **Architecture Summary** –This table presents summary information for all Regional and Project Architectures that have been defined in the file. This table has settings for displaying the description of each architecture, entries made on the "Start" tab for each architecture, and the region (US, Canada, EU, Australia) for which the architecture applies.

- **Architecture Summary Details** – builds a table of statistics about the architectures in your file, regional and any projects. For each architecture it lists the number of unique service packages, service package instances, elements, information flows, possible flows shown on the interfaces tab, interconnects, agreements, user defined physical objects, user defined flows, and the number of projects in the file.

- **Change Log** - A record of the changes made to the selected architecture as recorded by the user. Each entry includes timestamp, name, version, and change description.

- **Status Values** – List of status values (existing, planned, etc.) defined for this file.

- **Stakeholder Summary** – list of stakeholders in each architecture

- **Inventory Summary** – list of inventory elements in each architecture

- **Service Package Summary** – list of service packages in each architecture

- **Filter Settings** – list of the current filter settings for the file

The 4 summary reports are good when you have multiple architectures in your file and you want one table that shows them all.

**TIP:** This may work best if you don't include every column. For instance, a summary table may be too long if you try to include the description fields.

**TIP:** To generate a listing of Service Packages by project include the Architecture Type, Architecture, and Service Package. Then in the output filter out or remove the rows pertaining to the Regional architecture. Then use the Architecture and Service Package column for your final report. See an excerpt below from the Marinara sample file:

| Architecture | Service Package |
|---|---|
| MCDOT Saucelito Traffic Coordination | TM07: Regional Traffic Management |
| MCDOT Traffic Monitoring Expansion Project | TM01: MCDOT Traffic Monitoring Upgrade |
| MCDOT V2I Safety Initiative | SU01: Connected Vehicle System Monitor |
| MCDOT V2I Safety Initiative | SU04: Map Management with Connected Vehicles |
| MCDOT V2I Safety Initiative | SU08: Security and Credentials Management |
| MCDOT V2I Safety Initiative | SU10: Field Maintenance |
| MCDOT V2I Safety Initiative | TI07: In-Vehicle Signage |
| MCDOT V2I Safety Initiative | VS05: Curve Speed Warning |
| MCDOT V2I Safety Initiative | VS08: Queue Warning |
| MCDOT V2I Safety Initiative | VS09: Reduced Speed Zone Warning / Lane Closure |
| TOMATO | PM04: Regional Parking Management |
| TOMATO | SU04: Map Management |
| TOMATO | TI01: Broadcast Traveler Information |
| TOMATO | TI02: Personalized Traveler Information |
| TOMATO | TI04: Infrastructure-Provided Trip Planning and Route Guidance |
| TOMATO | TI05: Travel Services Information and Reservation |

*Stakeholder Topics Tables*

Information about the stakeholders – groups, organizations, enterprises, and the institutional activities that are associated with this architecture.

- **Planning** – Planning elements such as objectives and strategies, performance measures, and their relationship to the architecture. This table can be configured to show Service Packages mapped to the objectives/strategies.

- **Stakeholders** - Shows identified stakeholder names, descriptions, and associated elements. If there is a contact name, it should be included in the description in order to be displayed in the report. This can also identify stakeholder groups and their members.

- **Roles and Responsibilities** – Shows the roles and responsibilities, i.e., an operational concept, based on service package choices defined for the currently selected architecture. This table displays information in line with CFR 940. This can be sorted in various ways: by stakeholder name, with a description of the roles and responsibility area, or by displaying the service packages associated with the area, listing members of a stakeholder group, and listing available status values.

- **Agreements** - Listing the set of Agreements defined on the "Agreements" tab for the current or selected architecture. These are agreements between stakeholders or agencies, and are added as attributes of the architecture in line with CFR 940. Each agreement is defined by a number, type,

title, status, lead stakeholder, and may include associated stakeholders, elements, and service packages.

- **Interfaces to Agreements** – Listing the mapping between the Agreements and the Information Flows. Applicable if the interface level agreements were created.

## *Physical Components & Services Tables*

Physical objects, elements, service packages, and included functionality that make up the architecture.

- **Inventory** – Presents all identified inventory elements with associated physical objects, stakeholders, and projects, including user defined physical objects and flows. It shows the element inventory for the selected architecture, either project or regional. If in a Project Architecture, the entire Regional Architecture inventory does not appear.

- **Services** - Shows ARC-IT service packages, your service package instances, and their selection status related to the initial projects and services. This will appear differently for Regional and Project Architectures. You can also include Comments and a list of the Included Elements.

- **Needs** - Shows the need areas and needs defined for the currently selected architecture based on the service package choices and the customizations made for the architecture.

- **Requirements** – Report showing the functional objects and requirements defined for the currently selected architecture based on the element mappings and service package choices.

- **Functional Objects** - Shows the functional objects defined for the currently selected architecture based on the service package choices. The functional objects directly relate to the Functional Objects in ARC-IT.

- **Physical Objects** - Subsystems and terminators from ARC-IT that are included in the selected architecture along with any user defined physical objects.

- **Inventory to Service Package Comparison** - Compares Inventory and Service Package selections and identifies possible Inventory and/or Service Package selection gaps. This identifies ARC-IT and user defined physical objects and inventory elements that are not assigned to any Service Package, and physical objects and elements that are not assigned to a Service Package where it is possible to include them.

- **Needs to Requirements** – Provides a traceability table that maps the User Needs to the Functional Objects and Requirements.

## *Interfaces & Standards Tables*

Interconnects, flows, and standards activities for the current architecture.

- **Interconnects** - Shows the interconnected elements and their status values for the interconnects in the current architecture, similar to the "Interconnect" diagram. It can also show what communications elements the interconnect is using.

- **Information Flows** - Shows the permutations of element interfaces included and not included in the architecture with the source, destination, and their status value. This table can also show the

Service Package instances associated with a flow. Use the Filters and Elements button to select what is included.  If you want to create a report that shows the flows for each service package simply reorder the fields so that Service Package comes before the source, destination, and flow name.

- **Flow Definitions** - presents the information flows and definitions for this architecture.

- **Communications Solutions per Interface** – Identifies the selected communications solution for each interface in the architecture. It includes the information flow triple info, solution name, solution description, and issues that are assigned at the triple solution (or profile) level. Can be filtered by filters/element selection to make it easy to subset.

- **Communication Solution Details** – Presents the detailed definition for each communications solution associated with the current architecture. It identifies the included standards and all issues assigned at the standard, profile, or solution level. As a companion output for Comm Solutions By Interface, it can also be filtered by filters/element selections so the two outputs will be consistent. Issues include things like the standard is not yet complete or doesn't include key interfaces pertinent to the architecture. These issues are assigned a severity score and the lower the score the better or more feasible it will be to deploy using that standard or communications solution.

- **Physical Standards** – Presents all relevant physical standards and their relationship to the current architecture. Some standards have been identified that are mapped to physical and/or functional objects. This output will let you see the Element to which those standards apply.

**NOTE:** Users should refer to the Communications View on the ARC-IT website for more information about communications solutions and the standards they include. For projects, users should use SET-IT that will then generate a set of Comm View solutions that can be customized to meet the project's needs.

*Check Your Architecture Tables*
Identify inconsistencies and potential errors in your architectures

- **Inventory to Service Package Comparison** - Conflict resolution report that compares Inventory and Service Package selections and identifies possible Inventory and/or Service Package selection gaps. This report identifies ARC-IT and user defined physical objects and inventory elements that are not assigned to any Service Package, and physical objects and elements that are not assigned to a Service Package where it is possible to include them.

- **Discontinued Flows** - Report showing the discontinued information flows between elements that are included in the converted Regional and Project Architectures. This is a report created during the conversion of an architecture from a previous version of RAD-IT. The report is available during the conversion and from the list of standard RAD-IT reports. There are no settings for this report except report title.

- **Unsupported Flows** - Report identifying Regional and Project Information flows that are not supported by current element to entity mappings in the current version of ARC-IT or user defined flow definitions. This report shows the flows that are ignored by the conversion (i.e., they are included "as is" in the converted architecture), but that must be addressed by you in the converted

architecture. For example, information flow "ElementA => asset restrictions => ElementB" would be an unsupported flow unless ElementA is mapped to the "Asset Management" terminator and ElementB is mapped to MCMC. Many existing architectures include these flows on the "Interfaces" tab because element to entity mappings have changed over time. As part of the conversion from previous versions, unsupported flows that are "not applicable" are automatically removed. There are no settings for this report except report title.

- **Interfaces to Inventory Inconsistencies** – Report identifying the list of inventory elements that are not connected to any other inventory elements in the architecture as well as interfaces on the Interfaces tab where the source or destination (or comm element) are not included on the Inventory tab. This report includes the architecture in question (regional or one of the projects), the element and the issue.

- **Unconnected Stakeholders** - Report identifying the list of stakeholders that are not associated with any inventory elements in the architecture. This report has settings for displaying a description of each stakeholder and listing members of a stakeholder group.

- **Suspicious Information Flow Status Values** – Report identifying where information flows with older status go between elements with newer status. Say, for example, you started an architecture where everything was planned or future but then as you or your stakeholders were reviewing the information flows you started to see places where things already existed so you started changing the status of the flows to Existing. Because you hadn't gone back to the inventory tab to change the status of the elements that were sending or receiving that information you created a situation where elements that haven't been developed yet are already sending/receiving information. This is illogical and this report will point that out.

- **Suspicious Request / Response Status Values** – Report identifying request information flows that have a different status values than a corresponding response flow. This report has a setting to display the available status values.

- **Planning Gap Analysis** – Report identifying the differences between the service packages associated with planning (on the planning tab) and service packages (on the services tab) included in the architecture. There is a setting to display the description. This includes parent service packages or instances.

- **All Potential Needs** – Report identifying all needs associated with all of the service packages in the architecture; use the Applicability column to see which are assigned to the project.

- **Elements with complex Physical Object mapping** – Report identifying potential issues with inventory elements that are mapped to too many or to the wrong physical objects. For instance, a center mapped to both a Traffic Management Center and a piece of field equipment.

- **Suspicious Project Status Values** – Report identifying inventory elements, service packages, functional objects, and information flows that have newer status values than the current project architecture. This report has a setting to display the available status values.

- **Physical Object - Functional Object Inconsistencies** – Report identifying elements with mappings to functional objects (Functions tab) that are not consistent with that element's physical object mappings (Inventory tab)

- **Service Package - Interface Inconsistencies** – Report that calculates the percentage (%) of information flows, called 'triples', that are included in each service package. Triples is the shorthand way of saying source/destination/information flow combination. Use this report to debug places where you may not have as many elements as you want from the Services tab participating in that Service Package or if you did not include as many flows on the Interfaces tab.

| Triples Included% | Service Package |
|---|---|
| 0 | SU04: Map Management |
| 10 | TI02: Personalized Traveler Information |
| 13 | TI01: Broadcast Traveler Information |
| 20 | PM04: Regional Parking Management |
| 25 | TI04: Infrastructure-Provided Trip Planning and Route Guidance |
| 34 | TI05: Travel Services Information and Reservation |

**TIP:** Focus on the top rows of the table since those are most likely places where you have an issue with your element mappings to the service package. This report will be sorted from lowest percentage to highest.

For example, if you gone through the first pass of most of the tabs and run this report it might show a traveler information package with only 10% of the flows included. This may be a clue that you may have forgotten to include a source of data like at transit center. On the other hand you may look through the report and review your architecture and decide you wanted it that way. This report just arms you with the information to make that decision.

- **Needs to Requirements Mapping Issues** – Report identifying issues with mappings between needs and functional requirements (Functions tab) - Needs that aren't covered by any Requirements or Requirements that don't trace to any Needs.
- **Need Areas to Service Package Mapping Issues** – Identifies need areas where the mapped service package is not included in the architecture.


## *Region to Project Comparison Tables*
Identify inconsistencies and potential issues between the Region and any projects in your file

- **Compare Inventory** – Identifies any inventory differences between the regional and project architectures.
- **Compare Services (Service Packages)** – Identifies any service package differences between the regional and project architectures.
- **Compare Needs** – Identifies any differences in the needs defined between each of the projects and the regional architecture.
- **Compare Communications Solutions** – Identifies differences in communications solutions selected for the same information flow triples between the regional architecture and any of the project architectures. It also lists information flow triples that are assigned to one or more projects that are not included in the region.

## Documents

### Document Output - General

RAD-IT includes a method of generating a Word Document directly from the Regional ITS Architecture data stored in the RAD-IT database. This feature supports documents for regional architectures or project architectures.

> **TIP:** Select the architecture on the Start Tab before selecting the Output/Document… feature.

The user has the option to create the document or the diagrams or both. The user then can select Elements to be included or to set Filters just as with other outputs. The user then selects Setup to tell RAD-IT how to generate the document. Then the Create button will run the generator and the View button will launch the document in Word.

> **NOTE:** One must have Microsoft Word installed on their computer for this feature to work.

**NOTE:** If you are using a cloud-based or network based storage system like OneDrive or Drop Box that try to synchronize your local files over a network then you may get a message that you have a "Locked File Selected" and "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file." If this happens, you can still close RAD-IT and your information is still stored. To avoid this message go into the settings for the file sharing program, e.g. Drop Box, and pause synchronization until you are done generating the documents.

### Document Output – Setup and Creation

Much like the Web Page generation setup, the user has access to a number of settings that determine the content and format of the document that is created.

The General tab is used to specify where the document will be created, the document filename, and the Microsoft Word template file that will be used for document creation. Once the directory is identified for document creation, select Apply to create the directory structure and enable access to more detailed settings on the Content tab.

The General Tab provides access (use the Edit button) to the "ArchDocTemplateRegion.dot" template that is used by RAD-IT to control the format and layout of the created document.

Checkboxes are used to determine whether the content in the RAD-IT Database should be used or the content in the template should be used for things like the title page and chapter headings.



Before you create the document, you should edit the introductory text in each chapter of the template and update the document styles as desired. As you edit this template, you should maintain some minimal conventions and be particularly careful not to delete or modify the bookmarks and tags that RAD-IT uses so that the template can still be used by RAD-IT. See introductory text in the template itself for more information. The template is the place to insert introductory and boilerplate text and images that provide a

gentle introduction to the architecture details that will be inserted by RAD-IT. Including the content in the template will allow you to minimize manual effort in subsequent document creations as the architecture details change over time, but the introductory content stays the same.

The Content Settings has a tab on the left for each area of RAD-IT that then would generate a section in the Word document. There are optional settings to decide what to include in each section. The user can also decide to include some information in the Appendix – for instance, some architectures may generate pages and pages of tables that may be best to put into an Appendix.



Once setup is complete, select the Create button for either the Document body, the diagrams or both. Just as with the Web Pages generation, you may want to create the document body content in one step and the

diagrams in another step. A large architecture may take a while to generate. Once it is complete, you can click View to launch Word to view the resulting file or start Word separately and open the document.

**NOTE:** if you choose to include interface diagrams in your document it will automatically perform a Batch generation of the diagrams and insert PNG formatted graphics into the document.

## Web Pages

### Web Pages General Information

RAD-IT will automatically create a set of preformatted hypertext (web) pages that can be used to build a website to display a regional architecture. This hyperlinked set of web pages includes pages for each aspect of the regional ITS architecture that is defined in RAD-IT including Stakeholder information, an inventory of transportation systems, services, functional objects, interfaces, communications solutions information, and ITS project information. The user has the capability to customize the pages with their own agency logos, contact information, and can tailor the content of the pages to meet their needs. When hosted on a website these pages make the regional ITS architecture definition available to transportation professionals in an interactive, user friendly format. RAD-IT can only create web pages for a Regional architecture – not a project architecture.

**NOTE:** If you are using a cloud-based or network based storage system like OneDrive or Drop Box that try to synchronize your local files over a network then you may get a message that you have a "Locked File Selected" and "The selected file appears to already be open in another application. Please close the other application so RAD-IT has exclusive access to the file." If this happens, you can still close RAD-IT and your information is still stored. To avoid this message go into the settings for the file sharing program, e.g. Drop Box, and pause synchronization until you are done generating the web pages.

### Creating Web Pages

The Web Pages window is arranged as follows:
- Create – the top left area has 3 options to click to create varying levels of detail:
  - Top-Level Web pages
  - Detailed Web Pages
  - Diagrams

This allows the user flexibility in managing how the web pages are built. Early in the life of a project you may not be ready to show all the details but you want to go ahead and develop the basic screens so your stakeholders can see what the end product will look like once the details are done. At this early stage they can still see the basic list of Stakeholders, Inventory, etc. Later, you can generate the Detailed Web Pages that pull more information out of the RAD-IT database, including the pages for each inventory element, services, and interfaces. Lastly, the Diagrams can be built that bring in all of the context and interface diagrams and attaches them to the proper place in the hypertext.

It is recommended that the first time through the web page generation process, you should create only the Top-Level Web Pages to quickly generate pages that you can review. Make sure the look and feel is right, then go back and generate the Detailed pages, then go back and add the Diagrams.

**NOTE:** if you choose to include diagrams in your web pages it will automatically perform a Batch generation of the diagrams and insert PNG formatted graphics into the appropriate web pages.

Feature on the Web Pages Window:

- **Status** – below the Create area is a status box that tells you what process is being performed. This is helpful since it may take a while to generate the web pages for a typical architecture. This will let you know what pages are being built.
- **Progress** – colors in the bar below the status window from left to right to represent the overall progress of the build operation.
- **Setup button** – establishes the general settings and preferences for how and where the pages are built and what they will look like.
- **Create button** – initiates the creation of the web pages, pulling in the necessary data from the RAD-IT database and putting them into the proper files based on the settings entered during Setup.
- **View button** – launches the initial welcome page for your new architecture in your default web browser (e.g. Chrome, Microsoft Edge, Mozilla Firefox).
- **Close button** – returns to the main RAD-IT window.

## *Web Page Setup*

To start generating web pages, RAD-IT needs some basic information. You can configure RAD-IT to control the colors and fonts used, the nomenclature, the types of pages that are generated and the content to be included on each page, and more. Advanced users can use templates to augment the HTML that is included in each page and supply their own user defined pages.

Click on Setup from the Web Pages window and a form opens with the following tabs: General, Content, Style, and File Locations.

## Web Page Setup – General Tab

The **General** Web Page Setup information tab is used to capture information that applies to all web pages. An essential piece of information is the folder where all the web pages and supporting files will be saved. Clicking on the Browse button will bring up a windows explorer window to find and select the folder to use. If the folder is not empty, RAD-IT will determine that a new subfolder should be created to keep everything organized. In that case a popup window will appear once the user hits Apply.

The *Web Site Title* will be included at the top of every web page. In general, users will probably want to enter the name of their region, e.g. "Marinara County" in our example; but it could be anything.

**NOTE** – the title is limited to 40 characters to ensure it fits best in most web browsers.

The *Extension* pulldown allows the user to pick either htm or html or type another extension to use. The default htm is almost always going to work but some web server environments require a certain extension which can be selected/entered here.

The *Web Site Contact Information* area allows the user to include a Name, email address, and phone number that will appear at the bottom of the main web page. This may be important – perhaps putting the name and contact information for the maintainer of the architecture or a contact for the web administrator for the agency.

*Web Page Setup – Content Tab*

The **Content** tab of the Setup Window allows the user to select the web pages to be included (defaults to all). Selecting one of the pages on the left, brings up the information for that page on the right. For instance, by selecting Scope, you can confirm the scope as entered on the Start tab in RAD-IT and check off the various features to include on the Scope page: Architecture description, geographic scope, etc.
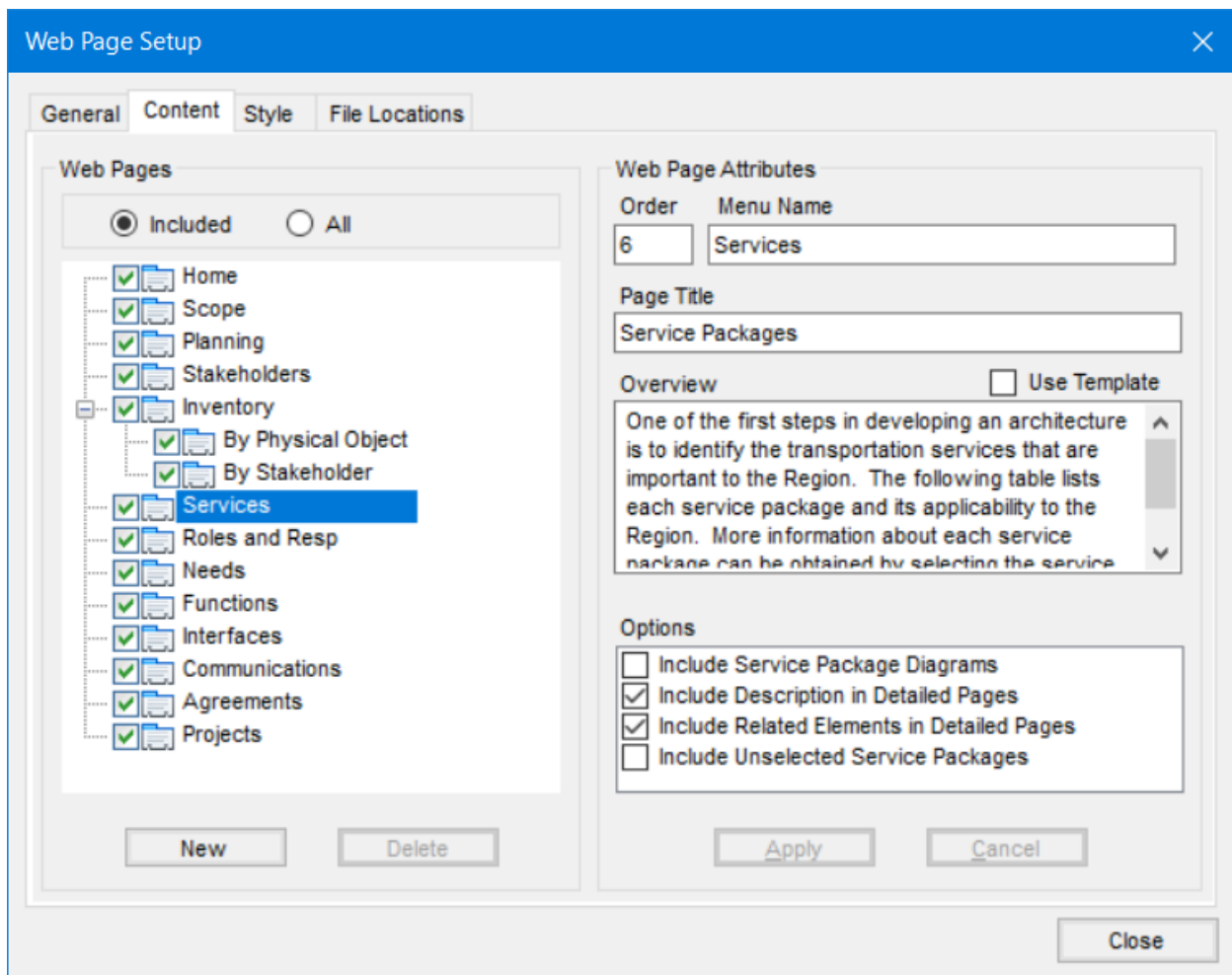


Just as on the Inventory and other RAD-IT screens if the user wants to add a page to be generated with the website, click on the All Web Pages tab and use the check boxes to include other pages and hit apply. Once the user has selected a page on the left, its attributes can be modified on the right.

Web Page Setup – Content Tab Attributes:
- **Order**: changing this will reorder the listing of the pages on the main menu panel for the architecture pages. For example, if you wanted Stakeholders to come after Inventory you would change Stakeholders to "4" and Inventory to "3" – hitting Apply each time.
- **Menu name**: allows the user to change the name that appears on the main menu panel for the architecture pages. For example, changing "Roles and Responsibilities" to "R&Rs".
- **Page Title**: changes the title that appears at the top of that page.

- **Overview**: is the text that appears at the top of the page.
- **Use Template box**: allows the user to direct RAD-IT to ignore this text box and pull the information from the html files that can be edited separately. The File Locations tab would be used to specify the Template files and where they are located.
- **Options:** depending on the page there may be options to include extra data either in tables or diagrams on this page and you can check or uncheck the options and hit Apply.

### User Defined Web Pages?

The user can also select "New" to create a custom web page for the project. For example, you could create a "Documents" page that includes links to all your architecture documents. In most cases, when you are creating a user defined page, you will want to use a template page to define the HTML for the new web page. Alternatively, you can enter all of the HTML right in the Overview text box.

User defined pages may also reference an external page that is not created by RAD-IT. In this case, the user would select the "External" page type and then specify the URL that will be used to access the page. The user must enter a complete valid URL (e.g., http://www.YourAgencyName.xxx).

### Web Page Setup – Style Tab

The **Style** tab of the Setup Window allows the user to specify the colors of the background, text, and other features pertaining to the look-and-feel of the web pages.

The Select Web Page Area shows what the basic web page will look like based on the colors, graphics, and fonts selected on the rest of the tab. To change the color of the web page banner, start by clicking on the top bar of the Web Page area on the left of the window then click the colored box next to Background and a pop-up screen will appear to change the color. Similarly with the Text color and borders. To change other areas of the screen like the menu bar, click on the menu area on the left side and then change the background and text colors on the right.

Use the check box beside Use Background Graphic to include or exclude a background image that appears in the upper left of the banner/main page. The default image that is provided with RAD-IT is a RAD-IT Icon, but this image should be replaced with a more relevant image by most users. You can find where this image is stored using the File Locations tab. The graphic extension pull-down allows the user to change the graphic file format to png, gif, or jpg. Note that png and gif file formats can have a transparent background which will allow the background color to show through the transparent area of the image. The options at the bottom allow the user to select how large the web pages should be in terms of pixels – 800 being the default but 1024 and 1280 are also available. The font family can be changed as well. Arial/Helvetica is the default and should be left as is for most applications.

### Web Page Setup – File Locations Tab

The 4th tab is the File Locations Tab and is generally for reference purposes except a web administrator may want to know where the files are located to be able to make specific changes for the environment. This tab shows where on the computer the web pages, templates, style sheets, and images are stored. When you select one of the files, RAD-IT provides a description of the file and the file location. The templates, images, and style sheet may all be edited to customize the web pages that RAD-IT produces.

You can select "Restore Default" to restore the selected file to the default RAD-IT content. Before overwriting the existing file, RAD-IT will confirm that you want to overwrite his file with the default file.

# Additional Topics

This section discusses some advanced topics that cut across how RAD-IT is used and how to construct and maintain a regional ITS architecture.

## Relationships between Elements, Stakeholders, and Tabbed Windows

The following discussion involves associations (relationships) between elements and between elements and stakeholders, and concerns the relationships between the tabbed windows in RAD-IT. In other words, changes made on the "Inventory" tab may or may not be reflected after a "Build" on the "Interfaces" tab or on the diagrams. An example follows.

On the diagrams, the upper, grayed portion of each box displays the stakeholder name, and the lower part of the box indicates the element name associated with that stakeholder.

For example, a user creates two Toll Collection elements associated with a single stakeholder. These elements both use the Payment Administration Center physical object from ARC-IT. Because the underlying Physical Architecture includes a terminator called "Other Payment Administration", the two toll elements will be connected to each other. In previous versions of Turbo and prior to Version 4.0 of the National ITS Architecture (April, 2003), they could have been connected by creating a user defined flow between these two elements. If these elements were traffic management elements (centers), however, they would be connected to each other because of the underlying ARC-IT Physical View ("Other Traffic Management" is a terminator, and there is a physical flow that connects the TMC to "Other Traffic Management").

If you then generate a Traffic Management Center (element) on the "Inventory" tab (using the same or a different stakeholder as the two toll elements), then associates this with the Payment Administration and Traffic Management Center Physical Objects and selects the "Regional Traffic Control" service package (on the "Services" tab), the new traffic element will be connected to each of the two original toll elements after building the architecture. This also occurs because of the underlying physical connections in ARC-IT.

If you then remove the Payment Administration Center subsystem from the associations for the traffic element on the "Inventory" tab, re-building the architecture will make no difference to the "Interfaces" tab or the "Interconnect" diagram. Payment Administration information flows remain connected to this traffic element and are not removed by re-building. You must go to the "Interfaces" tab and uncheck the "Include" box so that these flows are no longer connected to the traffic element in the current Project or Regional Architecture. This also changes the status of these flows to "Not Applicable". Then, the "Interconnect" diagram will no longer connect the traffic element to the two toll elements.

## Extending the Architecture

See the "*Add Physical Objects*" and "*Add Flows*" sections under Architecture Tools above but here are some other thoughts concerning extending the ARC-IT physical view.

## General Comments on User Defined Extensions in General

An item that cannot be represented by an ARC-IT physical object or information flow may be included in the Regional or Project Architecture as a "user defined physical object" or "user defined flow". Any element not associated with an ARC-IT physical object can be associated with a user defined physical object in the Regional or Project Inventory. As an example, this feature can be used for unique items, such as "red-light cameras" or "flood control", which are not ARC-IT physical objects.

There are two types of locally defined items:
- "User defined physical object" - with characteristics similar to an ARC-IT subsystem or terminator, these have flows associated with them and may be mapped to any element in the architecture.
- "User defined flow" - with characteristics similar to an ARC-IT flow. A user defined flow must be hooked to the architecture by establishing relationships with other elements and physical objects within the architecture. The user defined entity may be defined first, then the flow that references it.

GUIDELINE:  A user defined flow may be connected to a user defined Physical Object or to an ARC-IT Physical Object (subsystem or terminator). Their names must, however, be distinct and separate from ARC-IT names.

GUIDELINE:  User defined Physical Objects and flows may be added to an architecture at any time before or during the customization process, while on any tab. However, in order to see the user defined flows on the Interfaces tab, a "Build" must be done to add them to the architecture. These extensions may then be reassigned or modified on the Interfaces tab.

Remember that when creating locally defined objects and flows that this information is not mapped to any standards. This mapping may be required and will be a manual process of defining customized standards and mappings to the user defined flows. This process of defining custom standards along with other communications profiles is done in SET-IT.

## Connecting the Local Physical Object to the Architecture

If adding a locally defined Physical Object to the Regional or Project Architecture (for example, a "flood monitoring" element, or "snowplows and maintenance vehicles"), you may do this in various ways. First, look at the "Inventory" tab to display a list of all existing Physical Objects in the architecture. This list also includes user defined objects that have already been created. Pick a name not on the list to call the new user defined Physical Objects. Then, define this Physical Object in one of several ways:

1. If some of the data elements for the new system element exist in ARC-IT, you may connect to these subsystems, terminators, and information flows for this capability from ARC-IT. Do a "Build" in order for the new user defined Physical Objects and flows to appear during the customization step. This allows for reuse of ARC-IT flows. You may also add additional user defined Physical Objects and flows that are not in ARC-IT during this step.
2. OR, you may add an ARC-IT service package, then select certain flows that apply to the new capability, and add the additional user defined Physical Objects and flows that are not in ARC-IT. Do a "Build" in order for the new user defined Physical Objects and flows to appear during the customization step. The tool allows a user defined flow to connect to an ARC-IT source/destination Physical Object (subsystem, terminator). However, an ARC-IT flow cannot be used in a way that is inconsistent with the Architecture.

3. OR, If there are no data elements within ARC-IT that match the functions of the new capability or user service, you may add all the data elements for the new capability, connect them to user defined Physical Objects and flows, then "Build" and "Customize" on the "Interfaces" tab.

It is your responsibility to ensure that new locally defined physical objects (similar to ARC-IT subsystem and terminator physical objects) and user defined flows (similar to ARC-IT flows) do not conflict with the existing ARC-IT physical objects and information flows.

## Iterations through the RAD-IT Tool

Certain steps during the architecture creation process do not have to be done in any order. For example, you may re-enter the Inventory Generation step ("Inventory" tab) at any time during the process after creating the initial element inventory.

Where applicable, the tool will allow iterations in the process of defining a Regional or Project Architecture. You may create an inventory of elements associated with subsystems and terminators, map to service packages, and create an initial list of information flows (through the "Build" step). You may then reassign an element to a new subsystem ("Inventory" tab), terminator ("Inventory" tab), or service package ("Services" tab), select other service packages ("Services" tab), select new information flows ("Interfaces" tab), or de-select information flows ("Interfaces" tab) from his Regional or Project Architecture.

Where applicable, i.e., where process steps are sequential, if a previous step has not been completed, the tool will not allow you to continue until it has completed successfully. This does not apply to the iterative steps in the process. In most cases, a "Build" must be done before any outputs can be generated (tables or diagrams). If there is no data for an output table or diagram, then a popup window will appear saying this. The steps below must be completed before data may be available for these outputs. If a "Build" has not been done, there is no data available for the "Interfaces" window, and this table will be blank. The tool finds all situations possible to prevent an empty window from appearing, or from allowing you to attempt an option that must be preceded by some other option.

The following is a list of processes or steps in RAD-IT and what prerequisite processes or steps (if any) are associated with them:

1. You can characterize service packages before selecting an element inventory (characterizing subsystems and terminators) in the Regional or Project Architecture. Service packages may be selected. However, elements must exist in order to associate the service packages to elements, so after entering new elements on the "Inventory" tab, you must return to the "Services" tab to associate the elements to the selected service packages.
2. You will be able to return to the "Inventory" and "Services" tabs and remove service package associations (i.e., disassociate them from the architecture) if you have only previewed the uncustomized architecture in the "Build" step (before answering "Yes" to the final question about adding the flows to the architecture and to the "Interfaces" tab). After completing the "Build", if a service package association is removed from the architecture, the associated interconnects and flows must be deselected manually on the "Interfaces" tab. "Build" is an additive function - it does not remove anything from previous builds or customization.
3. The customization step for the architecture cannot be executed before subsystems or terminators (or service packages) have been characterized from ARC-IT. There will be no source or destination elements, and no information flows defined between them.

4. Once you enter the "Interfaces" tab and begins to customize the architecture, you may return to the "Services" tab to change service package associations, or you may return to the "Inventory" tab to change element/stakeholder mappings. A new "Build" will pick up any new element and flow selections, but not change his customization.
5. The "Extend" step to add user defined physical objects or flows to the architecture cannot be executed before subsystems, terminators, or service packages have been characterized from ARC-IT.
6. The "Extend" step for the architecture can be executed before or after the customization step. If after, then a "Build" should be done before "Customize" on the "Interfaces" tab to pick up any new user defined flows.
7. The "Merge" step (i.e., the "Project to Region" option on the "Start" tab) can be executed once a Project Architecture has been defined in the open database file ("Build" the project before "Merging" it into the Regional Architecture). This step may be used to initially define a Regional Architecture from an existing Project Architecture. To do this, simply create an empty Regional Architecture and return to the Project Architecture that is to be merged.
8. The "Standards Activities" output table for the architecture cannot be generated before subsystems, terminators, or service packages have been characterized from ARC-IT, and a "Build" has been completed (answer "Yes" to the last question about completing the "Build").
9. The "Standards Activities" report for the Regional Architecture can be executed before or after the customization step.
10. The "Interconnect" Diagram for the architecture cannot be generated before subsystems, terminators, and service packages have been characterized from ARC-IT. Information flows are required from the Service Package analysis to generate the "Interconnect" Diagram.
11. The "Interconnect" Diagram for the architecture can be generated before the customization or extend steps.
12. The "Flow" Diagram for the architecture cannot be generated before subsystems, terminators, and service packages have been characterized from ARC-IT. Information flows are required from the Service Package analysis to generate the "Flow" Diagram.
13. The "Flow" Diagram for the Architecture can be generated before the customization or extend steps.
14. The "Project Inventory based on a Regional Architecture - Element Inventory" step cannot be executed before a Regional Architecture has been defined. The Regional Architecture may or may not include a Project Architecture.
15. The "Extend the Project Architecture to include additional parts of an existing Regional Architecture" step for the Project Architecture cannot be executed before subsystems, terminators, or information flows have been selected from an existing Regional Architecture.
16. The "Extend beyond the Regional Architecture" step for the Project Architecture cannot be executed before subsystems, terminators, or information flows have been selected from an existing Regional Architecture.
17. The customization step for the Project Architecture cannot be executed before subsystems, terminators, or service packages have been characterized from ARC-IT or selected from an existing Regional Architecture.
18. The "Extend" step for the Project Architecture cannot be executed before subsystems, terminators, or service packages have been characterized from ARC-IT or selected from an existing Regional Architecture.
19. The "Standards Activities" report for the Project Architecture cannot be created if no information flows have been identified from ARC-IT or selected from an existing Regional Architecture.
20. The "Interconnect" Diagram for the Project Architecture cannot be generated before subsystems, terminators, and service packages have been characterized from ARC-IT or selected from an existing Regional Architecture. Information flows are required from the Service Package analysis to generate the "Interconnect" Diagram.

21. The "Flow" Diagram for the Project Architecture cannot be generated before subsystems, terminators, and service packages have been characterized from ARC-IT or selected from an existing Regional Architecture. Information flows are required from the Service Package analysis to generate the "Flow" Diagram.
22. The additional RAD-IT tabs that bring the architecture in line with the CFR 940 and FTA Policy on ITS Architectures and Standards may be populated at any point during development of a Regional or Project Architecture. These functions include:
    - Defining the operational concept for the architecture, i.e., adding role and responsibility areas to the architecture based on service package choices.
    - Assigning functional objects to all elements in the architecture based on service package selections.
    - Selecting the ITS standards used in the architecture.
    - Defining a list of agreements between stakeholders for the architecture.

## Managing Subsystem Permutations

When an uncustomized architecture is initially generated in RAD-IT, it is possible for all valid [source element / information flow / destination element] triplets for that architecture to be created. These triplets include all possible permutations of source/destination pairs based on ARC-IT and will typically number in the thousands for an actual Regional Architecture. Many of these triplets will not be selected in the final customized architecture. The task of "deselecting" possibly thousands of these irrelevant triplets is very time consuming.

The RAD-IT tool will identify and remove many of these extraneous permutations of subsystem interfaces. However, the software does not have enough information to generate a perfectly tailored architecture based on the Physical Object and service package mappings that you generate. Some must be removed manually.

Extraneous permutations are defined as sets of interfaces that do not have the same stakeholder. Some of the interfaces defined by the architecture rarely span multiple stakeholders. For example, the Traffic Management Subsystem to Roadway Subsystem interface normally represents intra-agency communications. This class of interfaces has been identified as having "product interoperability" in ARC-IT. For these interfaces, RAD-IT must only select triplets by default that represent communications between elements that are owned or operated by the same stakeholder.

Some connections are resolved by the tool, where others may be impossible to resolve and will have to be done manually. The tool will assist you to the extent possible with resolving permutations. You may also view the list of subsystems, terminators, and information flows on the "Interfaces" tab to determine which were included because of the permutation problem and should be deleted.

You may display a permutation report that lists the permutations that were created during the initial data entry. This is actually a portion of the regional and project output tables on the "Output => Tables" pulldown menu ("Regional Architecture", "Project Architecture", and "Additional Integration Options" reports for both the Regional and Project Architectures). [A "Build" may be required before generating these reports.]

You must then do a "Build" and customize the architecture on the "Interfaces" tab. On the "Interfaces" window, you will be asked for element name with the option to look at "All". "All" will include a "Connect" and an architecture "Flows" view for all interconnections between elements, and all information flows in the architecture. All subsystems may be connected to all subsystems through the

source and destination elements and flows listed. This must be corrected on this screen. Interconnects may be defined at the element level, e.g., TMC to RS connections.

On the "Interfaces" tab, it is recommended that you look at the "Connect" view first and remove extraneous permutations there before examining the architecture "Flows" view and deciding which information flows should be removed. However, you may look at the "Flows" view first then continue with the "Connect" view. You will be able to move from interconnect to flow or from flow to interconnect views during the customization process.

You generate an uncustomized architecture when the system inventory and service package mappings have been completed to your satisfaction. This is the only time that the permutation filters will be applied. Because this generation process is somewhat different between Regional and Project Architectures, the permutation requirements are addressed differently by the tool in the two cases.

### Regional Architecture Permutations

As the final step in the uncustomized Regional Architecture generation process in the "Build" step, the tool will attempt to deselect all flows that connect different stakeholders on the identified interfaces. This process does not deselect an information flow if it has been manually selected or customized already. In the general case, this should never occur since this query will be run as part of the uncustomized architecture generation process.

### Project Architecture Permutations

In the uncustomized Project Architecture generation process in the "Build" step, the valid triplets are added to the Project Architecture by the tool. Invalid permutations are identified exactly as they were before, and the entries are deleted from the Project Architecture by the tool. Also, there is no need to "deselect" the flows in the Regional Architecture since these flags are not set by default when a new uncustomized Project Architecture is generated. In this case, a delete query is executed by the tool that will delete the references to "stakeholder spanning" flows in the Project Architecture.

## Working with Large Architectures

The following are a few general guidelines for developing large architectures. See the Architecture Use tab of the ARC-IT website for more information about how to develop a Regional Architecture. Depending on the amount of space, running speed, and other parameters of your machine, VERY large architectures may begin to degrade the system **performance**. There are also **maintenance issues** with large architectures – a region will spend many weeks customizing a very large architecture on the Interfaces tab. There are ways to minimize the time spent on this tab.

1.  The following describes several ways to deal with architectures of many hundreds of interconnects and thousands of information flows.

    The Problem: Large architectures (e.g., including more than 50,000 information flows) are very cumbersome to work with in RAD-IT. Even simple manipulations on the Interfaces tab (e.g., switching from "Connect" to "Flows" view) cause substantial delays. Performance issues occur during the "Build" and "Customize" steps, and when generating the reports and diagrams. For instance, the "Standards (Interface)" output table may take 20 minutes to generate, and consist of hundreds of pages. The "Interconnect" and "Flow" Diagrams would be difficult to generate without problems. The scale of architectures of this size makes them unmanageable. If you only spend 10

seconds reviewing each flow, one person month would be spent on the Interfaces tab to review and tailor an architecture of 50,000 flows.

Suggested Solution #1: The RAD-IT Architect should look for ways to reduce inventory/architecture size by developing general elements that represent many similar local systems. For example, rather than enumerating the 30 local city police and fire dispatch operations in a region, one or two elements can be identified that represent (or combine) all 30. The same may be done for an architecture that includes 20 different municipal traffic centers – they can be combined into one or two elements depending on how unique each one is. You really do not want to create a region with a table of 60,000 flows that must be maintained! Diagrams must be filtered to avoid problems building and displaying the diagram.

GUIDELINE**:** When working with a large architecture (over 10,000 flows), general elements should be developed in the inventory that represent large numbers of centers or systems, such as a single element that combines several Traffic Management Centers.

Try to keep inventories less than **100 elements** and know there will be trouble if the inventory exceeds 150 elements. This is an easy rule of thumb to apply but you also have to look at the mix of elements that are being added (e.g., try not to add more than one roadway element per center). Architectures that exceed 150 elements and 10,000 flows will be difficult to maintain, not easily understood by the average stakeholder, and impossible to plan with.

Suggested Solution #2: An addition recommendation is to develop large Regional Architectures using **center subsystems** only. These are the primary connections of interest at a regional level. Vehicle, field, or traveler elements will mostly be connected to a center that has control over them. With regard to focusing on Center to Center interfaces, there are tools in the National ITS Architecture that help with this focus, since these also tend to be the "regional interoperability" interfaces in the architecture. There are filters to filter out certain types of interconnects, for example, only view center to center interfaces and filter out the rest. The regional interoperability class of interfaces also includes other interfaces with regional scope, such as the signal priority/preemption interfaces that are also good topics for inclusion in the Regional Architecture. Diagrams must be filtered to avoid problems building and displaying the diagram.

Suggested Solution #3: Large Regional Architectures could be developed using a hierarchical multi-tiered approach similar to the regional and statewide architecture discussion above.

2.  There are also limits to the **number of flows** that can be represented in and out of an **element box** on the "Flow" Diagram (a large "Interconnect" Diagram can present the same problem). In some cases, the element box expands to include all flow connections (typically at the middle of the diagram, where the boxes with the most connections reside). In other cases (typically at the edge of the diagram), the boxes do not expand and flows may be dropped, or attached to a single line. One limit to the number of information flows seems to be around **87** flows between elements.
    When these problems begin to occur during the plotting (generation) of large interconnect or flow diagrams, a **message will appear** warning the operator that the diagram may contain overflow errors. The user may either continue to plot the diagram, or abort.

    Suggested Workaround #1: If your "Interconnect" or "Flow" Diagram runs into a plotting or connection limit, you should break up the diagram into two or more diagrams using the element selection and/or filtering options.

Suggested Workaround #2: For correcting the plotting problem of a very *large diagram*: If there is a display problem on the diagram screen and many letters seem to be run together (e.g., flow names appear to overlap), the diagram may be saved to a file and imported into Microsoft PowerPoint. In PowerPoint, select the diagram and "ungroup" it. The font problem should fix itself. The font can be resized for better readability. Be aware that when importing the diagram into PowerPoint, there may be certain lines that must be redrawn or moved, if the diagram in RAD-IT contained many plotting problems. When the diagram is ungrouped in PowerPoint, some additional lines may appear that should be deleted near the element boxes. The architecture flow names may also appear with boxes around them when printed in black and white. These are some of the issues to be aware of when converting your RAD-IT diagrams into PowerPoint. It may be a lot of work to correct the converted diagram. First, try to filter out elements or flows, or select fewer elements and their connections prior to generating the diagram in RAD-IT. If this does not work, PowerPoint or Visio may be an option. It is suggested that you wait to spend the time editing the drawing on the final deliverable product so you do not find yourself having to throw away your work.

3. When working with large architectures, do not define elements for **personnel** and system operators since there is no standard for them (example: TMC to Traffic Operations Personnel).

4. Also, do not define a description field containing single or double quotes since certain export facilities (from the RAD-IT reports) or editors may misinterpret these characters.

5. One other item to be aware of when working with large architectures is the **size of the temporary file** called "*<archname+date+timestamp>.radit*" that is built by RAD-IT when working with a Project or Regional Architecture grows while working on the architecture. The user file may be compressed by saving the file. However, the only way to compress the temporary file is to exit and re-enter RAD-IT. When a "File => Save" is done, this temporary file is NOT restored to a small size. The size of the temporary file is a function of the number of flows in the architecture. There may not be enough space in your machine to handle a "Save" of this file. If a message appears saying "Save failed", you must compress this file by closing RAD-IT, opening the "*<archname+date+timestamp>.radit*" file in Microsoft Access and using the "Tools => Database Utilities => Compact & Repair Database" option. This will not be possible if Access is not available on your PC.

   For this reason, we have the following guideline:

   GUIDELINE**:** When working with a large architecture, you should **Save and Save Often, AND exit and re-enter RAD-IT** (suggestion – every half hour). This will ensure that the temporary file that is generated during RAD-IT sessions stays at a manageable size.

## How do I know if I have the current version?

Go up to the menubar and click "File" and then "About". There you will see a window showing the versions of RAD-IT and the underlying databases that is being used from ARC-IT to build your regional and project architecture. It should match the version listed on the ARC-IT website (http://www.arc-it.net/) under the Architecture Resources / Tools page and it includes the contents of the README file listing any version specific information to consider.