Systems Engineering Tool for Intelligent Transportation

Help Manual
Version 8.3

Prepared by the
National ITS Architecture Team

Prepared for:
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US Department of Transportation
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This provides help on the use of the **Systems Engineering Tool for Intelligent Transportation (SET-IT)** software tool. SET-IT is designed to integrate drawing and database tools with the Architecture for Cooperative and Intelligent Transportation (ARC-IT). ARC-IT represents what was formerly known as the National ITS Architecture that merged with the content of the Connected Vehicle Reference Implementation Architecture (CVRIA) so that users can develop project architectures for pilots, test beds and early deployments.

**Support Services**

Our customer support team is standing by to offer friendly, responsive technical support to SET-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 SET-IT that you are using (and whether it’s 32-bit or 64-bit),
  - Look at the splash screen when SET-IT opens or open the Project tab 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 (**Start**), 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: setit@iteris.com

**End User License Agreement?**

The SET-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 SET-IT software available on the ARC-IT website. Anyone interested in developing or maintaining a 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 you can:

- Make use of the latest ARC-IT v8.3 content which includes change to physical information flows and revised enterprise view stakeholder roles and other coordination rules
  - With this release several changes have been made to physical information flows and enterprise view stakeholder roles and other coordination rules
Two new service packages have been defined – PM04 Parking Reservations and SU09 Device Certification and Enrollment.

Two new physical objects have been defined – ITS Object and ITS Communications Object – to house functionality and support services that pertain to any ITS device or element. This allows for a more general representation of communications, security, and management functions.

Standards that are related to the characteristics of a physical or functional object are now included. These are in addition to the traditional mapping of information flows to standards.

Build a Concept of Operations using a new template similar to that of the Federal Highway Administration (FHWA) Model Systems Engineering documents.

Build a Concept of Operations using an updated template based on the International Standards Organization (ISO)-29148 standard for Systems and Software Engineering that has now superseded the previous Institute of Electrical and Electronics Engineers (IEEE) 1362 standard.

See much better layout of the output context diagrams.

Cancel the creation of Layer 0 or Layer 1 diagrams.

See much better layout of the Layer 0 and Layer 1 diagrams. For example, shapes that only share one interconnect will be placed closer together so you don’t have to spend as much time rearranging the drawing.

Along with the better performance you now have access to a new Settings screen to change how elements and interconnects should be arranged.

See and use an updated Sample Project that shows new support objects and services.

Save and Open files/projects over a network drive - You can now save a project 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.

Also, with Network or Cloud Drives it is best if you Pause Syncing while creating, importing, or producing outputs with SET-IT.

Access new enterprise validation options to identify missing stakeholder agreements.

Notice numerous performance enhancements to improve working with Diagrams and on the Definitions grids.

See better performance during synchronization, particularly when using Copy/Paste.

Export all project files into a single zip file.

Install a version of SET-IT that supports 64-bit Office (Visio) applications.

Identify the RAD-IT file and Regional Architecture associated with your project.

Import project architectures from RAD-IT.

Decide whether to include every shape on the service package diagram even if they were not included or applicable in the RAD-IT file.

See more feedback on the progress of the import (especially helpful with large projects).

Add project information including procurement strategy and operations resources.

Assign Completion Status to my diagrams.
This version includes numerous performance improvements and corrections to bugs and errors. Be sure to upgrade to 8.3 for the latest features and best performance.

As with each version you can open and migrate projects that were created in previous versions of SET-IT. The “Conversion” process as it is called will go through and update your architecture so that it works with the current features of SET-IT. For example, older architectures may have included bidirectional information flows which are no longer supported. Conversion will tell you that you will need to separate those flows into 2 unidirectional flows. SET-IT will produce a report during conversion that lists objects that have been deprecated (no longer supported) and replaced in the new version. This report can be saved as a text file for analysis later on.

This version corrects a number of defects in the previous build related to saving files and installation.

NOTE: The development of SET-IT is an ongoing activity with new features being added periodically so an update is likely to be released every 8 weeks or so. At that time you will want to download and install the new version in order to get the most up-to-date features. Be sure you exit SET-IT and save your files before trying to uninstall SET-IT and install the update.

Getting Started Using SET-IT

This section provides answers to basic questions like:

- What is SET-IT?
- What’s in this version?
- What can you do with this version?
- How should you get started?
- What do these terms mean?

What Is SET-IT?

The Systems Engineering Tool for Intelligent Transportation (SET-IT) provides a single tool that integrates drawing and database tools with the Architecture for Cooperative and Intelligent Transportation (ARC-IT). ARC-IT represents what was formerly known as the National ITS Architecture merged with the content of the Connected Vehicle Reference Implementation Architecture (CVRIA). Users can develop project architectures for pilots, test beds and early deployments. This tool is based on Microsoft Visio for the drawings and Microsoft Access for the underlying data definitions.

The ARC-IT framework includes physical, functional, enterprise, and communications views for a wide range of ITS and connected vehicle applications, including Safety, Mobility, and Environmental applications as well as supporting services.
SET-IT Help

SET-IT users are encouraged to start by copying Service Package diagrams (by clicking Include) and customizing them to meet their own project needs. This way users can take advantage of a common set of drawings, objects and interface definitions.

Considerations for This Version

This tool is provided as-is, with no implied warranty. While the development team will make every effort to maintain compatibility between versions, it is possible that a future version will not be 100% database compatible with this release. Please pardon the construction dust...

In this version you can create physical view, enterprise view, and communications view architecture drawings using the same Visio template as ARC-IT.

You can select/copy any of the ARC-IT service packages to use as starting points for your project. You can customize the physical object elements and flows descriptions. You can also generate outputs in the form of diagrams or tables that can be used in tools such as Microsoft Word or Excel.

**NOTE:** You can create Enterprise View Layer 0 drawings and assign stakeholders to enterprise objects after you have created a Physical Layer 0. You can also use the Definitions grid to build a list of agreements based on the relationships between stakeholders that perform various roles with respect to the elements in the Physical View.

This version includes the ability to create a Concept of Operations (ConOps) document using either an ISO Standard 29148 template, a template used as a reference implementation in connected vehicle research projects, or a template used for Federal Highway Administration Model Systems Engineering Documents.

SET-IT imports the Needs and Requirements from ARC-IT for the Service Packages (application); you can include these needs and customize them for your project or you can create a new set of needs for your project. You can also define Scenarios for a Service Package and define Sequences as an additional layer to the physical diagrams that will be used as part of the ConOps.

This version supports the Communications View by providing customizable templates for the communications profile drawings. The Communications View defines the layered sets of communications protocols that are required to support communications among the system elements that participate in the connected vehicle environment. SET-IT uses the templates and the information contained in the definitions tables that map the communications protocol standards to the element/flow triples selected in the physical view in order to generate the layered protocol diagrams for each interface.

This version includes a Sample Project that you can use in different ways – to see how a project is constructed or even to use to jump-start your own project. The Sample Project shows a mix of transportation and support Service Packages that many ITS and connected vehicle projects will need. You can start with the sample project file and customize it by adding your own Service Packages and drawings in addition to the Service Packages included in this sample project.
Known Issues
There are a few issues based on different configurations or errors that happen on a sporadic basis that you may encounter.

- One issue that has reoccurred on a sporadic basis is the wiping out of data entered on the Project screen from the Overview menu. This sometimes occurs with a new architecture and when the user has filled-in data for the cells on the Project Overview screen and then goes to another table or menu area. You may notice that your typing has been wiped out. To avoid disruption please do a SAVE before you leave the Project Overview screen.

- SET-IT seems to be incompatible with older 32-bit versions of Microsoft Windows operating systems. Install SET-IT on an up-to-date 64-bit windows and then either 32-bit or 64-bit Office/Visio.

- Access Database Engine (ADE) 2016 seems to be incompatible with Office 365 ProPlus or other versions of Office that are considered “Click-to-Run”. Users with this combination received SET-IT initialization errors. Users had to uninstall ADE 2016 and go to the Microsoft website to download and install ADE 2010 before SET-IT would work with Office 365. This impacted both Win 7 and Win 10 platforms. SET-IT looks to see which ADE version is installed and install a version automatically that will work with SET-IT.

- 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 SET-IT, go to the Control Panel and look for your Microsoft Office, click “Modify” and select a “Quick Repair”. Restart SET-IT and it should generate outputs again.

- 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 SET-IT has exclusive access to the file.” If this happens, you can still close SET-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.

- Deleting stakeholders on the Definitions grid that are associated with a shape on an enterprise diagram will result in an error on sync; avoid the error by deleting the shape on the diagram first; (will be fixed in a later release).

- Some users have reported an error message that occurs after they close or exit SET-IT. The error mentions an “Unknown software exception (0xc000000d)”. Clicking OK to the error message completes the exit process and no harm to any user data or to the computer configuration has been seen. This seems to be due to a conflict with Office/Visio 2016.
Some users have reported a clipboard error when the certain diagrams are begin generated or when a project is imported from RAD-IT. This happens when there are other programs running on the computer that are also trying to access the Microsoft Windows Clipboard. Steps have been taken in v8.2 to alleviate this but if this happens the best thing to do is delete the diagrams affected and regenerate the diagrams or redo the import. If it happens during Import you may see a screen suggesting that you Exit SET-IT without saving the imported project and start over. To try and prevent these errors it is best to try and not do anything else like Cut, Copy, or Paste on other programs while SET-IT is working on Import or diagram creation.

Some drawings when they are imported into SET-IT have boxes that show up with just a white box and no color to represent their class. This appears to be a resource issue on the user’s computer. Delete the diagram and try again.

A Resources Exceeded Error may occur when generating lots of diagrams or building a complex Layer 1 or Layer 0 diagram. Errors like this can lead to a catastrophic failure in the SET-IT database. SET-IT will prohibit future work on that database until the database is properly repaired. Once an error of this class is logged, any subsequent operation on the database should be prohibited and the user so notified. Upon any subsequent opening of the project the user will be notified that the database is corrupt and to choose a different file. Notify the SET-IT Help Line if this occurs. Also, the usual caution to save your work and use the Export feature to periodically save of your project files into a separate zip file applies here.

Steps for First-Time Users

This version includes a Sample Project that you can use to jump-start your own project. The Sample Project shows a mix of transportation and support Service Packages that many ITS and connected vehicle projects will need. You can start with the sample project file and customize it by adding your own Service Packages and drawings in addition to the Service Packages included in this sample project.

If this is your first time using this tool here are some practical steps to take to get started using the tool. There are additional help topics for each of these steps.

1) From the Project tab, start by creating a New Project
2) From this point you can use the Service Packages button to select one of the ARC-IT diagrams to include in your project. This will copy the physical diagrams as well as the needs and enterprise content defined in ARC-IT.
3) Use the Search box at the bottom of the list to search for an ARC-IT service package that includes a key word or phrase you are interested in.
4) If you want to start your own diagram, use the Diagrams button at the bottom of the left menu to start the Diagrams then click the Diagram button at the top and fill in the information to start a new diagram.
5) Use the diagrams tool bar and edit the **Shape Properties** of the objects and flows on the diagram.

6) Use the **stencil** to drag new shapes (physical and functional objects) and lines (information flows) onto the diagram.
   - **a. Physical Objects**: represent the major physical components of the transportation environment.
     - i. **Elements** – are local/customized instances of the ARC-IT physical objects.
     - ii. Physical Objects are shown on the diagram shapes (see the bottom of the Shape Properties window to see what Physical Object a shape represents) and can be related to Elements using the Details button on the Shape Properties.
     - iii. Physical Objects can include one or more functional objects if they are providing connected vehicle functionality.
   - **b. Functional Objects**: define more specifically the functionality and interfaces that are required to support a particular service package.
   - **c. Information Flows**: depict the exchange of information that occurs between Physical Objects and Functional Objects.

7) Double-click on each object and create a list or inventory of local/project-specific elements that represent the systems and device types that will be deployed or developed in your project or region. Associate the Elements with one or more physical objects on your diagram.

8) While still on the **Element Details** window enter **stakeholders** for who **owns** and who **operates** that element. These will be used later when you customize the Enterprise view and when you output the Stakeholders and the Relationship reports. You can also select roles like **manages** for cases where one agency or company may be managing the operation of a center that is owned by another entity. You can also use the **uses** role to show a case where a word like **uses** conveys more of the idea that a user is touching the controls of an interface like on a piece of Traveler Support Equipment located in an airport or mall.

9) Click on **Outputs** from the toolbar and export tables to be used in other publications.

Those steps will give you a basic physical view of a project architecture. You can go further by selecting the Enterprise View from the ribbon and customizing the stakeholders and their relationships, initially based on ARC-IT, and then generate Communications view protocol drawings for each interface that can be exported and included in your project documentation.

**SET-IT Terminology**

SET-IT and the Architecture for Cooperative and Intelligent Transportation (ARC-IT) upon which SET-IT is based use some terms that may be unfamiliar to many users. Use this table and the ARC-IT website (www.arc-it.net) to learn more.

**Application**

Former term for a connected vehicle or ITS application from CVRIA describes the physical objects and interfaces, communications, functions, and enterprise relationships needed to provide a certain set of connected vehicle needs or requirements. See **Service Package**.
Architecture, Customized
A customized architecture is one in which element and information flow associations have been modified on the Diagrams tab in SET-IT. The flow status or other characteristics may be changed or the project association for a flow or element may be deselected.

Architecture, Uncustomized
An uncustomized architecture is one which has been built by including Service Packages from ARC-IT, including the prior Connected Vehicle Reference Implementation Architecture (CVRIA), via the “Service Packages” option on the Overview tab from the Home screen in SET-IT, but no changes to element or information flow selections have been made, i.e., no tailoring of the architecture has been done yet.

Center
Center is a term used in SET-IT and represents the primary Administration or Management “Element”. This may often be a physical building (such as a Freeway Management Center) that includes one or more physical objects such as traffic management or transportation information functionality.

Coordination
In the Enterprise view, Coordination refers to the relationships that tie enterprise objects, or stakeholders, together. Formal coordination between Enterprise Objects is shown by red lines on an Enterprise Layer 0 diagram. This indicates that the parties involved enter into a formal agreement, where the nature of the relationship is documented by license, specification or other document. Informal coordination between Enterprise Objects is shown by blue lines on the Enterprise Layer 0 diagram. This indicates that the parties involved do not enter into any formal agreement, but nonetheless have some understanding of how the other party will act, either in terms of actions taken or data provided.

SET-IT will select relationships or points of coordination to include in the Coordination Report or on a generated Enterprise Layer 0 drawing by looking at the service package as well as other potential relationships that are defined among those same Enterprise Objects in other parts of ARC-IT.

Element
This is the basic building block of a local, regional or project architecture. It is the name used by the stakeholders to describe an instance of one or more connected vehicle/ITS physical objects. An element is defined by the name that a user gives to an instance of the physical object (e.g., Caltrans/California Highway Patrol District 12 Traffic Management Center). [An element is also assigned to one or more stakeholders.]

Field
Field, a type of ARC-IT physical object and used in SET-IT 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 Roadside Equipment (RSE) include the wireless communications to communicate directly with mobile devices, e.g. vehicles with onboard connected vehicle equipment.
Files
The definition of an architecture is saved in a set of files. A user’s architecture will be saved by SET-IT in a set of files – a drawing file, a database, and a configuration file. Within these project files the user may define zero to many Service Packages.

FIPS
Federal Information Processing Standard (FIPS) Publication 199, Standard for Security Categorization of Federal Information and Information Systems, is used to characterize the flows of information into and out of a device in terms of its requirements for Confidentiality, Integrity, and Availability (C-I-A). This can be used on any service package physical diagram by selecting a flow and bringing up Shape Properties. From there you can select a check box to say “Using FIPS” and bring up the FIPS Details form to select from Low, Medium, or High for each of the Confidentiality, Integrity, and Availability settings and provide a rationale for your selection. Using this method is in lieu of using the Encryption and Authenticability values in Shape Properties. ARC-IT used this approach for its service packages and those are available in SET-IT to use as a starting point for your own projects.

NOTE: For flow lines on a diagram that have more than one flow name changing the FIPS basis and/or values will change information for all selected triples on that line. If you want to change FIPS information for individual triples, add another line to the drawing, assign the flow you want to change to that line and change the FIPS settings from there.

Functional Objects
Functional Objects, formerly known as Application objects or Equipment Packages are the smaller boxes within the physical objects on the drawings. They define the functionality that is required for each physical object to support one or more ITS Service Packages. Deployment status of a given Functional Object is indicated by its color; white (existing) light gray (included in project) and dark gray (future).

Hyperlink
An automatic link or reference to another location or file, perhaps to another location on the internet. In SET-IT you can create hyperlinks in order to add references or pointers to source material located on other websites or in other documents. You can use SET-IT to generate hyperlinks for Information Flows, Physical Objects, Functional Objects, Enterprise Objects, and Resources that can be used as references in your output documentation.

Interfaces, Information Flows
Information flows define direction-specific information flow between ARC-IT physical objects and between elements of a Project Architecture – such as “road network conditions” from a traffic management center to an emergency center. Forms the basis for the standardization of interfaces.

Interfaces, Interconnect
Communications paths that carry information between physical objects of ARC-IT and between elements of a Project Architecture. P-Interconnects, or Physical Interconnects, appear on Layer 0 or 1 and contain all of the information flows between 2 physical objects.
Layers (Communications Diagrams)

Layers on a communications diagram refers to the abstract layers among communications protocols or partitions of functionality that are needed to achieve interoperability. These layered diagrams, also called protocol diagrams or profiles, show how each part of the communications ‘stack’ contributes to overall communications. The Communications View in SET-IT is based on the Communications View of ARC-IT. The 8 layers and 1 cross-cutting security plane of the ARC-IT Communications Model are described below:

- **ITS Application Information Layer**: The ITS application information layer standards specify the structure, meaning, and control exchange of information between two end points.
- **Application Layer**: The application layer standards define the rules and procedures for exchanging encoded data.
- **Presentation Layer**: The presentation layer standards define the rules for representing the bits and bytes of information content to be transferred.
- **Session Layer**: The session layer provides the mechanism for opening, closing and managing a dialogue between application processes. Sessions may be asynchronous as in paired requests and responses (information exchanges), asynchronous as in an unsolicited publication of information, and may require acknowledgement or receipt or not.
- **Transport Layer**: The transport layer standards define the rules and procedures for exchanging application data between endpoints on a network.
- **Network Layer**: The network layer standards define routing, message disassembly/re-assembly and network management functions.
- **Data Link Layer**: The data link layer standards define the rules and procedures for exchanging data between two adjacent devices over some communications media. These standards are roughly equivalent to the Data Link layer of the Open Systems Interconnect (OSI) model.
- **Physical Layer**: The physical layer is a general term used to describe the numerous signaling standards, typically developed for specific communications media and industry needs. With the exception of IEEE 802.11p (air interface to the 5.9GHz spectrum), developed to address the needs of WAVE/DSRC, these standards are largely governed by the telecommunications industry.
- **Security Plane**: The security plane identifies standards that specify policies and system-to-system authentication, and encryption of data across one or more layers of the communications stack.

The Communications View tools allow you to view the standards assigned to each layer by ARC-IT or use the grid or diagram Shape Properties tool to assign standards to each layer, including the Security Plane. Validation tools can be used to help you find places where you may have put a security standard on a physical layer for internal communications or other inappropriate choices.

Each Communications View Diagram shows the information flow triple at the top and potential communications protocols in a layered stack that may be used for deployment.
Layers (Physical Diagrams)

One way to think of the physical view of a project is to think of it hierarchically where each layer in the hierarchy helps understand different aspects of the project. The layers can be briefly described as follows:

Layer 0 – high-level view showing all of the physical elements in a project and high level links or “physical interconnects” (called P-Interconnects on the stencil) to show which elements are connected to each other and what type of communications may be required. There can be one or more Layer 0 drawings for each project. SET-IT will generate the Layer 0 drawings based on the Layer 2 drawings.

Layer 1 – adds the Functional objects that are inside each of the physical elements and uses the same P-Interconnects as on Layer 0. There can be one or more Layer 1 drawings for each project. SET-IT will generate the Layer 1 drawings based on the Layer 2 drawings.

Layer 2 – is based on each service package and includes all of the physical elements, the functional objects, and information flows for a single service package (formerly application) within the project. There will be as many Layer 2 diagrams as there are service packages for a project. Typically, Layer 2 will be the starting point as SET-IT provides the tools to Include or copy the ARC-IT service packages into your architecture.

Layer 3 – [future capability, will allow project designers to capture and document the detailed definitions of the engineering objects and interface specifications within their project]

Need

A specific goal or problem that the system, Service Package or project is intended to achieve or solve. Sometimes referred to as a User Requirement as compared to a System Requirement.

Origin

The country or region from which a project, service package, physical object, flow, etc. originated. SET-IT provides 3 defaults: Australia, European Union, and United States; but more can be added on the Project Overview window by typing a new origin into the Origin field.

Personal

Personal, as a class of ARC-IT physical object and used in SET-IT, represents the equipment used by travelers to access transportation services pre-trip and en route. This was formerly known as the Traveler class. This includes equipment that are owned and operated by the traveler as well as equipment that are owned by transportation and information providers.

Physical Interconnect

Also known as P-Interconnects, these are thought of as the high level communications paths that carry information between 2 physical objects on a Layer 0 or Layer 1 physical diagram. They contain all of the information flows between 2 objects.

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 SET-IT, each shape on a physical view drawing represents a physical object. Physical objects are grouped into five classes: Center, Field, Personal, Support, and Vehicle. Examples include Traffic Management Center (TMC), Vehicle Onboard Equipment (VOBE), and ITS
Roadway Equipment, corresponding to traffic operations centers, equipped automobiles, and legacy ITS field equipment. Physical Objects are associated with Elements (local, customized versions of the physical object).

Profile
One of 16 combinations of standards that are each assigned to a communications protocol layer in order to support interoperable communications. In ARC-IT, each physical view information flow triple (source, destination, flow) is assigned to one, or sometimes more, profile(s). For example, the flow “road network conditions” from a Traffic Management Center to a Traveler Information Center would be assigned to either a Center-to-Center XML profile or a Center-to-Center DATEX profile. The deployers would decide which to use and document their decision in the design documents for the project. The XML profile is shown below to show how each layer is assigned to a communications standard:
In SET-IT, these profiles become “templates” to use when generating the communications diagrams.

**Project**
A Project is a set of activities involving planning, development, integration and/or acquisition of systems/technologies to deliver one or more ITS Service Packages as defined in the National ITS Architecture (ARC-IT). A Project typically has defined boundaries within the context of a Region.
**Project Architecture**
This term defines the elements and information exchanges of a single project that may include more than one Service Package / application.

**Protocol Stack**
An implementation of a communications suite or profile.

**Region**
A region is a geographical area spanning one or more jurisdictions; its boundaries are defined locally and may or may not conform to existing political boundaries. A region could be a state or multiple states, a metropolitan area or multiple metropolitan areas, one or more Metropolitan Planning Organizations (MPO), a corridor (e.g., I-95 corridor), counties, rural towns or areas.

**Relationship**
In the enterprise view, physical objects or elements from the physical view appear as resources in the enterprise view. In addition to the Roles that enterprises objects play with respect to the physical objects, enterprise objects can have relationships with each other. In ARC-IT and in SET-IT these Relationships may include agreements or expectations.

**Roles**
Enterprises or stakeholders can have certain roles with their physical objects or elements which requires them to interact in some way. For instance, enterprises like stakeholders have a relationship with physical objects or elements in which one owns or operates an element.

**Scenario**
In a Concept of Operations, a scenario is used to describe how the system will be operated under various conditions. For example, incident management scenarios will include normal monitoring, the sequence of events following an incident, and response to failure [e.g., sensors or communications]. In other service packages you might want to describe a ‘sunny day’ scenario and contrast that with the activities that take place in a ‘rainy day’ scenario. These scenarios will describe the activities from the viewpoint of each of the participants.

**Sequence**
A series of steps or events that happen as part of a scenario. This can be expressed as a sequence of flows sent back and forth on a physical view diagram. Or simply ‘tagging’ the system elements in the order in which they participate in the sequence.

**Service Package**
From the Architecture for Cooperative and Intelligent Transportation (ARC-IT) - describes the physical objects and interfaces, communications, functions, and enterprise relationships needed to provide a certain set of transportation needs or requirements. The service packages collect together one or more “functional objects” that must work together to deliver a given transportation service and the “information flows” that connect them and other important external systems/objects. They identify the pieces of the physical view that are required to implement a particular service. ARC-IT has five types of service packages: Environmental, Mobility, Safety, Convenience, and Support.
Including ARC-IT Service Packages into a SET-IT project file allows a user to have a starting point to customize their own service package.

**Service Package Instance**
A Service Package Instance is the local, customized version of an ITS application or service that you have decided to include as part of your project. It can be based on a service package from ARC-IT or one that you defined yourself. Each instance includes the physical and enterprise drawings as well as the needs and requirements for that service package. Using service package instances allows architectures to include more than one approach to doing certain activities like traffic signal priority in a region with multiple jurisdictions.

**Stakeholder**
A stakeholder defines an organization that owns, operates, or interacts in some way with the elements in a project. When multiple stakeholders are involved there are relationships between them that appear on the Enterprise view of an architecture. Stakeholders can also be grouped together for joint or combined roles.

**Standards**
Documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently as rules, guidelines, or definitions of characteristics for the interchange of data. A broad array of transportation system standards and communications standards will be identified on the communications diagrams.

**Support**
Support, a class of ARC-IT physical object and used in SET-IT, 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.

**System**
A system is a collection of hardware, software, data, processes, and people that work together to achieve a common goal (definition from the National Highway Institute’s 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 SET-IT, a Freeway Management Center System may be a part of the overall surface transportation system for a region.

**Terminal**
Terminals are small rounded rectangles with an abbreviation that appear on some ARC-IT or SET-IT physical diagrams to represent another physical object on that same diagram.

**Terminators**
Terminators are physical objects that lie on the outside boundary of an architecture. These physical objects represent the people, systems, and general environment that interface with the physical objects known as subsystems that are inside the boundary of an architecture. The interfaces between terminators and the physical objects and functions within ARC-IT are defined, but no functional objects or functional requirements are allocated to them. The human operators, including drivers, are
shown as physical objects with an icon of a person in the corner of the box. Human operators are also stakeholders so as you create and edit a Human Operator on the physical diagram you are creating and editing an element and a stakeholder at the same time.

**Triple**
Defined by three things: the source, destination, and the information flow between them. This "triple" represents a particular instance of an information flow from ARC-IT. For example, the information flow, “incident information”, goes between many ITS objects so the instance of incident management that goes from the TMC to the Emergency Management Center would be a ‘triple’.

**Vehicle**
Vehicle, as a class of ARC-IT physical object and used in SET-IT, represents the 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.

**Views**
The Architecture Reference for Cooperative & Intelligent Transportation (ARC-IT) is defined in a series of Views where each view provides a different perspective to understand the architecture and to address certain stakeholder concerns.

- **Enterprise**: relationships between organizations
- **Functional**: decomposition of system functions and their interactions
- **Physical**: connections between physical objects and their functional objects
- **Communications**: layered communications protocols between physical objects

**Starting SET-IT**
As you click to start SET-IT or double-click on a .setit file SET-IT will start and a ‘splash’ screen will indicate what version of SET-IT is starting.

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

**Projects in SET-IT**

This section describes the operations and steps to follow in order to create, save, and modify an ITS project architecture using SET-IT.

Using the steps in this section you will see how to:
- Create a project architecture
- Open an existing project architecture
- Convert an older project architecture from a previous version of SET-IT
SET-IT Help

- Save a project architecture
- Close a project architecture
- Print the information about the project
- Export or Zip Up the project’s files
- Describe the project architecture
- Import a project architecture from RAD-IT
- Select Service Packages that are included in the project architecture

Other features of the Project Menu include:
- Help menus
- Sample Project
- Options

Create a New Project

1. Select **Project** tab at the top of the menu,
2. Click **New**.
3. This will open the **Create New Project** box.
4. Enter the name of the new project in the **Project Name** text entry field.
5. The **Project Location** field shows the default location where the new project file will be stored. Click **OK** if the location shown is acceptable. To store the new project’s files in a different location, click the **Browse** button and select the location desired.
6. Click **OK**.
Open an Existing Project

1. Select **Project** on the top menu,
2. Select a **Recent Project** from the list on the right or,
3. Click **Open**, 
4. On the browser box identify the location of the existing project to open the file,
5. Click **OK**.
Project / Open will look at the folder that you last used to open or save a project file. If you haven’t done that yet it will look at your Options settings in case you designated another default folder. Otherwise, it will start at the default folder for your machine, usually “My Documents.”

Alternatively, you can open an existing project by using Windows Explorer to find the folder containing the project files and double-clicking on the .setit file. This will launch SET-IT and open the files for that project.

As the project is opened, SET-IT will ask if you would like to run a set of Validation reports on this project. This may be a good idea if you weren’t the one that developed it or you haven’t worked with it in a while. You can turn this option off using the Options menu.

SET-IT locks the files so you can’t have a conflict where one application writes data that the other application is also editing. If you try to 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.

**Converting from a Previous Version of SET-IT**

If you open a file that was created using a previous version you will be warned that the data will be changed and will no longer be compatible with the previous version.

Upgrading or Converting allows you to preserve your prior work while taking advantage of the latest ARC-IT definitions – new Physical Objects, new Service Packages, new Communications Profiles, etc.

Before converting such a project save a copy to use in case you need to open it again in the older version.

SET-IT’s conversion routines will then copy the project data into the latest data schema. Sometimes it will find issues where things are no longer supported or they are supported differently. When it tries to map the components from the older architecture to match objects and flows of the new version there may be cases where more than one option exists, e.g., an older service package may now be represented as 2 service packages. In that case, SET-IT will default to choose the first service package. If that happens it will let you know in case you want a different choice.

SET-IT now no longer supports Enterprise Layer 2 diagrams. If the SET-IT project was created with a pre-v8.0 version of SET-IT and it had Enterprise Diagrams the conversion process will ask if you would like to save the old diagrams as Deprecated Enterprise Diagrams in Visio format. SET-IT also changed how Layer 1 diagrams were created from the original versions so you may be asked if you want to save those old diagrams also.
**NOTE:** You may get a pop-up asking about macros. The older SET-IT Visio drawing files were stored with macros and you can choose either option since you won’t be using them.

Service Package Instances and Diagram names will be reviewed by the conversion process. Earlier versions of SET-IT allowed these to be called differently which sometimes caused confusion later. SET-IT will give the user the option to either:

- Update the Service Package Instance name to match the name used on the Diagram
- Update the Diagram name to match the name of the Service Package Instance
- Do Nothing – use what is shown for each of the names

The default will be to use the Diagram Name.

SET-IT will also convert the Communications view content. The old diagrams will no longer be in the right format so the conversion process will ask if you would like to save the old diagrams as Deprecated Communications Diagrams in Visio format. Then it will ask if you want to delete those communications diagrams – you should always say yes to delete the old diagrams and let it build new ones as soon as you go into Communications View after conversion.

**NOTE:** Converting from older files may lead to situations where there were 2 of something in the older architecture and now there are 5 of that same thing. The Conversion routines will not be able to sort out how to convert those cases. An example is the 2015 version of the Security Credentials Management System (SCMS) that had 2 functional objects. In the current version of ARC-IT that same physical object now has 5 functional objects. Conversion will not be able to know how to convert those functional objects so it will show the 2 as deprecated on the converted diagram. You will need to go through and manually edit your diagram to make sure the current functional objects are shown.
Concept of Operations (ConOps) Templates have evolved over the years with SET-IT. The Conversion process will look to see if you had customized the template using the previous version. To avoid any loss of your customized data, SET-IT will save an archived version of your old ConOps Template:

In other situations, the changes to the ConOps template were small enough that SET-IT simply renamed your file to match the new template. An example is the case in version 8.2.75 where the old IEEE 1362 based template was renamed and updated to match the current industry standard, ISO 29148. In this case, the actual changes to the template were so insignificant that there would be no real impact to your project by simply changing the name of the template. So you may see a message like this:

In either case, you will want to check your ConOps at the end of the conversion process to see that it has your customizations. In the case where SET-IT archived your template to make room for the new template you will need to open both files and copy your customizations into the new template’s structure. Use SET-IT / Output / Document / ConOps and click Edit Template for the new template and open your old template in a separate window using Word. Then move your customizations over and save the new template file. Now you should be able to regenerate your ConOps using the new format and new version of SET-IT but retaining your customizations.
At the end of the process a Conversion Report will be displayed showing the warnings and messages for the parts of the conversion process where changes had to be made to your data.

You are given the option to save this report for later – that’s probably a good idea the first time you are converting to a newer version to make sure there are no surprises.

At this point, SET-IT will tell you that the Upgrade or Conversion is complete but that it needs to synchronize the data on the diagrams with the data in the database. Depending on the size of the project and, especially, how many diagrams there are this step could take a while.
Once complete you should save this project. You are now ready to use SET-IT with the latest ARC-IT definitions.

Save a Project

SET-IT is capable of saving changes made to a project. Projects may include multiple files within a folder. Modified diagrams can be saved to the project folder. You can set a directory to be your default directory for SET-IT projects files folders.

There are two ways to save a project.

- Click **Save** icon on the top ribbon,
- OR
- 1. Select **Project** on the top menu,
- 2. Select **Save** from the pull down menu,
- 3. Click **OK**.

You can also save the file with a different name:
- 1. Select **Save as** from the pull down menu,
- 2. On the **Save as** box identify the new project name and project location,
- 3. Click **OK**.

**NOTE:** SET-IT is designed to work in a Microsoft Windows environment and there are certain characters that you can’t use in a filename and those are:

\ / : * ? " < > |

If you try to use one of those characters in a filename or folder name you will most likely get an error message that says something about invalid path or filename. If that happens just try again without those special characters.
File Notes
SET-IT saves the information about a project in multiple files – a database, several Visio files, several Word documents, a text file for the log, and a small file with a .setit extension. The only purpose of the .setit file is to let you double-click on a file to start SET-IT and open that project.

Read-Only Files
When you open a project the database file is set to Read-Only to prevent you from accidentally opening another copy of the project and writing over data being edited on screen.

You may find yourself in a situation where you forgot your file was already open and try to open it again. You may see a message like this:

If so, just click Cancel and pick another file. You can also go to the window currently running and close that copy of SET-IT with that file in use and then click 'Try Again.'

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 exit periodically from the file, or from SET-IT. Saving the architecture 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 closed.

SET-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\ITS Architecture\SET-IT). Copy .sad file to your project folder and change the file name to be the same as your project name and then try opening the project with SET-IT.
A utility in the SET-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 .sad file and re-open it in SET-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 SET-IT.

**Export** – Sometimes you may encounter a situation in which you need the help of the SET-IT support team to fix your file or to find out what is wrong with SET-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 SET-IT files that you can email to the team.
SET-IT Help

Close a Project
1. Select **Project** on the top menu,
2. Select **Close** from the pull down menu,
3. If there are pending changes you will be prompted if you want to save or not. Click **OK**. Or go back up and say you want to save your changes.

Print a Project
1. From an open Diagram or Definitions window select **Print** from the Project menu,
2. For Diagrams, select the Printer to use, and use the Print dialog box options or Properties button to change the settings before clicking OK.
3. For the Definitions tables, a Print Preview window will open where you can choose different settings and the printer to use.

Export / Zip Up the Project Files
SET-IT saves the information about a project in multiple files – a database, several Visio files, several Word documents, a text file for the log, and a small file with a .setit extension.

If you want to share your project with someone else you have to share all the files in that directory.

SET-IT provides a utility to let you Export the project and all of its files in one compressed zip file.

Clicking Project then Export will open a File Save dialog window asking you to identify the folder and the filename to call this zip file. Enter a new unique name, something different than the name of the project folder so it will be able to create a new file.

SET-IT will take all the files in the project folder and create a compressed zip file that is compatible with most file compression programs, including Microsoft Windows, PKZip, 7Zip, etc.

You can email or share the zip file with another user. They can then expand the folder and open the .setit file to launch SET-IT and see the same things you had on your system.

This Export or Zip capability also provides a useful to archive versions of your project files to maintain a record of changes at various milestones during project development.
Access Help

Selecting Help from the Project menu gives you access to this file. You can also click on the question mark icon (❓) located on the upper right corner of the screen.

Describe the Project

To display a high-level summary of your project click ‘Overview’ in the navigation pane on the left side of the screen.

The first time a new project is created Name field will contain the name you entered on the dialog box when you started the project and everything else will be blank. The fields on the Project Information screen provides place to record a description of the project. The most direct output for this is the Project Information report, however details such as the Project Name (entered in the Name field) are also used to automatically populate the ConOps document with information.
**Project Information**

The Start and End date boxes let you establish the start date and end date for your project. Clicking the pull-down will bring up a calendar allowing you to select the year, month, and day for the start and end of your project.

The Geographical Scope and Service Scope fields are useful for letting project stakeholders know the extent of the project, e.g. the size of the region(s) involved in the project and the nature of the services/functions being developed, respectively.

The Developer and Maintainer fields can be used to show the individual or organization that created the project architecture and the individual or organization responsible for maintaining it. The Date field is used to set the date the current version of the architecture as represented in this Project was created or updated.

The initials can be up to 5 characters and are used on the title block of the drawings as they are updated.

The Origin Location field allows you to assign a country or region of origin to assign to the project. The default selections available are United States, Australia, or European Union. To add another origin location simply start typing in the text area of the field and you will prompted to decide if you want to create a new origin. When you say yes this will be added to the project database and can be used as the Origin for other things like physical objects, elements, and flows later on.

The Version block is a text block. Some users want numbers but some use character strings to identify the version, e.g. 2.1a.

The date fields are pull-downs with a calendar feature to help you pick start and end dates for the project and the date when this SET-IT file was created and/or updated.

**Additional Information on the Overview Screen**

There is a “+” symbol just below the Version number that allows you to expand the screen to add additional project information: Procurement Strategy and Operations Resources. Both of which are to support items required in United States Code of Federal Regulations (CFR) 940 and the Federal...
Transit Administration (FTA) Policy on ITS Architecture and Standards. CFR940.11 on Project Implementation requires systems engineering analysis to include procurement options and procedures and resources necessary for operations and management of the system. This allows the project to say how they intend to carry out this part of the project.

Click the “+” symbol on the screen and the screen will expand to show 2 additional fields.

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.

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.

**NOTE**: One issue that has reoccurred on a sporadic basis is the wiping out of data entered on the Project screen from the Overview menu. This sometimes occurs with a new architecture and when the user has filled-in data for the cells on the Project Overview screen and then goes to another table or menu area. You may notice that your typing has been wiped out. To avoid disruption please do a SAVE before you leave the Project Overview screen.

The Region field allows you to identify the region that this project is taken from, also a requirement of United States Code of Federal Regulations (CFR) 940.11. If you import the project from RAD-IT it will automatically populate this field if that information is in the RAD-IT file or you can type it directly.

**Importing a Project from RAD-IT**

SET-IT can also import projects from RAD-IT – the Regional Architecture Development for Intelligent Transportation (RAD-IT) tool. 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, also available at [www.arc-it.net](http://www.arc-it.net).
Regional and Project ITS Architectures

A regional ITS architecture 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. A region is a geographical area spanning one or more jurisdictions; its boundaries are defined locally and they may or may not conform to existing political boundaries. 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. Once a region has a regional architecture they can begin to identify projects to implement the vision of ITS in that region.

A RAD-IT file can include 1 regional architecture and many project architectures. A project architecture in RAD-IT can be a subset of the regional architecture and defines the elements and information exchanges of a single ITS project.

Steps to Import a RAD-IT Project

Importing a project from RAD-IT will import that information into your currently open project in SET-IT. If you already have information populated, including descriptive text, service packages, customized elements, etc. then the Import will add to and in some cases replace what you currently have. If that is not what you want to do then close the current project and start a new SET-IT project to use for importing from RAD-IT.

Use the link on the bottom of the Project Overview screen to identify the location of the RAD-IT file that contains the regional architecture. Then use the pull-down to select the project architecture from that file that you wish to import. That will then automatically populate the RAD-IT Region field with the name of the Regional Architecture in that .radit file. Alternatively, you can manually enter the name of the regional architecture if you are not yet ready to import the project architecture from that file. As soon as the project is selected it will overwrite the Regional Architecture field with whatever is in the .radit file.

You can also add a Note to describe that project and how it may be applied in SET-IT.

NOTE: This tool will only let you import Project architectures defined in RAD-IT of a similar version. You will not be able to import an entire regional architecture or from an older architecture file. Go to RAD-IT and create a project and make sure it’s converted to the most current level.

NOTE: Save and close the RAD-IT file before starting to import it into SET-IT.
After identifying the RAD-IT file and the project in that file, click the Import button and the process will start.

1. **Status** – first step is to align the status values if they were different. For instance, if something was called Planned in RAD-IT it will become Project by default but you can use the pull-down to change it. Then click Continue.

   ![RAD-IT Import](image)

   **NOTE:** Not Applicable cannot be used to translate an imported status.

2. **Project Overview** – the next step is to show how the Project Overview attributes will be imported from the RAD-IT file. Click Continue.

3. **Stakeholders** – next, the system will display a list of the stakeholders that are going to be imported from the RAD-IT file. This list may include stakeholders indirectly associated with an element of the architecture (e.g., members of a group that “own” a TMC, etc.), in addition to stakeholders explicitly included on the RAD-IT Stakeholders Tab. Click Continue.

4. **Physical Objects** – next, the user defined unique physical objects that are part of the RAD-IT file will be shown. Click Continue or Skip. Clicking “Skip” will mean that any user defined physical objects that were in the RAD-IT file will not be imported but the rest of the import process will continue.

5. **Functional Objects** – next, the user defined unique functional objects that are part of the RAD-IT file will be shown. Click Continue or Skip. Clicking “Skip” will mean that any user defined functional objects that were in the RAD-IT file will not be imported but the rest of the import process will continue.

6. **Elements Import** – as shown below, the next step is to show the list of Elements to be imported. In some cases, it says “Add” and in some cases it says Add (Element is connected... }
to project’s interfaces). Import takes an expansive view of what to import to make sure the SET-IT project has enough to work with. Click Continue.

7. Service Packages – next step, Service Packages – now SET-IT lists the service packages to be included. A new Service Package diagram will be created for each Service Packages to be included in the new SET-IT project file. Click Continue.
   - This step will take longer because SET-IT is importing diagrams for each service package to match what was in the RAD-IT file and then synchronizing the diagram to the database information imported from RAD-IT.
   - You may get a screen regarding shapes that weren’t included on a RAD-IT service package diagrams. Regional Architectures may not include an element for every possible physical object that is shown on an ARC-IT service package diagram. As a project for that region is then imported into SET-IT you can decide what to do. Either,
     i. Click Yes to remove those shapes that are not applicable to the project, or
ii. Click No and let SET-IT build the diagram normally (which may show you additional opportunities for systems and devices you may want to include in your project).

**NOTE**: this part of the process may take a while depending on how many service packages are to be imported.

**NOTE**: some have seen a Clipboard error while the service package diagrams are being imported. However, if you get a Clipboard In Use error in the middle of that process then it will give you the option to skip that diagram. It may be best to exit SET-IT and start over to make sure the right diagrams and database definitions are imported together.

**NOTE**: there is now a Diagram Clean-Up tool to help you put back shapes that were deleted or that are no longer necessary.

8. Flows Import – the next step will be a list of user defined or project-unique information flows from the RAD-IT file that are to be imported. Click Continue or Skip. Select “Skip” if you will not need to use those user defined flows in your project.

9. Interfaces Import – this step will list any interfaces that need to be imported that are not already on one of the service package diagrams.

You may see a pop-up window (dialog box) informing you that some of the flows are not on any diagrams. Use this information that will be saved in the Import Report that you can open or save in Word or Excel at this end of this process to edit your diagrams so you can put them onto the appropriate diagram.
10. Standards – this step will list the standards to be imported, these are any user-defined standards that were created/defined in the RAD-IT file.
   - Currently, any exclusions made in the RAD-IT file will not be imported, e.g., decisions to un-include a standards profile in a project; those will need to be taken care of manually in the SET-IT project.
   - This may also include standards that pertain to a physical object or functional object rather than in interface standard.

   **NOTE:** There is a limitation with importing the standards content from RAD-IT files. If a project-unique user-defined standards profile or physical standard was created in RAD-IT then the mappings of that profile to any information flows in the project or physical standard to physical object will not be visible in SET-IT. This is due to a difference in the database tables used. If you need this information in SET-IT go to the Definitions grids and change the mappings there. For physical object standards use the Physical Standards grid in the Physical View. For information flow or communications profiles use the Standards and Profiles grids in the Communications View.

11. Needs – this step will list the Needs to be imported that are not already included in the Service Packages imported in step 7 above.

12. Requirements – this step will import functional requirements defined in the project that are not already defined in the ARC-IT based set of requirements for the service package and their functional objects previously imported, i.e. user defined requirements.

13. Import Completed – now press Close and see the RAD-IT Import Report. This report can be exported in either Word or Excel.
14. After exporting the report, click the X to close this RAD-IT Import Report window and it will then complete the necessary refresh of the database and definitions.

15. Now your project Overview screen shows the information from the imported RAD-IT project.

Notes on Project Import from RAD-IT

- Some RAD-IT projects may have multiple elements of the same physical object participating in a service package. TM08 Traffic Incident Management is a good example where there may be more than one traffic management center in a project. SET-IT imports service package diagrams from the ARC-IT reference model and, in the case of Traffic Incident Management or Regional Traffic Management shows one box for a TMC and one box for an Other TMC. If a RAD-IT project is defined to show multiple TMCS (say a state DOT’s center, a county, and a city center) then you will need to edit the diagram after the import process is done. It will map both of your traffic management centers to both shapes. Use Shape Properties so that one center is mapped to one shape and the other center is mapped to the other shape.
Beware of going back and forth between RAD-IT and SET-IT too much – as in importing a project from RAD-IT into SET-IT, editing it in SET-IT, then importing that back into RAD-IT; 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.

- Aggressive Builds in RAD-IT may mean that there are more interfaces in the project than appear on a Service Package diagram. In RAD-IT Build Settings are used to determine the flows to include on the Interfaces Tab and which flows are to be included as part of the scope of the project architecture. The user can then customize the grid in RAD-IT to include or exclude flows between elements based on their needs. During import into SET-IT the service packages listed in the RAD-IT file are included along with the associated elements and interfaces. There may be a situation where a flow was added in RAD-IT that didn’t appear on a Service Package. The user will be notified about this situation during import and warned that they may not want to do a Synchronization if they have "Delete database relationships not included in diagrams" selected.

**TIP:** if you get this message, be sure and Open/Save the report you are offered at the end of the Import process. It will tell you what Information Flow Triples it could not assign to a diagram.

<table>
<thead>
<tr>
<th>Import Step</th>
<th>Import Item</th>
<th>Import Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfaces</td>
<td>MCDPW GARLIC Information System→regional road closure information→TOMATO Regional Traveler Information Center</td>
<td>Failed to find a diagram for the triple.</td>
</tr>
<tr>
<td>interfaces</td>
<td>PASTA Bus Operations Center→transit and fare schedules→TOMATO Regional Traveler Information Center</td>
<td>Failed to find a diagram for the triple.</td>
</tr>
</tbody>
</table>

Then you can edit your diagrams to include them on one or more of your service packages.

- RAD-IT projects can include custom choices about standards to include in a project. Once you have imported the project go to the Communications View and select the “Flow Triples to Profiles/Standards” grid to see the project-unique standards and their mapping to information flows in the project.
- If a project in RAD-IT shows flows that were to go through a Communications element then they will have to be manually mapped to a data distribution system or ITS communications object using the “Via” option on Shape Properties.

Questions about Import

- Can I Import Another Project? Yes, you can change the project and import another set of project data from that same RAD-IT file. This might help build a ‘super-project’ to include services identified in multiple projects in the RAD-IT file.
SET-IT Help

- BEWARE: if the 2nd project had different mappings/relationships then you will be warned. Importing multiple projects into the same RAD-IT file should be done with care as the links to the previous project will not be preserved.

- What if I Make Changes to that RAD-IT file? You can reimport that RAD-IT project into SET-IT and SET-IT will update those same components in RAD-IT 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 RAD-IT file”.

- But to be able to take advantage of this, you must keep the name of the RAD-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.

Select Service Packages

The Architecture for Cooperative and Intelligent Transportation (ARC-IT) has 141 service packages, or subsets of the architecture that combine to deliver one or more ITS and/or connected vehicle services and satisfy a set of needs and requirements in the surface transportation environment. Some of these are Safety based, some are Mobility oriented, others are geared to protecting the Environment, and others are there to Support the other services. Most were defined by US DOT projects in the United States but others have been defined internationally and are now part of the reference architecture. This provides project designers with a broad range of ideas and definitions for consideration when developing their own projects.
Service Package Selection Window

The Service Packages screen available as part of the Overview menu is shown below:

On the Service Packages window, the full list of Service Packages is shown on the left. The list shows the Type (Safety, Mobility, Environment, or Support), the Group within each Type, whether or not it is already in your project (0=no and 1 or more tells you how many copies or instances of that service package are in your project), the name of the Service Package, and the origin (United States, Australia, or Europe). When a row is selected (click on the left side of the row) the top right box will show the description of the Service Package from the Architecture for Cooperative and Intelligent Transportation (ARC-IT) and the bottom right will show the Layer 2 Physical diagram from the architecture. The Description will also say how many diagrams are included.

You can sort the list(s) by Type (Safety, Mobility, Environment, or Support), Group (of service packages), or Name by clicking the heading at the top of each column. Click it to sort that column alphabetically either ascending or descending. Use the Combine Type or Combine Group check boxes at the top of the window to combine the columns and hone your sorting for what you are interested in.

Click the “Group” button at the bottom to re-sort everything by Type, Group, and Service Package Names with the service packages / applications that have already been included in your project at the top of the screen.
Once you have selected the service packages / applications to include in your project’s architecture, click the “Include” button at the bottom of the window; SET-IT will then copy the physical diagram(s) from the ARC-IT reference diagram file into your project file. SET-IT also copies the Needs and Requirements from SET-IT that were developed in ARC-IT for the selected service packages. SET-IT has now created an “instance” of that service package for your project.

**TIP:** Be careful using too many filters when viewing the Service Package screen, you may end up with a blank screen if you filter everything out. Click one of the checkboxes at the top to reset the filters and sorts.

Is it possible to have more than one “instance” of a service package in a project - yes, it is possible to have multiple instances of a given service package, depending on the specific characteristics of a given project. You may, for instance, decide to show one version of a data distribution service to show the streaming of mobile sourced data through a data clearinghouse before going on to centers subscribed to that type of data. And then perhaps another version of data distribution to show the distribution of information from a management center out to the traveling public.

When you include more than one instance of a service package, SET-IT will ask if you also want to import a second copy of the needs and requirements. This is completely optional. You may decide to have unique needs/requirements for each service package instance or decide that one set of needs will be enough.

**NOTE:** Some Service Packages have more than one physical view drawing. SET-IT will include both drawings and you can decide to customize both as part of your project or delete one that you are not going to use.

**NOTE:** Items in the Service Packages menu that cannot be edited are shown in blue; in this menu you are limited to making changes in the white column which indicates which service packages you wish to include. Select or deselect service packages by checking or unchecking the appropriate box in the “Include” column.

**Searching for Service Packages**

If you are interested in a particular type of ITS or connected vehicle technology but aren’t sure if it’s included in the Architecture you can search for it using the box at the bottom of the Service Packages window. Where it says “Enter search text here...” you type in the phrase you are interested in and click “Search”. (You don’t have to click Search – since SET-IT will start searching as you type.) The Service Packages window changes to only show Service Packages from the Architecture that include the phrase you entered – in their title or in their description. There is a toggle button to turn Case Sensitive searching on and off depending on how precisely you need to search.
Open a Sample Project

SET-IT provides users with an example project which may serve as a starting point for new users; it includes a basic set of objects and interfaces that are common in many ITS or connected vehicle projects.

Opening and Saving the Sample Project

Click on Project Tab to open navigation pane; click on 'Sample Project' folder. The Create New Sample Project dialog box will open, showing “V2I Safety Initiative” in the Project Name field. You can change the name if desired, otherwise confirm that the location shown in the Project Location field is where you want to store the sample project (files) and click OK.

Clicking on the Sample Project option brings up a window called Create New Sample Project. This window 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 project.

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 project to better understand how SET-IT works and how to build a connected vehicle project architecture.

More on the Sample Project

The sample project's file name is the “V2I Safety Initiative” and once it is open the longer name for the project appears as the “MCDOT V2I Safety Initiative”. It portrays a project developed as part of the fictitious Marinara County's regional ITS architecture. In SET-IT the idea is to show a project that demonstrates how to include system elements, Vehicle-to-Infrastructure Safety service packages along with support services and systems that will be needed for a connected vehicle project.

The sample architecture currently includes 8 Layer 2 Physical diagrams, a Layer 1 physical diagram, a 1 Layer 0 Physical diagram, and a Layer 0 Enterprise diagram. The project includes the following services:

- In-Vehicle Signage
- Reduced Speed Zone Warning / Lane Closure
- Queue Warning
- Curve Speed Warning
- Security credentials distribution and Certificate Revocation Lists (CRLs) distribution
- Service Monitoring of connected vehicle field infrastructure
- Map Management
- Dynamic Message Sign Maintenance

Use this sample as a starting point for your own project architecture or simply to refer to how these concepts are shown.
SET-IT Help

The current version of SET-IT now includes all of the service packages, objects, and flows as part of the Architecture Reference for Cooperative & Intelligent Transportation (ARC-IT). This includes merged content from both the former National ITS Architecture and CVRIA so they can be included in your own project just like other ITS or connected vehicle applications defined in the Architecture.

SET-IT Options

There are a number of options that a user can establish and change in order to personalize the software.
SET-IT Help

1. Select **Project** on the top menu,
2. Select **Options** from the pull-down menu and a pop-up window will appear with 5 tabs on the left: General, Diagrams, Synchronization, Validation, and Output. See details about each type below.
3. When you are done making changes to the SET-IT Options just close this window by clicking the **X** at the top right of the window.

**General Options**
- Project Settings: used to set a default directory for your SET-IT project files. 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 project.
- Appearance: used to set defaults for the color scheme, lightness, and styles for the project files
- Configuration Warnings: used to verify that you have current versions of Office, and specifically, Microsoft Visio, in order to support proper SET-IT functionality.

**Diagrams Options**
1. Warnings: includes checkboxes to set or change when warnings will be issued:
   a. “when the title block is being updated”
   b. “if any shape is being deleted”
2. Resources Question: asks if you want SET-IT to update Resource shapes [in Enterprise view] when elements are assigned to physical drawings. Choices from the pull-down are Always Ask, Yes, or No.
3. Appearance: used to set the Font to be used as the default in the notes boxes
4. New Diagram Content: used to produce less complicated Enterprise drawings and has 2 check boxes:
   a. Include resources on my enterprise diagram – as you add Physical Objects to your physical diagram checking this will prompt to add a corresponding enterprise view Resource onto the Enterprise diagram that is for that same Service Package. Unchecking it will not add it to the enterprise diagram.
   b. Include functional object resources on my enterprise diagram. Functional objects are a type of resource so if the first option (Resources) is checked then the second checkbox will be greyed out.
   c. There is also a box to bring up another window for “Physical Layer 1/0 Settings” to change how the elements are positioned and lines are drawn on the higher-level diagrams.
Layer Diagram Settings Window

The Layer Diagram Settings window allows you to manipulate details such as how tall or wide to allow a shape to get or how far apart shapes should be and whether to draw lines with dynamic or static connections to the shapes.

It is recommended to only make changes to these settings once you have become comfortable with the layer 1 or layer 0 diagram generation process and are needing to tweak certain things.

**NOTE:** sometimes you may notice differences in the way the text on some buttons looks or inconsistencies in the labels for different columns. This may be caused by a Display Setting that some Windows users select called Font Scaling. SET-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%.

**Synchronization Options**

Synchronization enables users to specify the “direction” the synchronization process should work:

1. Update the database (Definitions tables) to match the Diagrams
2. Update the Diagrams to match the database (Definitions tables)
3. There is also a check box to check if you want to delete the database interfaces that are not included in any of the diagrams.
**TIP:** The first option is good when you have been doing most of your work by editing the diagrams and want the definitions in the tables to match the changes you've made on the diagrams. The second option would be good if you had been making changes on the definitions and wanted the diagrams to be updated to match. The Delete checkbox will be good when you have finished with the project architecture and want to clean out unused entries in the database.

The Synchronization options also includes radio buttons to either:
- Sync all diagrams
- Only sync diagrams that I edited after opening the project
  - This will improve performance especially if you have a lot of diagrams.

Lastly there is a checkbox to decide whether to all SET-IT to automatically synchronize.

Keep “Automatically Synchronize” checked as much as possible. This way the diagrams and database will stay updated as you work on your diagrams or definitions tables. If you want to temporarily turn this off to overcome a performance issue that’s OK but turn it back on as soon as you can. SET-IT will remind you about this if you start SET-IT and save a project and it sees that Auto Sync is off.
Validation Options
This supports the process of validating the architecture and includes a number of Rules and Options. This screen allows you to establish the default settings to use whenever you run Validation. There are tabs for each view and a general set of validation rules:

From the General tab you can decide whether you want validation to run every time you open a project or never or tell it to ask you each time.

For more on validation check the Validation section in the Review chapter.
Output Options

These options are used to change how the reports or Output tables will look, including:

1. A set of radio buttons to choose whether your tables include all possible rows from the database or only the rows specifically associated with your project. For smaller, simple projects you may not want to see data on all possible ARC-IT components.
2. A checkbox to roll up (or merge) identical data in multiple rows into a single cell.

Event Log Options

This screen includes options to turn on/off an event log utility that can be used for debugging errors caused by SET-IT or issues in a project’s 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 orVerbose.

  **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 SET-IT development team will be able to diagnose your problem more quickly if you have this enabled.

- **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 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:** 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 SET-IT from the program menu or the desktop. Right-click on the SET-IT icon and select “Run as Administrator...”

  **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\SET-IT\. A subfolder is created for each new version of SET-IT and the file is called “SET-IT.log”.

  **TIP:** An easy way to find the Start-Up log is to start SET-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.
If you ‘run as Administrator’ you will then be able to change the Trace Sources options to control how much detail is collected. After you make the changes you will be prompted to restart SET-IT to apply the changes.

Import Options
When you import a project from RAD-IT you will be given a choice of removing objects that are Not Applicable on the service package diagrams. This will make for less cluttered diagrams but may hide opportunities for future inclusion of objects in a service package.
Here the Options window gives you the option to set a default of:

- Always Ask (default)
- Yes
- No

Searching My Project

Once you have a project with lots of diagrams it may be hard to remember where everything is and what is on each diagram. Use the “Search” box at the top of the SET-IT screen. This box also has a pull-down arrow you can choose to open a Find & Replace feature.

In the Search or Find/Replace window simply enter the word or phrase you want to look for in the box and click search.

SET-IT will open a new form showing the Search Results.

Each row lists the object within the architecture that contains that word – either in the name or within a description. Click on the “Details” button to see the definitions details form or click on “In Diagram” to open the diagram that has that flow, resource, element, or object.

You can search for something again by clicking the down arrow and cycling through your search history. This is useful if there are key phrases you typically search for.
You can select the Find & Replace tab and enter a phrase to change from and to across your architecture. As you press Find it will open the Details form where that phrase is found, either in the name or description. Press Replace to make the changes and then select Find Next to find the next occurrence of the search phrase.

In either tab you can use the Case Sensitive button to toggle between whether to search or find phrases exactly as entered.

Another way to Search is to use the Search feature at the bottom of the Overview / Service Packages screen to search for key phrases among the ARC-IT service packages.

Diagrams & Architecture Components

SET-IT uses a combination of Diagrams and Database Tables to represent a project architecture. The project architecture is also expressed from different Views:

- **Enterprise**
- **Physical**
- **Communications**

Common Usage Notes

SET-IT makes use of Microsoft Visio to provide the underlying drawing surface and many of the tools to draw and edit your project diagrams.

When you select a Service Package from the Overview menu you are selecting information from multiple aspects of Architecture Reference for Cooperative & Intelligent Transportation (ARC-IT) (formerly National ITS Architecture & CVRIA) including physical diagrams along with definitions of the architecture components that make up the physical and enterprise views. Communications View includes definitions for the standards and the protocol profiles. There are also the templates used to draw each of the communications view diagrams. This also copies over the Needs and Requirements for that Service Package as defined in the Architecture.

Switching between Views is accomplished by selecting the view from the menu bar or ribbon:

SET-IT will try to switch you to the appropriate place in the other view and remember where you were so you can switch back. For example, if you are in the Definitions grid and are looking at a list of Stakeholders while in the Physical view when you select the “Enterprise” button SET-IT will take you to the Stakeholders table on the Enterprise view. Switching between Enterprise and Physical diagrams...
works the same way allowing you to easily flip back and forth between the enterprise and physical views of the same service package.

Some common issues you may encounter on any type of diagram:

- **Disappearing Stencil?** On the diagrams it is possible for a user to right-click at the top of the Stencil area and it will activate the Stencil context menu. One of the choices is to Close or Hide the window which removes the stencil completely from the user interface. If this happens and you want to use the Stencil you will need to Close SET-IT and restart it.

- **Red Asterisk?** You may notice a red asterisk appear in the Stencil area next to Physical Stencil. This indicates that Visio has the stencil in Edit mode and you may be able to see other options. There is no cause for concern. SET-IT has the stencil in Read-only mode to prevent any permanent changes.

- **Ctrl-g?** Pressing the Control key and the g key or <Ctrl-g> is a way to "Go To" a certain location or position within a file, including a Visio file. Unfortunately, in SET-IT this has had unpredictable effects. Because of this it is recommended that users do not use Ctrl-g.

**Visio:** SET-IT is designed to work with either the 2010, 2013, or 2016 versions of Visio.

**Completion Status:** You can right-click over the name button for a diagram in the left menu and assign a Completion Status of Started, Partial, or Complete. The color of the button will change accordingly so you can see at a glance how far along you are.

- Blue = Unknown or Not Started
- Pink/Red = Started
- Yellow = Partial
- Green = Complete

These values are manually assigned. SET-IT isn’t keeping track of what you’ve done and setting the values for you. This is just a way to help you and your stakeholders see the status.

Then you can use the grid for Diagram Information to add a note about this Completion Status.

**Physical View**

The architecture’s physical view is where most of the work takes place to define the system elements and interfaces for an intelligent transportation system project. The other views will build on this
section which describes how to create and modify your architecture’s physical view, including how to create a new Physical diagram and modify its components.

Including a Service Package
When you start SET-IT and create a new project you use the Overview screen to fill-in that project’s information. The next step typically is to select a Service Package to include in your architecture as the starting point for your project. Click the Service Packages button on the Overview menu.

You are then shown a list of all of the Service Packages in ARC-IT.
You can use the search box at the bottom of the screen to search for a particular service package based on key words or phrases like “transit” or “security”.

As you highlight a row you will see the description and diagram for that service package appear in the right side of the screen.

Click one or more checkboxes and the “Include” button at the bottom and SET-IT will import those diagrams from the ARC-IT library into your project along with the database descriptions of the service package, objects, and flows.

The next step will be to customize the drawing by creating and assigning locally named Elements to the Physical Object boxes and making other customizations described in the next sections.

**NOTE:** Some users have reported that as some drawings are imported into SET-IT boxes show up with just a white box and no color to represent their class. This appears to be a resource issue on the user’s computer. Delete the diagram and try again.

---

**Create a New Physical Diagram**

1. Click on the **Diagram** button from the new area of the menubar (top-left).
2. Select a **Layer** from the drop-down menu. For Physical the choices are 0 for the project level perspective, 1 for mid-level perspectives, and 2 for the service package level.
3. Enter a name for the diagram in the **Title** box.
4. Select a **Service Package** from the drop-down menu. This creates a database entry to associate this diagram with a particular service package / application. (NOTE: at this point this is optional as it doesn’t pull in objects from ARC-IT to draw the diagram it simply creates a database relationship.) It does allow you to select custom or user-defined service packages created on the Service Packages table from the Definitions menu.
5. Click **OK**.
You can choose from the ARC-IT service packages or a new user defined service. Any user defined service packages that have been created in this project architecture file will be listed first. You can add a service package by selecting <New Service Package> from the Service Package pull-down which will open the New Service Package window. See “Creating New Items from the Ribbon” for more information.

**NOTE:** You cannot create a copy of a Physical Layer 2 diagram directly from the Diagrams menu (go back to the Overview / Service Packages screen to include another instance of the Service Package).
Add a Shape to a Diagram

Create a New Diagram, or open an Existing Diagram.

Select a Shape from the stencil on the left.

Shapes include Information flows; Physical Objects – either Center, Field, Vehicle, Vehicle(mobile) which is a nomadic device like a smart phone that could be carried into the vehicle and turned into onboard equipment, Personal, or Support; Functional Objects; Notes or Comment boxes; Human objects (operators or users) – either Center, Field, Personal, Vehicle, or Support; Communications objects like Data Distribution Systems or Wide Area Information Distribution systems; Terminals; Legend (vertically or horizontally oriented); or a Title Block. The ITS Object is also available if you need to show a generic object representing all of the elements and their common functionality and interfaces.

Drag the Shape to the drawing area.

Double click on the Shape or right-click and select Shape Properties to view and edit the properties of that new shape.

For Physical Object and Communications boxes select the physical object down in the bottom part of the Shape Properties.

Click New to create a new element mapped to this physical object or communications shape. If an element already exists for that PObject you can just click to select and map that element to this new shape.

Delete a Shape

Select a Shape in the drawing area by clicking once on the shape.

Click Delete on the keyboard. It will ask if you are sure.

You can also right-click and select Delete.
Create an Element

An “element” in SET-IT represents an instance of a physical object from ARC-IT. Think of this as the local or customized version of what the national or reference framework has defined.

You can create your own elements and associate them with one or more physical objects.

There are several ways in which to create an element:

- From diagram, double-click on one of the rectangles that represent a physical object. This will open the Shape Properties window shown above. From there select New... to open the Element Details window.
- From the ‘New’ area of menu bar on the “Home” ribbon, select Item / Element. This will also open the Element Details window
- From anywhere in the Physical or Enterprise view press Control-e which is a shortcut key to open the Element Details window

When starting with the Shape Properties window you will first select the appropriate Physical Object from the checkboxes located on the middle of the form.

If you dragged a system shape onto the diagram and opened Element Details using the New or Edit buttons on Shape Properties then certain fields will be locked. Use Shape Properties to make those changes first.

Select the Type – System or Human. This will be established by the shape you chose to move onto the drawing

Select the Domain – Transportation or Communications. This will narrow the choices available on the other pull-downs. If you select Transportation then only transportation related PObjects will be available for selection and if you select Communications then only communications related PObjects will be available, e.g. Data Distribution or Wide Area Information Dissemination.

Select the Class – Center, Field, Personal, Support, Vehicle

Select the appropriate Physical Object(s) from the pull down menu to select an ARC-IT physical object or a user defined object. SET-IT will filter the selections based on the domain, class, or type of object.

Select from an existing element in the center of the Shape Properties window.

Once you have selected an element to associate with this shape you can select its status. It will default to what you have set as the Default on the Status Values table (see Status Values in the Definitions Menu), usually “Project”.

If you don’t see an element listed click the New button in the shape properties form.
The **Element Details** form appears as shown below:

NOTE the Lock symbol beside Physical Object(s). This appears when you come into Element Details from Shape Properties. This is preventing you from changing something that is based on a diagram. You would have to make the change on Shape Properties first. Or from the Definitions grid.

Type an **Element** name and its description and the selected **Element** name will appear on the shape. A default abbreviation will also be entered in the Abbreviation box but you can change this to something that makes more sense to your stakeholders.
You can type in a **Description** for the element. If you don’t quite know what to say use the **“Auto-Populate”** button to the left of the Description box to let SET-IT create a Default Description. This will copy the descriptions of the physical object(s) the element is mapped to from the ARC-IT database. Then you can customize it.

**Center/Field and ITS Object:**

You may notice that as soon as you clicked New from Shape Properties there were additional check boxes in the Physical Object area. SET-IT automatically associates your element with the generic physical objects that are appropriate to the class of object you are creating. All elements will get assigned an ITS Object mapping and the Center and Field class elements will also get a Center or Field object assignment. These general objects provide functionality across all the objects in this class, including security, management, and communications. This simplifies the overall architecture so these functions and interfaces do not have to be defined multiple times.

**Human Objects:**

The figure below shows the Details form when creating a ‘Human’ type of element:

![Details form for creating a 'Human' type of element](image)

When you edit the details of a Human type of element the ‘class’ of the object is not shown. When you create or edit the element details from the Definitions menu you can associate it with more than one physical object from different classes. This allows you to support situations where the same element, City Centre Traveling Public, may drive but they may also use other modes of transportation.
such as a transit vehicle so you want to show them as both a Driver (vehicle class) and a Traveler (personal class).

The other feature of the Element Details form is to associate the human element with a stakeholder. This is a variation of the normal Element Details form in that the Roles column is not shown. This allows a user to associate a stakeholder/human that may be managed or be part of a larger organization – such as a Taxi Driver that is part of a Taxi company.

*Element Creation Notes*

**NOTE:** the ability to assign an element to multiple physical objects is disabled when you enter the details form from Shape Properties on a diagram. In that case, SET-IT is restricting controls to only what is on that diagram.

**CAUTION:** If you enter the Element Details from the Definitions menu you can also change the Class of the object with the Class pull-down to either Center, Field, Personal, Support, or Vehicle or the Type of the object to either System or Human. A warning will pop-up to say “Changing the Element’s Class will uncheck physical objects currently assigned to this element. Do you want to proceed?”

This can have big consequences later so you may want to leave this assignment alone. If you have something that is part of multiple classes, go back to the diagram and choose one of the hybrid objects from the Stencil.

Next, you can also use the area below the physical objects list to enter Stakeholders for the various Roles and their Status with that element.

**TIP:** It is a good idea to make sure your elements have a stakeholder for who owns, manages, and operates the element. This will help SET-IT map out the relationships among Stakeholders. This will be exercised more with the Enterprise View.

**NOTE:** You can assign multiple stakeholders to a role depending on their status. You may define one stakeholder who is currently operating a system (Existing status) and another stakeholder that will be operating the upgraded system once the project is implemented (Project status). However, two stakeholders cannot have the same role and the same status. No two stakeholders can operate a system at the same time.

When you are done select OK and the selected Element name will appear on the shape on the diagram. Now as you edit other diagrams for other service packages you can reuse this Element for similar physical objects.

The other way to create a new Element is to use the New pull-down menu from the Home or Diagram ribbon.
NOTE: If the new element is a center type of element, when you say OK to create the new Element, SET-IT will automatically associate the element with the generic “Center” physical object. This will allow you to assign generic interfaces to your element such as system monitoring or permissions data.

NOTE: If the new element is a field type of element, when you say OK to create the new Element, SET-IT will automatically associate the element with the generic “Field” physical object. This will allow you to assign generic interfaces to your element such as field equipment status or configuration settings.

Creating a Complex Element
Is it possible to create an element that is mapped to multiple types of physical objects? Yes, you can. In most cases, elements should stay mapped to objects of one class (center, field, personal, support, vehicle) but there may be times when you have an element that is more complex – say a center that is also doubling as your traffic data archive. Or a mobile unit that has a piece of field equipment mounted on the back.

In those cases, open element details from the Definitions grid or from the menu when you create a new element. In the Physical objects area, click the “All” radio button on the Element Details form. That will expand the list of physical objects to show you all of the possible physical objects of the same type and domain. Type is either system or human and Domain is either transportation or communications. You cannot map a transportation system to a communications system and you can’t map a system element to a human, either.

The list of PObjects will also change to show the class of the physical objects if they are different than what was already selected in the Class pull-down above.
Creating Communications Elements

Because Communications objects are of a different class they typically cannot be mapped to one of the Transportation class elements. An exception to this is the Transportation Information Center (TIC). It can also be mapped to a Data Distribution System (DDS) physical object since they are often done by the same stakeholder system or center.

But note that it does not go the other way – a DDS cannot also be mapped to a TIC.
Creating a Child or Instance of Another Element

There is another type of element – an Element Instance. These are elements that inherit many of their characteristics from another 'Parent' element. This is used to define a general element, e.g. ITS Field Equipment, for perhaps a regional or larger scope project and then in later activities/phases break down the parent or general element into specific instances, e.g. Surveillance CCTV Cameras.

To create an Element instance, use the New Elements menu Item to open Element Details. Provide a name and click the pull-down for "Parent Element" and select one of the elements already create.

Be careful – this warning gives you a chance to make sure that’s what you want to do. For instance, think twice before you start with a field device but accidentally picked a center as the parent. Say no and go back and correct your mistake.

Say yes, and the new Element will be created with the PObject assignment of the parent element and a copy of the parent’s description that can be tailored to the instance.

You can reverse this – you can turn an Element Instance back into a regular instance simply by going to the Parent Element pull-down and clicking the top, blank row.

The idea of Element Instances is good when creating sub-projects that use more detailed versions of the general elements for parts of the project. This feature also sets up compatibility with the RAD-IT Tool which has used parent/instances for a long time to distinguish between regions and projects.

Create a New Physical Object / Assigning Element

These steps will show how to work with the diagram to add a physical object to a diagram that will then be mapped to a local or customized Elements. This is based on a set of predefined physical objects that came from ARC-IT. You can also add your own custom, unique, or user defined Physical Objects if ARC-IT does not have what you need. Go to Creating a New Physical Object in the Creating New Items from the Ribbon section.

Now, back to the diagram and the physical shapes - Start with a New Diagram, or open an Existing Diagram, then Select one of the 6 different Physical Objects types from the stencil on the left.
Physical Objects come in ‘classes’ based on how they are defined in ARC-IT. The Physical Object Classes are:

- Center
- Field
- Personal
- Support
- Vehicle

A 6th class known as the ITS class is really a higher level of the physical view’s hierarchy and is used to represent common functions and interfaces that all ITS objects share, including system management, communications, and security.

SET-IT also lets us show the human operators of the various objects in a different box to show that it is a human-to-machine interface.

The Nomadic or hybrid type of Physical Object represents a combination Vehicle (Mobile) object. It’s really a Vehicle class but might support vehicle safety or mobility service packages that run on a personal mobile device and may, in some cases, connect to the vehicle databus, when they are driving.

To create a new physical object, drag the Physical Object shape from the Stencil to the diagram area.

Double click on the Physical Object.
Shape properties form appears on the left of the window.

Select appropriate **Status** from the pull down menu located on the middle of the Form.

**Physical Object** menu is on the bottom of the element Details form.

Select the appropriate **Physical Object(s)** from the checkboxes located on the bottom of the Shape Properties Form. SET-IT preselected the physical objects to list here based on the Class and Type of box you brought in from the stencil.

The selected **Element** name will appear on the shape.

**NOTE:** The Shape Properties box will be ‘floating’ to the left side of the window when it first opens. To re-dock it simply click the title of the box and drag it over ‘drop’ it over the icon that looks like a closed door on either the left side or right side of the screen. You can ‘undock’ it by clicking the title of the box and dragging it to another area of your screen. You can also simply close the Shape Properties by clicking the X button in the top right of the window.

**NOTE:** The human operators, including drivers, are shown on the physical view drawings as physical objects with an icon of a person in the corner of the box. Human operators are also stakeholders so as you create and edit a Human Operator on the physical diagram you are creating and editing an element and a stakeholder at the same time. Human elements / stakeholders also correspond to Resources in the Enterprise View. So if you create a new, user defined human element then SET-IT will automatically add that to the list of Enterprise Objects you can use in the Enterprise View.
Shape Properties for Elements with Multiple Physical Objects

A note about the mapping of Elements to Physical Objects. As has been stated, an element can be assigned to more than one physical object. Think of this as having one device doing multiple jobs or one center being used to house more than one activity.

When ARC-IT was defined the physical objects were defined to show where the interfaces might be in order to see what standards may need to be developed if information was to pass over an interface between different systems.

It was realized that some implementations would combine functionality in ways that ARC-IT may not have conceived. In some cases functionality from one Physical Object may be distributed across multiple elements, e.g. 2 traffic management centers – one for freeway surveillance and another for traffic signal control. On the other hand, one element may be combining functions from more than one Physical Object, e.g., an integrated operations center that pulls together traffic management and emergency call dispatching into one system.

- SET-IT diagrams are based on Architecture Reference for Cooperative & Intelligent Transportation (ARC-IT) service packages, formerly CVRIA applications. As such, they show the Physical Objects that are supporting that service package. In some cases, you may have an element that is doing those functions but may be mapped to other physical objects that support other service packages (on other drawings).

- SET-IT shows that in Shape Properties for an element as shown below:
In this example, the “Super Center” element is mapped to many different ARC-IT physical objects but the diagram is only showing a Transportation Information Center (TIC). So Shape Properties for this case shows the assignments of the Super Center to the TIC and the generic Center by using the color blue and checking the box. Shown in blue, but with no check marks are other Physical Objects to which it is mapped on other diagrams. Move your mouse and hold the cursor over the physical objects and the ‘hover-help’ text will show what is meant by the coloring and checking.

The Elements grid in the Physical View Definitions menu will show the complete mapping of the Element to Physical Objects.
Create a New Information Flow

Creating a new information flow or what SET-IT calls a “User-Defined Flow” can be done from the diagram or from the Definitions menu.

To create a new flow from the diagrams start by creating a New Diagram or opening an Existing Diagram.

Select the Info Flow from the stencil on the left and drag it to the diagram area.

Connect the selected Flow to appropriate Physical Objects/Elements in the diagram.

**TIP:** You will need to have associated Elements (local/customized things) with the ARC-IT Physical Objects in order for the next step to work. The assignment of flow names to lines on the diagram is done at the “element triple” level – that is, source element, destination element, and information flow. You may need to go back and edit the Shape Properties for the boxes to make sure they all have local/customized Element names.

**Sync:** For changes made on the Shape Properties window to take effect on the diagram you should have Sync set to ‘Always Synchronize’ on the SET-IT / Project / Options / Synchronization window.

**Disappearing Corners?** Sometimes an information flow seems to lose its cornering ability. It goes from a right angle connector (the default) to a straight line connector or seems to go off at a 45 degree angle. If this happens, you can add corners if they are lost by dragging the line mid-points and end-points to get the corners in the desired spots.

If the information flow you want already exists in the project database use the steps in the next section to select the line, select one of the flows already defined for that source and destination combination, and assign the properties or characteristics for that flow.

If the flow you want doesn’t exist yet – perhaps something unique to your project or situation – then click on the New… button on the Shape Properties to create the flow. See Create a User Defined Flows below.
Identify Shape Properties of Flows

From the diagram, double click on the **Flow**.

**Shape properties** Form appears.

The Shape Properties form is available in several places, including when viewing flows on diagrams. This form will be used to identify Name, Status and communications characteristics of flows.

**Flow(s):** Depends on the source and destination of the **Flow**, a list of appropriate Flow names appears on the box at the top of the form.

Click on the appropriate **Flow** name from the list and the selected **Flow** name will appear on the line.

**Flow Status:** Select appropriate **Status** from the pull down menu on the middle of the form. Status has to do with the timeline of deployment – whether this interface already exists (**existing**), is part of the project you are architecting (**project**), or might be a new concept that a future project might want to consider but you want to go ahead and let your readers start to see the concept (**new opportunity**).

Select **Status** from the pull down menu, and the line style of the line changes appropriately for different Status values.

**Via:** If this flow will go through a data distribution system or other communications domain element (e.g., Wide Area Dissemination) use the pull-down to select the Element that will act as the data distribution system for this information. On the diagram the flow name will have a “**(d)**” appended to the name to indicate that it goes through a data distribution system.
NOTE: According to ARC-IT, not every information flow is eligible for routing through a data distribution system. Some flows like human interfaces just don’t make sense so the pull-down will be greyed out. Other flows might be appropriate for information broadcast from a single source to many destinations at once and might use a Wide Area Information Distribution mechanism but not something like a data warehouse or clearinghouse. In those situations, the via pull-down will be activated but will show the Wide Area Dissemination elements instead of the Data Distribution elements.

NOTE: The “(d)” symbol will be displayed to the left of the first flow name on a line. Even if there are multiple information flows on the same line but only one of them is going through a communications element the (d) will be in the same place. Printing the information flow triples as a report will show the details. Depending on how complicated your diagrams already are you may consider splitting the flows up into multiple lines to better indicate which are and aren’t using a communications element.

NOTE: This may seem obvious but you cannot route a flow through itself which means if you see a flow going to a communications type element like a Data Distribution System (DDS) then you will not be able to use the Via pull-down and select that DDS for it to go through.

See the section on **Using Data Distribution** in the Other Diagram Tools for further discussion on Data Distribution. Yes, you can connect flows directly to the communications elements if they are ‘comm-eligible’, meaning they are defined in ARC-IT as flows that could be directed through a data distribution system or a wide area information disseminator.

*Flow Characteristics:* **Flow Characteristics** attributes on the bottom of the **Shape Properties** Form identifies the communication characteristics of the flow.

*Using FIPS:* The "Using FIPS" check box indicates whether the methodology from the FIPS 199 to characterize the flow in terms of its requirements for Confidentiality, Integrity, and Availability. Check this box and click **FIPS Basis...** to document the settings and rationale with this approach. See **Using FIPS** below. NOTE: this method is in lieu of using the Encryption and Authenticability values directly in Shape Properties. **Using FIPS doesn’t make sense for every flow – the human interfaces, for instance, will not have FIPS analysis.**

Select the appropriate **Flow Characteristics** values form the pull down menu on the bottom. By modifying these attributes, different communication symbols appear on the line to indicate their spatial context requirements or their timing requirements and the color of the line changes appropriately.

The **Time** context requirements are expressed as a number:

1. **Now** (something needed in near real-time such as an intersection movement indicator from another vehicle)
2. **Recent** (something used to understand the current situation such as traffic flow data at an intersection)
3. **Historical** (something that has already happened such as a set of transit ridership numbers for an archive)
4> **Static** (something that doesn’t change or doesn’t change very often such as the text of a roadside sign)

The time context is then followed by a letter indicating the flow’s *Spatial* context:

A> **Adjacent** (something very close to where it is needed such as data within the onboard systems of a vehicle)

B> **Local** (something to be used in close proximity of where the data was created such as an intersection controller)

C> **Regional** (something used by the surrounding region such as traffic flow data along a freeway corridor)

D> **National** (something used by the entire country such as a nationwide emergency message)

E> **Continental** (something used wherever connected vehicles may be such as an application update)

At Layer 2, the information flows can also have the following characteristics:

- Acknowledgement – True / False
- Encryption – True / False
- Authenticability – True / False (if FIPS is used this will be locked)
- Cardinality – Unicast / Broadcast / Multicast (if FIPS is used this will be locked)
- Initiator – Destination / Source / None (blank)

**TIP**: Include a Legend on at least one of your diagrams. This will help you and your readers see what the different symbols and color-coding mean. The physical and enterprise drawing stencils include either a vertically oriented legend or a horizontal legend depending on where you have the most real estate on your drawing.

As you go higher in the project architecture hierarchy different characteristics will apply because the interconnects are collections of flows and not all flows will have all of the same exact characteristics.

At Layer 1 and 0, the physical interconnects can have the following characteristics:

- Encryption – True / False (if FIPS is used this will be locked)
- Authenticability – True / False (if FIPS is used this will be locked)
- Cardinality – Unicast / Broadcast / Multicast

Click **New...** or **Edit...** from the Shape Properties window to open up the **Information Flow Details** form/window. From here you can also make changes to the flow’s characteristics and descriptions.
You can view the Functional Object assignments provided by ARC-IT and add additional Functional Object assignments. From here you cannot remove assignments provided by ARC-IT. Note the Blue text used to indicate Read-Only.
Using FIPS

The "Using FIPS" check box on Shape Properties indicates whether the methodology from FIPS 199 was used to characterize the flow in terms of its requirements for Confidentiality, Integrity, and Availability. Check this box and click “FIPS Basis...” to document the settings and rationale with this approach.

Click the “FIPS Basis” button from Shape Properties or Click the FIPS button on the menu bar for the Physical Diagram.

NOTE: Shape Properties must also be active (open) in order for the FIPS Basis window to be populated. Even if you click the FIPS button from the menubar it will only populate if Shape Properties is also opened.

Definitions from the Federal Information Security Management Act (FISMA) of 2002 and FIPS Publication 199:

**Confidentiality:** Preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information. A loss of confidentiality is the unauthorized disclosure of information.

Valid Values: Not Applicable, Low, Moderate, High

**Integrity:** Guarding against improper information modification or destruction, and includes ensuring information non-repudiation and authenticity. A loss of integrity is the unauthorized modification or destruction of information.

Valid Values: Low, Moderate, High

**Availability:** Ensuring timely and reliable access to and use of information. A loss of availability is the disruption of access to or use of information or an information system.
Valid Values: Low, Moderate, High

The Confidentiality and Integrity of a flow affects whether not Encryption should be used and whether or not the sender of the flow should be Authenticated. Here is the formula:

- If Confidentiality > Low, Encryption = True; Else If Confidentiality <= Low, Encryption = False
- If Integrity > Low, Authenticability = True; else If Integrity <= Low, Authenticability = False

**NOTE:** Using FIPS is in lieu of using the Encryption and Authenticability values in Shape Properties. If there are values set on the FIPS Basis screen then the Encryption and Authenticability values on the Shape Properties menu will be set based on the formula above and the pull-down will be locked.

**NOTE:** When you click on a flow line on a diagram that has more than one flow name on the same line and bring up the FIPS Basis window you will see the list of flows at the top area of the FIPS Basis window. As you click each flow at the top you will see the C-I-A values and rational in the bottom. SET-IT calculates the coloring of the flows on the diagram based on the most stringent setting of the multiple flows. For example, if one flow has Low confidentiality but another has Medium Confidentiality then the flow will be colored based on the Medium setting (Blue or Red depending on the Integrity setting).

**TIP:** If you want to change FIPS information for individual triples, add another line to the drawing, assign the flow you want to change to that line and change the FIPS settings from there.

**NOTE:** For Human Interface flows, regardless of what settings there are for the C-I-A values on the Using FIPS screen the flows will still appear as ‘black’ for no Encryption or Authenticability since there is no way to encrypt or describe how to encrypt a machine-to-human flow or to practically authenticate the information on such an interface.
Create a New or User Defined Information Flow

Sometimes SET-IT may not have the information flow you need. The database that comes with SET-IT contains over 750 information flows based on the physical view from ARC-IT. But as ITS and connected vehicle technology keeps evolving new projects are bound to have interfaces that are new and unique. Creating a new or User Defined Flow in SET-IT is easy.

There are a couple of ways to create a new flow:
  o From the New Items menu
  o From Shape Properties on a Diagram

Creating a flow from the New Item Menu
At the top left of the screen click the Item pulldown from the New area and select the Information Flow. The Information Flow Details window opens.

If you use the New menu Item to start the process you will be in what SET-IT calls “PObject Mode”, meaning that the flow is being created completely from scratch and you have to select the source and destination physical objects before selecting the project’s elements.

In the PObject Mode for a new user defined information flow the pull-downs for Source and Destination are Physical Objects as shown above.

Once the PObjects are identified SET-IT will run some queries and determine which Functional Objects should be available to select as part of the interface. It will also populate the default settings for the flow characteristics including the security settings, cardinality, as well as time and spatial context.
The other thing you can do at this point with a New or User Defined Information flow is define this new flow as a preplacement for an existing ARC-IT information flow.

Identifying a New User Defined Information Flow as a replacement for an ARC-IT flow is a good idea if you want to show things are certain way in your region. Beware that it may also make sense to retain the linkage both in name and underlying data between your architecture and the ARC-IT reference to assist with interoperability with other projects and agencies that may not know what your names mean.

Once you have finished filling in the characteristics for your new flow you can now select this on your diagrams whenever you have shapes that match the source and destination PObjects selected.

**Creating a flow from the Diagram’s Shape Properties**

From the Shape Properties window shown in the previous section, click the New... button. The Information Flow Details window opens.
This is accessed from the Diagrams via the Shape Properties window by clicking dragging a flow between 2 elements (physical object boxes that have been customized with local, project-specific names) and clicking “New...” This is what SET-IT calls “Elements Mode” for new information flows.

Note that in Elements mode – the Information Flow Details screen is different. Here, instead of seeing the Physical Objects we just see the Elements. The Functional Objects portion of the form only shows a few functional objects. The Element mode of the form is inheriting information from the Diagram and you are not allowed to make as many changes since it could corrupt some of the mappings between the shape on the diagram and the physical object assignments in the database.

In either Elements or PObjects mode, the Flow Details window contains an area to enter the Name of the information flow, a brief description, and then areas to determine the source, destination, and the other characteristics described on the Shape Properties window.

If you access this Information Flow Details from the diagrams and you already had the line connected to 2 customized objects (elements) on the diagram, then the source and destination elements will be pre-populated. If the flow was drawn between 2 boxes that hadn’t been customized with elements on both sides yet, the source and destination area will be filled with the physical objects corresponding to the objects on the diagram.

You can also select the Functional Objects, the smaller units of functionality within the Physical Objects, affiliated with this new flow. As you select the Physical Objects for source and destination the Functional Objects choices will be narrowed down to the appropriate functional objects from the Architecture for the service package selected.
Also, if all you did was select the source and destination and say OK, SET-IT will pre-populate the flow characteristics with a predefined set of defaults. You can change them but this will give you a starting point.

Sometimes, your element may be mapped to more than one physical object. When this occurs SET-IT will not be able to automatically determine which pair of physical objects to associate with the flow. So, if you were in Elements view SET-IT will prompt you to switch to Physical Objects view in order for you to determine the precise mapping for this new flow.

**NOTE:** If the “Using FIPS” checkbox is checked on the Shape Properties window the Encryption and Authenticability settings will be greyed out. Use the FIPS Basis screen to change the Confidentiality, Integrity, and Availability requirements that will then affect the Encryption and Authenticability values.

Create a New Functional Object

Functional Objects are subsets of a physical objects and are used to define more specifically the functionality and interfaces that are required to support a particular ITS or connected vehicle service package / application.

In SET-IT, after you Create a New Diagram, or open an Existing Diagram.

Select the **Functional Object** from the stencil on the left.

Drag the **Functional Object shape** to the diagram area.

Double click on the Functional Object.

**Shape properties** form appears on the left.

Select appropriate **Status** from the pull down menu on the bottom.

Click the **New** button in the shape properties.

Select a **Functional Object** name on the list.

The selected **Functional Object** name will appear on the shape.

**NOTE:** You may need to press the “Refresh” button at the top of the Shape Properties window. When you do the selected functional objects will move to the top of the list.
Add a Hyperlink

Hyperlinks provide a way to automatically link terms or objects in your SET-IT project to another location or file, perhaps to another location on the internet. From the Information Flows, Physical Objects, physical Functional Objects, Enterprise Objects, and enterprise Resources windows click on the Hyperlink button and you will see the following screen:

The first time you will need to add a hyperlink by pressing the Add/Edit button at the top left of the Hyperlink screen:

In the 3 columns on the Hyperlinks details screen you can enter the following:

- **Hyperlink Name** - is the readable text you want your readers to see in the documentation, e.g. "Architecture Team Website."
- **Hyperlink Address** - is the fully qualified Uniformed Resource Locator (URL), e.g. "https://www.standards.its.dot.gov/DevelopmentActivities/CVReference".
- **Hyperlink Description** - is a place for you to provide any additional descriptive text explaining what the link is used for or where it's located, e.g., "provides resource material used as background for this project".
Can I draw my own Layer 2 diagram without an ARC-IT service package?

Yes, you can also start from scratch, that is, create your own layer 2 drawing.

You can use the stencil to drag physical objects onto the diagram and flows to build your own ‘service’ or ‘application’ of sorts. Refer to the directions above about how to use each of the diagram tools.

You can also drag Functional Objects onto the drawing. When you place the blank Functional Object over one of the Physical Object shapes SET-IT will populate the Shape Properties with the appropriate functional objects. The list may be blank if there are none defined for that physical object in ARC-IT, e.g. a Driver or an external object with respect to the ITS architecture like a Financial Institution.

You can use terminals to help unclutter a diagram and add Notes.

The title box also works the same on a from-scratch Layer 2 diagram as it does on other diagrams: (use the Update Title to automatically update the title, date, etc.).
Diagram Clean-Up Tool

There is now a diagram clean-up tool to help you remove shapes that are on the diagram but are not necessary because you have decided they are not applicable. Or create versions of the diagram that show only the Existing and another diagram that shows only Project status flows.

**TIP:** make a copy of your project first and zip that so you have a record of your project before the Cleanup exercise.

Status of Multiple Shapes

Using Shape Properties for a Layer 2 diagram you can set the status for all shapes or elements at the same time. This may be useful if you've been making changes individually but decided that everything needed to have the same status – maybe a project is now done and you need to show everything in the diagram as existing. Or the opposite – a part of the project has been deferred and you need to show that service package as having been moved out into the future.

Start by selecting a diagram in Physical view.

Next, select all the shapes you want to have that same status, including Elements, Flows, or Functional Objects within the selected Elements.

Then bring up Shape Properties, either by clicking Shape Properties from the menubar or by right-clicking one of the selected shapes and clicking Shape Properties.
In this situation Shape Properties will come up with only one attribute to change, Status. Use the pull-down to change the status of all the selected shapes.

**Drawing Higher Layer Physical Diagrams**

When a project spans more than one service package it will be good to see a summary of the project that includes all of the elements involved in the project. This can be done by using SET-IT to create a Layer 0 or Layer 1 diagram to show the physical elements and their interconnects.

**Layer 0** diagrams show all of the physical elements in a project and which ones are connected to each other via communications links, known as Physical Interconnects or P-Interconnects. They are also created from Layer 2 service package diagrams but unlike Layer 1 they don’t include any functional objects. The Layer 0 drawing may be more helpful to external stakeholders or decision makers to quickly see the scope of a project.

For **Layer 1 Diagrams** SET-IT will take the Layer 2 service package diagrams that you choose and come up with the combined set of physical objects and all of their functional objects that are needed to support the various service packages in which they are involved. The Layer 1 diagrams will also include physical interconnects between those objects.

SET-IT will place the elements on the Layer 0 or Layer 1 diagrams and will attempt draw the lines as best it can. In many cases, the user may need to rearrange the lines and elements to look presentable and legible.

The elements on a Layer 0 diagram are smaller versions of their Layer 2 or Layer 1 counterparts.
Layer 0/1 Settings
Layer 0 and Layer 1 diagrams are generated by SET-IT in real-time instead of being pre-imported from ARC-IT.

There is a Settings window for either Layer 0 or 1 diagram to allow you to change the appearance of the drawing.

As you click New / Diagram and choose either Layer 0 or Layer 1 you will see a Settings button. The Settings button launches a new screen called the Layer Diagram Settings window. It has options for shapes and lines.

For the shapes you can manipulate the following:
- how far apart the connection points should be spaced,
- how far apart the functional objects (on a Layer 1) should be spaced
- The maximum number of functional objects (on a Layer 1) to include in a single stack. As the number approaches that maximum the diagram generator will then widen the Element box to include a 2nd or 3rd column of functional objects.
- The default height and width of physical objects and/or elements.
- The spacing – either fixed or variable – between physical objects and/or elements. If it is fixed, you can say by how much and if it is variable you can give it a minimum or maximum distance

For the lines (interconnects) you can manipulate the following settings:
- Whether or not it should even bother with drawing lines – perhaps you’re going through this in iterative steps and want to focus on the placement of the physical objects or element shapes first
- Whether the line should be straight, creating a star effect or the traditional lines with bend points between source and destination
• Whether the ‘glue’ that is used to stick or connect them to the source and destination shapes is static or dynamic.
  o If dynamic then SET-IT will decide where the end point should be
  o If static you can tell SET-IT whether to connect the line to the closest available connection points or to the middle of the closest edge

**TIP:** these settings are for an advanced user. Save and Export a zipped copy of your project before starting to manipulate the settings on your diagram. It’s also a good idea to try it with the default settings first as that may be just fine for your needs.

Behind the Scenes on Layer 0/1: SET-IT’s diagram generation algorithms will try to build a diagram that is oriented similarly to the layer 2 diagrams that came from ARC-IT. It will try and put the Centers and Support objects on the left and Mobile devices on the right. If a DDS is in the project it will put that to the right of the centers and Field devices will be in the middle of the drawing. It will then place the shapes where it makes the most sense in terms of what they are connected to. You will probably still need to move shapes around in order to fit onto a reasonably-sized image.

During the diagram generation process you can click “Cancel” to stop it and go back to the Diagram window.

**NOTE:** Layer 0/1 drawings are not editable in the same way Layer 2 drawings are. You can move shapes around and delete them if desired but you cannot add shapes from the stencil. To add additional items to a layer 0/1 drawing you will need to regenerate the diagram and reselect which layer 2 drawings to choose.

**Layer 0 Specific Instructions**

While many of the basic SET-IT diagram features apply equally at all physical layers there are some rules or techniques that only apply to Layer 0.

**What is a Layer 0 diagram?**

A Layer 0 diagram is a high level drawing used to show the Physical Objects or Elements from your project and how they are connected. That’s it. It’s a summary of what lies beneath. It helps the project team and stakeholders reviewing the system documentation to see just what all of the systems are and how, at a very high level, they are connected.

**How is a Layer 0 Diagram Drawn?**

Typically, users will want to create a Layer 0 diagram after they have completed or nearly completed their Layer 2 service-level diagrams. Then when you use the New/Diagram/Layer 0 dialog you will see all of your service packages pre-selected.
You can un-select service packages that you don’t want included – perhaps they aren’t complete or won’t be part of the specific phase of the project you are embarking on at the time.

Can I Draw My Own Layer 0?

Currently (v8.3) SET-IT asks that you include at least one service package to initiate a Layer 0 drawing but then you can use the stencil to drag physical objects, physical interconnects, and other shapes like Comment Clouds, Legends, or Text Boxes onto the diagram just as you would for a Layer 2.

What’s on a Layer 0?

There are some differences about a Layer 0 from a Layer 2 drawing on the physical view. For one, on the Stencil for Layer 0 Flow is replaced with Interconnect. As you drag an interconnect from the stencil onto the drawing surface and connect it to 2 objects SET-IT will show what is the likely type of interconnect based on the classes of objects on either end.

The types of Layer 0 Interconnects include:
- Center to Center
- Center to Field
- Wide Area Wireless
- Short Range Wireless
- Human Interface
- Vehicle On-Board
- Contact or Proximity

On a Layer 0 drawing, time and spatial context values represent the range of values for the flows that make up that interconnect. So for instance, if that interconnect is made up of 3 flows on the Layer 2s that range from Now/Local to Historical/National then the Layer 0 P-Interconnect will show “1-3,B-D”.

In each case, the attributes of the interconnect will be assigned based on the flows upon which it is based:
- Status: Existing, Project, New Opportunity
- Encryption: True, False
- Authenticability: True, False
- Cardinality: Unicast, Multicast, Broadcast

If you draw your own Physical Interconnect then you will be able to assign status value yourself.

Just as with other drawings you can use terminals to help unclutter a diagram and add Notes.

The title box also works the same.

**NOTE:** Layer 0 drawings do not include Functional Objects (the small white or grey boxes inside the physical objects). They will be on the Layer 1 or Layer 2 drawings.
CAUTION: Creating or modifying a Layer 0 diagram on your own may be helpful to sketch ideas out but beware. You may not be able to keep things synchronized between the layers. For instance, drawing an interconnect as encrypted at Layer 0 but then some of the specific flows on Layer 2 may end up with different characteristics. SET-IT’s validation tools will help sort these out.

CAUTION: Lastly, as the number of service packages (Layer 2s) in your project grows so will the size and complexity of your Layer 0 drawings. SET-IT will attempt to place objects in a logical place and route the interconnects as best it can but you will need to edit these yourself.

Layer 1 Specific Instructions

While many of the basic SET-IT diagram features apply equally at all physical layers there are some rules or techniques that only apply to Layer 1.

Like Layer 0 described above, Layer 1 drawings provide a higher-level summary of what all is included in your service package. Now at Layer 1 we can show all of the functional objects that will be running or reside in the physical objects or elements of your project.

It helps the project team and stakeholders reviewing the system documentation to see just what all of the systems are doing across all of the services or applications and the interactions (physical interconnects).

How is a Layer 1 Diagram Drawn?

Typically, users will want to create a Layer 1 diagram after they have completed or nearly completed their Layer 2 service-level diagrams. Then when you use the New/Diagram/Layer 1 dialog you will see all of your service packages listed but not selected.

That’s a key difference between Layer 0 and 1. At layer 0 SET-IT assumes you want to see everything in one picture. At Layer 1, SET-IT is assuming you may want to create multiple Layer 1s depending on areas of focus so it lets you pick the Layer 2 drawings to include.

Can I Draw My Own Layer 1?

Currently (v8.3) SET-IT asks that you include at least one service package to initiate a Layer 1 drawing. Also with 8.3 you cannot use the stencil to add shapes to your diagram due to limitations with the Visio drawing tools.

On a Layer 1 you can edit the diagram by moving shapes around to get the placement you want and you can reconfigure the interconnects to suit your needs.
**CAUTION:** Lastly, as the number of service packages (Layer 2s) in your project grows so will the size and complexity of your Layer 1 drawings. SET-IT will attempt to place objects in a logical place and route the physical interconnects as best it can but you will need to edit these yourself.

*Can I Create My Own Physical Interconnect?*

Yes, you can create your own Physical Interconnect for use on a Layer 0 or 1 diagram. A user defined Physical Interconnect is created in the same manner as a User Defined Flow on layer 2. (See “Create a User Defined Flow”.)

The process is very similar – from the diagram drag a line from the stencil. You can select either the uni-directional or bi-directional lines. Connect it to 2 shapes on the diagram and double-click on the line to bring up Shape Properties.

SET-IT will look up the class of physical objects on either end of the line to determine if there is an existing type of Physical Interconnect that can be used. For example, if you draw a line between 2 operators and double click the line to open Shape Properties you will see that SET-IT went ahead and assigned the “Human Interface” interconnect.

If none of the existing physical interconnects match what you need then click New... to create your own.

In the Physical Interconnect Details form, as with the Information Flows form, you have the option of creating the P-Interconnect based on the Elements of your project architecture which would apply just to that instance or on the Physical Objects which would apply to potentially other elements mapped to those same Physical Objects.

On the P-Interconnects Details form for a new User Defined Physical Interconnect you give it a description and then select the layer 2 information Flows to associate with this P-Interconnect. The area in the middle of the form will list the available flows that apply to this interface.

The attributes or characteristics of the interconnect will be assigned based on the flows upon which it is based:
- Status: Existing, Project, New Opportunity
- Encryption: True, False
- Authenticability: True, False
- Cardinality: Unicast, Multicast, Broadcast

If you draw your own Physical Interconnect then you will be able to assign status value yourself.

**Enterprise View**

This section describes how to create and modify your architecture’s enterprise view, including how to create a new Enterprise diagram and modify its components. The Enterprise View addresses the relationships between organizations and users, and the roles those entities play in the delivery and
consumption of ITS services. Relationships between entities are dependent on the roles those entities take in the delivery of user services.

An Enterprise view consists of drawings at the overall project level (Layer 0). The components of an Enterprise diagram include:

- **Enterprise Objects**, boxes with solid lines, that will be related to project Stakeholders
- **Resources**, boxes with dashed lines, that will be related to physical objects or elements from the physical view as well as some functional objects (internal subset of functionality within a physical object)
- **Agreements**, red lines, that represent a type of relationship between stakeholders or enterprise objects (the boxes) in a project
- **Expectations**, blue lines, that represent another type of relationship between stakeholders or enterprise objects in a project
- **Roles**, black lines with a solid circle on one end, represent a relationship between a stakeholder and their elements, e.g. who owns or who operates an element.

The key questions to be understood by the development of an enterprise view for a project include “Who owns or who operates which components of the overall system” and “How are they related to each other?” In other words, what agreements need to be in place for the system represented in the physical view to work?

**TIP:** Typically, SET-IT users will start by selecting one or more ARC-IT service packages for their project and begin customizing the *Physical* view. Once elements have been defined for each object in the physical diagram and stakeholders have been defined along with their relationships (Owns/Operates) to the elements.

**NOTE:** A physical layer 0 diagram must be created before creating an enterprise layer 0 diagram.

Once the Physical View is populated and the Enterprise View is entered – either by creating an Enterprise Diagram or going to one of the Enterprise View grids – a set of Rules is executed generate the appropriate relationships. The agreements are established based on the Enterprise View in ARC-IT.

Agreements can be classified by their ‘Specificity’, either a “General” or a “Specific” agreement. General agreements are typically applied broadly and perhaps include more than just 2 stakeholders, perhaps everyone involved in a project or initiative. Specific agreements are typically centered around an interface or system element being developed or used in some way. The table below lists the General and Specific Agreements that come out of ARC-IT’s Enterprise View

**Table 1. ARC-IT Enterprise View Agreements**

<table>
<thead>
<tr>
<th>Specificity</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Funding Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Handshake Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Interagency Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Master Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>Specificity</td>
<td>Name</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>General</td>
<td>Project Blanket Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Service Package Blanket Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Shared Operations Agreement</td>
</tr>
<tr>
<td>General</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Specific</td>
<td>Acquisition Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Application Interface Specification</td>
</tr>
<tr>
<td>Specific</td>
<td>Application Usage Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Device Placement and Operations Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Device Usage Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Employment Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Equipment Operations Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Information Exchange Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Information Exchange and Action Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Information Provision Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Information Provision and Action Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Installation Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Interface Description</td>
</tr>
<tr>
<td>Specific</td>
<td>Maintenance Data Exchange Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Operations Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Security Credentials License and Usage Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Service Coordination Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Service Delivery Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Service Usage Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>System Maintenance Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>System Monitoring Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>System Usage Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Vehicle Data Access Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Vehicle Operating Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Verification Agreement</td>
</tr>
<tr>
<td>Specific</td>
<td>Warranty</td>
</tr>
</tbody>
</table>

For interface related agreements SET-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 display when a user enters the Enterprise View after making changes in the Physical View.
TIP: The Enterprise Layer 0 diagram is a useful addition to a Concept of Operations document as it shows the overall set of Stakeholders and their relationships to each other.

Create a New Enterprise Diagram

An Enterprise Layer 0 diagram is a high level drawing used to show the Enterprise Objects or Stakeholders from your project and how they are related. That’s it. It’s a summary of what lies beneath. It helps the project team and stakeholders reviewing the system documentation to see just who all of the stakeholders are and their relationships.

To create a new Layer 0 diagram:

1. Click on the **Diagram** tab.
2. Select a **Layer** from the drop-down menu. For Enterprise the single choice is Layer 0 for the project level perspective.
3. To create a Layer 0 diagram, in the **New Diagram** box:
   a. Enter the title of the new diagram.
   b. Select Layer 0 with the pull-down
   c. Select the physical layer 0 diagram that you already created and customized to use as the basis for the enterprise diagram.
   d. Click OK.

**NOTE**: you must have already created a Physical Layer 0 drawing before creating an Enterprise Layer 0 drawing. Otherwise, you will get a warning that “No physical layer 0 diagram has been selected” and it will ask if you would, “Like to create a blank enterprise layer 0 diagram.”

It is probably best to go to Physical and create a Layer 0 diagram for your project and then come to enterprise to create the Layer 0 diagram.
If you picked a physical layer 0 diagram that you had already created, SET-IT will use those elements to create resources and any stakeholders you created to assign to enterprise objects. You can finish customizing it by reviewing some of the mappings and ensure they reflect what you want. SET-IT will take a conservative approach and assign stakeholders to enterprise objects based on the assignments in the selected service packages as well as other ARC-IT service packages that have similar enterprises.

Shown below is an example of a Layer 0 drawing. This project had been imported from the V2I Safety Initiative project that is in RAD-IT’s sample file. After import, a Physical layer 0 diagram was created then, after switching to Enterprise View, a new Enterprise layer 0 diagram was created and edited to move the shapes around for legibility purposes.

SET-IT will select relationships or points of coordination to include in the Coordinations Report or on a generated Enterprise Layer 0 drawing by looking at the service package as well as at other potential relationships that are defined between those same Enterprise Objects in other parts of ARC-IT.

**TIP:** Once you have your Stakeholders on your drawing you may notice that some of the stakeholders appear more than once. For instance, on a diagram involving traffic centers and field infrastructure you may have the same stakeholder, e.g. “County
DPW” in 3 different places as the owner of the traffic management center, the owner of the ITS Roadway Equipment, and the owner of the Roadside Equipment. You can consolidate these by deleting the boxes you don’t need and consolidating the relationships to just the one occurrence of that stakeholder. This will make what could otherwise be complicated drawings somewhat easier to understand.

**Add a Shape to a Diagram**

In order to add a shape to an enterprise diagram, select a *Shape* from the stencil on the left. For enterprise these include Enterprise Objects, Resources, Agreements, Expectations, Roles, Comments, Notes, Legend, and an extra Title Block.

Drag the *Shape* to the drawing area.

Double click on the Shape or right-click and select *Shape Properties* to view and edit the properties of that new shape.

The Enterprises and Resources are colored coded based on their class: center, field, personal, support, vehicle, or unspecified – used for functional objects or for when enterprises are repeated on the same diagram. There is an additional shape for Resources – the Resource Communications has the color of a resource class and the rounded corners or a communications element. Note there is no Communications Enterprise because the enterprises – companies, agencies, and staff – that run or own a communications domain system are the same enterprises that run other support systems.

**NOTE:** the Shape Properties box will be ‘floating’ to the left side of the window when it first opens. To re-dock it simply click the title of the box and drag it over and ‘drop’ it over the icon that looks like a closed door on either the left side or right side of the screen. You can ‘undock’ it by clicking the title of the box and dragging it to another area of your screen. You can also simply close the Shape Properties by clicking the X button in the top right of the window.
Delete a Shape

Select a **Shape** in the drawing area by clicking once on the shape.

Click **Delete** on the keyboard. It will ask if you are sure.

You can also right-click and select Delete.

Create a Stakeholder

A “stakeholder” in SET-IT represents an instance of an enterprise object from ARC-IT. Think of this as the local or personalized version of what the national or reference framework has defined. A stakeholder defines an organization that owns, operates, or interacts in some way with the intelligent transportation or other system elements in a project. When multiple stakeholders are involved there are relationships between them that appear on the Enterprise view of an architecture. Stakeholders can also be grouped together for joint or combined roles.

You can create your own stakeholder and associate them with one or more enterprise objects.

**NOTE**: while a stakeholder may be associated with more than one enterprise object, the shapes on any particular diagram only represent one enterprise object at a time.

There are several ways to create a stakeholder:

- From an enterprise diagram, double-click on one of the rectangles that represent an enterprise object. This will open the Shape Properties window. From there click the **New** button to open the Stakeholder Details window.
- From the ‘New’ area of menu bar on the “Home” ribbon, select Item / Stakeholder. This will also open the Stakeholder Details window
- From anywhere in the Physical or Enterprise view press <Control-t> which is a shortcut key to open the Stakeholder Details window

When starting with the Shape Properties window you will first select the appropriate **Status** from the pull down menu located on the middle of the form.

Select the appropriate **Enterprise Object** from the pull down menu to select an ARC-IT enterprise object or a user defined object. SET-IT will filter the selections based on the class or type of object – if you dragged a Field shape onto the diagram it will only show field objects.

Select from an existing stakeholder in the center of the screen.

If you don’t see a stakeholder listed click the **New** button in the shape properties form.
The Stakeholder Details form appears as shown below:

Add an Enterprise Object

Create a New Diagram, or open an Existing Diagram.

Select one of the 6 different Enterprise Objects from the stencil on the left.

Enterprise Objects come in ‘classes’ based on how they are defined in ARC-IT. The Enterprise Object Classes are:

- Center
- Field
- Personal
- Support
- Vehicle
- Unspecified

**NOTE:** Unspecified is unique to Enterprise and represents Enterprise Objects that aren’t necessarily tied to one class of physical objects, e.g. a Maint and Constr Vehicle Owner that may have responsibilities over both the vehicle based maintenance and construction vehicles onboard equipment as well as the center based dispatch and monitoring systems.
Drag the **Enterprise Object shape** to the diagram area,

Double click on the **Enterprise Object**, 

**Shape properties** form appears on the screen.

Select the appropriate **Enterprise Object** from the pull down menu located on the bottom of the **Shape Properties** Form,

Select a **Stakeholder** from the list in the middle of the form. If none are listed you will need to click **New** to add a Stakeholder. You can skip this step but the box will simply have the generic italicized name with braces around the name indicating that it needs to be customized.

Select appropriate **Status** from the pull down menu located on the middle of the Form,

Optionally - select or add a Hyperlink for this Enterprise Object. Click on the word "**Hyperlink**" just below the description and the Hyperlink window will appear. See **Add a Hyperlink** for details.

The selected **Stakeholder / Enterprise Object** name will appear on the shape.

**Add a Resource**

Resources are shown as boxes with dashed lines in the Enterprise view to indicate the things that are being managed, operated, etc. by the Enterprise Objects. In terms of an ITS project, think of a Resource as one of the Elements from the physical view just as the enterprise objects are related to the project’s Stakeholders.

Resources, like Physical Objects, can be one of 6 classes:

- Center
- Field
- Personal
- Support
- Vehicle
- Nomadic (combination of Vehicle and Personal)

To create a resource, drag a **Resource** shape from the Stencil onto the diagram.
Double click on the **Resource**. **Shape properties** form appears on the screen.

Select the appropriate **Resource** from the pull down menu located on the bottom of the **Shape Properties** Form. These choices are based on the ARC-IT resources that are from that class. They also include User-Defined Physical or Functional Objects that were created while in the Physical View.

Select an **Element** from the list in the middle of the form. If none are listed you will need to click **New** to add an Element. You can skip this step but the box will simply have the generic italicized name with braces around the name indicating that it needs to be customized.

Select appropriate **Status** from the pull down menu located on the middle of the Form.

Optionally - select or add a Hyperlink for this Resource. Click on the word "**Hyperlink**" just below the description and the Hyperlink window will appear. See Add a **Hyperlink** for details.

The selected **Resource** name will appear on the shape.

Remember Resources are linked to the Physical view so that as Resources are added or edited they will be reflected in the Physical Objects or their customized Elements that are also in the Physical View.

**Add a Hyperlink**

Hyperlinks provide a way to automatically link terms or objects in your SET-IT project to another location or file, perhaps to another location on the internet. From the Information Flows, Physical
Objects, Functional Objects, Enterprise Objects, and Resources windows click on the Hyperlink button and you will see the following screen:

The first time you will need to Add a hyperlink by pressing the Add/Edit button at the top left of the Hyperlink screen:

In the 3 columns on the Hyperlinks details screen you can enter the following:

- Hyperlink Name - is the readable text you want your readers to see in the documentation, e.g. "Architecture Team Website."
- Hyperlink Address - is the fully qualified Uniformed Resource Locator (URL), e.g. "http://www.newtown.net/standards101".
- Hyperlink Description - is a place for you to provide any additional descriptive text explain what the link is used for or where it's located, e.g., "Describes New Standard Links for New Town ITS Projects".
Creating a New Agreement

Agreements are shown as red lines on the Enterprise diagrams with arrowheads on one or both ends. They connect Stakeholders, also known as Enterprise Objects, together by defining what has to be agreed upon in order for a service package to be implemented, operated, coordinated among agencies, maintained, etc.

To create an agreement, drag an Agreement line from the Stencil onto the diagram area. Connect it between Stakeholder or Enterprise Object shapes. SET-IT will prevent you from attempting to draw an agreement between an Enterprise and a Resource.

You can choose from a unidirectional or bidirectional agreement – indicated as “(Bidir)”.

NOTE: Generally, agreements are bidirectional since both parties have to agree. Occasionally, there may be a situation where you want to indicate that one party is the lead and the other party is the recipient or dependent part of the agreement.

Double click on the Agreement line and the Shape Properties form appears on the screen.

Select the appropriate ARC-IT Agreement from the pull down menu located on the bottom of the Shape Properties Form to choose the desired agreement type. The list of agreement types from ARC-IT are shown and you can also choose "<Unspecified>" if the agreement type you need isn’t listed.

Select an Agreement from the list in the middle of the form. If none are listed you will need to click New to add an Agreement. You can skip this step but the box will simply have the generic italicized name with braces around the name to indicate that it needs to be personalized.

Select appropriate Status from the pull down menu located on the middle of the Form,

The selected Stakeholder / Enterprise Object name will appear on the shape.

If you need to create a New Agreement or if you choose to Edit one of the existing agreements in the Shape Properties list then the Agreements window appears with a box for Name, Description (that can be Auto-populated if an ARC-IT Agreement was selected on Shape Properties) and columns for Source, Destination, and Status. For Bidirectional agreements the ordering of source and destination really don’t matter.

If you are creating a new agreement the Source and Destination will be prepopulated based on what was selected on the diagram. For agreements not already defined in ARC-IT the User Defined box will be checked.
From this Agreements details form you can edit the name, fill-in a *Description*, adjust the *Status*. Use the Auto-Populate button to fill-in the Description field with the description of that type of agreement from ARC-IT.

**NOTE:** You will need to go back to Shape Properties on the diagram if you want to change the type of ARC-IT agreement that this custom agreement is based on.

**Creating a New Expectation**

Expectations are shown as blue lines on the Enterprise diagrams with empty arrowheads on one or both ends. They connect Stakeholders, also known as Enterprise Objects, together by defining what is expected from each other in order for a Service Package to be implemented.

To create an expectation, drag an *Expectation* line from the Stencil onto the diagram area. You can choose from a unidirectional or bidirectional agreement – indicated as “(Bidir)”.

**NOTE:** Generally, expectations are unidirectional since one party may expect information or some action from another. Occasionally, there may be a situation where the expectation flows both ways between Stakeholders.

Double click on the *Expectation* line.
**Shape Properties** form appears on the screen.

Select the appropriate **Expectation** from the list in the middle of the form.

Select appropriate **Status** from the pull down menu located on the middle of the Form,

The selected **Expectation** name will appear on the shape.

If you need to create a **New** Expectation or if you choose to **Edit** one of the existing expectations in the Shape Properties list then the Expectations window appears with a box for Name, Description and columns for Source, Destination, and Status. For Bidirectional expectations the ordering of source and destination really don’t matter.

**Creating a Role**

Roles are shown as black lines with a black circle on one end. They are used to graphically depict how Stakeholders and their Resources are related.

To create a Role, drag a **Role** line from the Stencil onto the diagram area.

Double click on the **Role** line.

**Shape Properties** form appears on the screen.

Select one or more of the available Roles defined in ARC-IT or click “New...” and define a user defined role. ARC-IT defines 17 potential roles as shown below:
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advises</td>
<td>An Enterprise that can provide information about a Resource or Document. An Enterprise verifies that a target Resource meets relevant performance, functional, environmental and quality requirements. This could be an independent third party or it could be the same entity that has the Develops role. For instance, an automotive OEM practicing &quot;self-certification&quot; would have this role with respect to the Basic Vehicle, whereas an independent certification body might have this role with respect to a Vehicle OBE (though of course the OEM could also fill this role).</td>
</tr>
<tr>
<td>Certifies</td>
<td>An Enterprise creates the target Resource or Document. The Enterprise that engineers a traffic signal controller (ITS Roadway Equipment), or designs a vehicle (Basic Vehicle) or authors a technical standard will have the Develops role.</td>
</tr>
<tr>
<td>Develops</td>
<td>An Enterprise performs the initial delivery, integration and configuration of the target Resource. This might be a system integrator, a state DOT Enterprise performing its own installation, or a device supplier that performs on-site installation.</td>
</tr>
<tr>
<td>Installs</td>
<td>An Enterprise administers the hardware and software that comprise the target Resource. The entity that takes the ‘maintains’ role typically is delegated authority by the entity with the “Owns” or “Manages” roles, depending on the environment. The maintainer interacts with the target Resource so as to keep that Resource in the Operational state.</td>
</tr>
<tr>
<td>Maintains</td>
<td>The Enterprise that is accountable for performing actions with a Resource, typically in support of one of the key operations-related roles (operates, installs, maintains). This authority is typically delegated by the Enterprise with the “Owns” role, and commonly accomplished by delegation to Human E-Objects with the “operates”, “installs” or “maintains” roles, depending on the context.</td>
</tr>
<tr>
<td>Manages</td>
<td>The Enterprise that provides the basic service of a service package.</td>
</tr>
<tr>
<td>Operates</td>
<td>The Enterprise that supplies (provides) a device or software product. The Supplier delivers the target resource to the Owner.</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>Uses</td>
<td>An Enterprise or Human that interacts with a Resource or Document in a way not captured by other roles. For instance, the person that reviews a document, or the agency informed of project status would have this role.</td>
</tr>
<tr>
<td>Verifies</td>
<td>The Enterprise that determines whether or not a target Resource meets documented requirements. This action is typically on behalf of the Owner.</td>
</tr>
</tbody>
</table>

Select appropriate **Status** from the pull down menu located on the middle of the Form. The selected **Role** name(s) will appear on the shape.

**Notes about Drawing Enterprise Diagrams**

When a project’s stakeholders have been defined and their roles with respect to their elements defined it will be good to see a summary of the project that includes all of the stakeholders involved in the project. SET-IT’s **Layer 0** enterprise diagram shows the project’s stakeholders and their relationships. The Layer 0 drawing may be helpful to external stakeholders or decision makers to quickly see the scope of a project.

Typically, users will want to create a Layer 0 diagram in Physical View after they have completed or nearly completed their Physical View Layer 2 service package-level diagrams.

**Can I Draw My Own Layer 0?**

While you will usually create an enterprise diagram after creating the physical layer 0 but you can also start from scratch, that is, create your own layer 0 drawing. You can use the stencil to drag enterprise object shapes onto the diagram and assign them to ARC-IT enterprise objects (and stakeholders).

**Enterprise Diagram Complexity**

**CAUTION:** Lastly, as the number of service packages (Layer 2s in physical) in your project grows so will the size and complexity of your Layer 0 drawings (both physical and enterprise). SET-IT will attempt to place objects in a logical place and route the relationships as best it can but you will need to edit these yourself.

**Communications View**

This section describes how to create and modify your architecture’s communications view, including how to edit the Communications diagram templates and modify the standards and protocols used in your project.
A Communications view consists of drawings and tables to describe the layered sets of communications protocols that are required to support communications among the physical objects (or elements) that participate in the connected vehicle environment.

The Communications View describes the communications protocols necessary to provide interoperability between Physical Objects in the Physical View. Each triple (source, destination, information flow) from the Physical View has been mapped to one or more data dictionary standards, referred to by ARC-IT as an information layer standard. They have also been mapped to one or more of 16 standards profiles, defined to identify the communications protocols necessary to transport data described by an information flow.

In SET-IT, you can see the standards, standards development organizations (SDOs), and the profiles (the layered communications protocols for different types of interfaces) used in connected vehicle projects. The Communications View does not show standards that pertain only to the physical or functional objects like the Advance Traffic Controller cabinet standard nor will it show physical security standards. Physical and Physical Security type standards are defined and shown in the Physical View.

The components of the Communications view include:

- **Templates** – each drawing represents the template for the standards profiles associated with the interfaces in the project
- **Definitions** – menu of tables to view, tailor, and add to the following:
  - Diagram Information
  - Physical Interconnects (from Physical View)
  - Protocol Layers
  - Standards Profiles
  - Standards
  - Mapping of Profiles to Standards
  - Mapping of the Flow Triples to Profiles/Standards

**Populating the Communications View**

As flows are defined in the Physical view – or more accurately, when Elements are defined for the sources and destinations – then profiles are identified for the Communications View.

As each flow is added to the architecture the likely standards profiles are selected. In most cases there is just one likely profile but there are exceptions where more than one profile may be appropriate depending on the needs of the deployment.

The Communications View will then be updated to add new drawings to the Templates area for each of the new profiles. The Definitions area will also be updated to include the new profiles, standards, and mappings between them.

**NOTE:** There have been issues noted where a conflict occurs during the import of communications diagrams. SET-IT will block non-ARC-IT and non-SET-IT elements from
being copied onto SET-IT’s diagrams. There have been issues where a user copies something to the Windows Clipboard in the middle of this process. An error will pop-up in this case but the SET-IT Communications View drawings will be intact. You may have to re-copy and paste the image or text you were working with in the other program.

**NOTE:** This process will not add a template if the flows in physical that are assigned to that profile are statused as “Not Applicable” in physical view.

This is what the Communications View looks like once the user has finished customizing their physical diagram and hits the Communications View button:

Elements of the Communications View Templates

The Templates look similar to the diagrams for the Physical and Enterprise Views. The biggest difference is that here you are not viewing and editing your diagrams. You are viewing and editing the *templates* that will be used to generate your diagrams from the Outputs menu.

Each button on the left menu represents a Communications Profile. Each profile represents the set of layered protocols and the standards associated with those protocols that are necessary in order for an interface to work over a particular communications media.
The drawing canvas has the layered protocols for each type of interface profile. There is one box associated with each ‘layer’ in the communications protocol stack. You can double-click on a box, say the Link Layer, and Shape Properties will open to see the standards associated with that layer. What is shown initially is the mapping of standards to profiles from ARC-IT.

Here is where you can decide which standards do or don’t apply to each layer for your project.

Note that each diagram has a left side for the Source and a right side for the Destination. In most cases, the standards should match each other on each side of an interface. You can use the ‘mirror’ button ( ), the 3rd button at the top of the Shape Properties window, to make the sides match each other so that changes made to one side are automatically reflected on the other.

You cannot customize the top of the drawing – the source, destination, flow name, and the information layer standard will all be populated when the individual communication diagrams are created.

As you customize these template drawings you are making changes that will be reflected every interface that uses this profile. If you have a fairly moderate size connected vehicle project you may end up with a dozen or so center to field information flows. When you generate your diagrams each of the Center-to-Field type interfaces will use the template diagram you have customized here.

The Communications View Templates do have some features like the Physical and Enterprise drawings. You can drag the following drawing features from the stencil over onto your drawing surface:

- Note (rectangular box)
- Comment (cloud shape)
- Title Block (use the Update Title to automatically update the title, date, etc.)

Use Shape Properties to edit the Note and Comments as you would in Physical or Enterprise.
Editing a Communications Protocol Template

With SET-IT, the Output/Diagrams tool will allow you to generate a separate communications profile diagram for each information flow triple in your project. Those diagrams will be based on the Profiles Templates defined here in Communications View Templates area.

On the Templates, you can customize the way your diagrams will look by changing assignments for layers within the protocol stack to different standards. You can also customize the look of the diagrams by adding comments, notes, or a title block.

On the Definitions menu for Communications you can add to the list of standards available and how they relate to the profiles. Or you can define a new information layer standard that will be mapped to an information flows. You can then edit the mapping of Flow Triples to Profiles/Standards by changing either the profile assigned to a triple or by changing the information layer standard associated with a triple.

These customizations will be reflected in the diagrams that are generated for your project using the Outputs menu. See “Communications Diagrams” below.

Using the Communications View Definitions Menu

The Definitions menu includes tables to view, tailor, and add to the following:

- Diagram Information
  - For each template drawing, this table shows the data about when the diagram was created and other information.
- Physical Interconnects (from Physical View)
  - This lists the physical interconnects from the physical view and their characteristics
- Protocol Layers
  - Use this table to View the names and descriptions for each of the protocol layers. Note this is view only – you cannot change or add to the communications protocol layers.
- Standards Profiles
  - This lists the profiles that are used to carry out the communications of information in your project. For each profile, the tables show the short name, the long name, the order in which it appears, the description of the profile, an editable comment, a checkbox of whether it is User Defined, and a checkbox of whether it is currently included in your project.
    - You can uncheck this box if you do not want a particular profile to be used in your project’s Communications View.
    - There is also a button at the top that says “Restore Profiles”. This will update the selections on the Flows to Profiles grid to their ARC-IT defaults if they haven’t already been customized.
    - You can also create a new or User Defined Profile here or from the New Items menu at the top of the screen. Once you create a new profile the next time you go to the Templates it will add a generic profile template drawing that you can customize by assigning standards to the layers of your User Defined Profile.
• Standards
  o This lists the standards that are included in the ARC-IT database tables and have been assigned to a profile or as an information layer standard to a flow in your project. The table shows the name, the Standards Development Organization (SDO) that developed the standard, the Document number, the Document Title, a Description or abstract of the standard, an indication of the protocol layer that it best fits, and a checkbox indicating if the standard is user defined.
  o Standards can be created in SET-IT in cases where the user knows of a new or different standard that will be needed for a particular interface. Use this table by clicking on the last row and filling in each column. You will then be able to use the next tables, “Standards to Layers” and “Profiles to Standards” to assign that standard to a layer/profile.
• Standards to Layers
  o This list allows you to customize the assignment of standards to layers in the protocol stack. This can also be done on the Templates (drawings).
  o Yes, a standard can be assigned to more than one layer.
• Mapping of Profiles to Standards
  o This shows the interface profiles currently in use in your architecture and it shows which standards at each layer have been assigned to the interface profiles
  o You can use this list to customize the assignments
  o You can also map a new, user defined, standard to a profile by going to the last (new) row and entering your mapping of standard to profile
• Mapping of the Flow Triples to Profiles/Standards
  o This lists the Information Flow Triples (source element, destination element, and flow name) from the physical view and the assignment to a profile.
  o It also lists the Information Layer standard associated with the flow.
  o Initially, it lists the triples shown in the physical view drawings and the initial mapping to profiles and information layer standard is based on the work done in ARC-IT.
  o You can use this grid to add and create a custom mapping of flow to profile or information layer standard.
    ▪ To do that, click on the last row (see the asterisk) and select the flow, source, destination, and then select a profile and a standard.
    ▪ Make sure every column is filled-in
  o The diagram generator will then use this information in order to populate the individual communications drawings.

The Definitions menu in the Communications View works similarly to the grids in the Physical or Enterprise view.
• You can sort the tables by clicking the top column
• You can click the right corner of the column heading to bring up the filter menu and choose to filter on a particular value or values. Use the Apply, Clear, or Cancel buttons as you would on the other views.
• Much of the information in the Communications View tables is read-only as it is largely based on ARC-IT, but as you add rows to create your own Profiles, your own unique Standards, or your own custom mappings of Flows to Profiles in the Triples table you will see the User Defined checkbox checked on the right side of the table.

Other Diagram and Architecture Tools
This section describes how to use other tools, either on the diagrams or from the ribbon.

Creating New Items from the Ribbon
The Diagram ribbon contains an area called New that includes 2 choices: Diagram and Item. New Diagram has been described in “Create a New Physical Diagram” and “Create a New Enterprise Diagram” above.
In the Physical View, the **New / Item** button allows you to create a new:
- Service Package,
- Stakeholder,
- Element,
- Status Value,
- Physical Object,
- Functional Object,
- Information Flow,
- Physical Interconnect, or
- Requirement

In the Enterprise View, the **New / Item** button is different. It allows you to create a new:
- Service Package,
- Stakeholder,
- Element,
- Status Value,
- Enterprise Object (future capability),
- Agreement,
- Expectation, or
- Role

In the Communications View, the **New / Item** button allows you to create a new:
- Profile

Then you can use the Definitions menu and the Templates (diagrams) to assign layers and standards to that profile.

**Creating a New Service Package**

For **Service Packages**, you can create a new Service Package and then use that Service Package as the basis for new diagrams. That new Service Package can also be used to associate new operational Scenarios and sequences that will go into your Concept of Operations (ConOps).

To Create a New Service Package, select the Item button and Service Package from the pull-down. Alternatively, you can select *<New Service Package>* from the Diagrams window when you use the Service Packages pull-down.
As shown in the figure above you give the new service package a name, a text description that will appear in output reports and the ConOps. You can then use the pull-downs to associate this new service package with one of the Types and Groups used to categorize ARC-IT service packages, formerly CVRIA applications.

Use the Service Packages report to list the service packages along with their type, group, name, descriptions, and the diagrams with which they are associated.

Creating a New Stakeholder

For Stakeholders: you can create individual stakeholders – the agencies, organizations, or persons that own or operate a connected vehicle element. You can also create a group of stakeholders that may have a joint role with an element, e.g. a joint operations center. First, create the individual stakeholders that will be members of that group. Then you can create a new stakeholder and press the “group” button and select the member stakeholders for that group. Now that stakeholder group can be assigned roles with respect to elements just like individual stakeholders. You can also turn a ‘regular’ stakeholder into a group later if you decide it needs to be divided up.

TIP: Use Control-t as a short-cut to create a new stakeholder

Creating a New Element

There are 2 variations of the Element Details form depending on the Type of element – either a system element or a human element.
Creating a New System Element
This is the same screen as on the diagram and creating a new element from Shape Properties or creating a new element from the left menu.

Note how come objects will automatically be checked. For instance, if Center or Field are selected for the class then the Center and Field physical objects will automatically be checked in order for the new element to automatically inherit the functionality of all center and field devices, accordingly. Also, the ITS Object physical object will automatically be checked so that functionality common to all ITS centers and devices is included. Now you can choose the other Physical Objects that you need to associate with this element.
Creating a New Human Element

Human elements are a little different. Sometimes physical view diagrams will show a human operator like a system operator, driver, or traveler.

When we create a human type of element we can still assign a stakeholder to it – say an employer, or a higher level organization. In the example below, “Metro Taxi Drivers,” is mapped as a Driver that will appear as operators of vehicle onboard equipment and has a stakeholder assigned called “Metro Taxi” to show the company that manages the drivers.

Creating a New Status Value

Status refers to the relative deployment timeframe of an element, flow, resource, agreement, etc.
SET-IT Help

SET-IT includes basic status of “Existing”, “Project”, or “Future”. “Project” is the default value which is to say the default value of things is that they are part of project currently being defined. Other status values may be needed to distinguish different phases or future projects.

Use the Status Value Details screen to give the new status value a name (up to 25 characters) and a description to explain what’s unique about this status. Then decide if this should be the Default Status with the check-box and use the up-down arrows to set the order of this.

There are 8 possible values but one is always reserved for Not Applicable and its value is locked at 8. Use the Order keys to determine where each of the other 7 status values fall, you can’t go past 7. This is how you can tell SET-IT whether Legacy comes before or after Existing or if Project comes before or after Future.

Creating a New Physical Object

ARC-IT provides a vast array of physical objects for connected vehicle and other intelligent transportation system objects as well as objects that interface with the transportation objects. Sometimes, however, a project may need to go beyond ARC-IT and define their own physical objects. Use this menu to create the Physical Object and then it can be mapped to elements of the project.
To Create a New Physical Object, select the Item button and Physical Object from the pull-down.

As shown above, use the Physical Object Details screen to enter a Name and a Description for this object. Use the pull-downs to select the Origin (Australia, European Union, United States), Class (Center, Field, Personal, Support, or Vehicle) and Type (System or Human). The User Defined flag will automatically be set since this is not something previously defined by ARC-IT.

Optionally, you can use the "Hyperlink" button to use a hyperlink as a reference to further information about this object. See Add a Hyperlink for details.

Creating a New Functional Object

Functional Objects are shown as the smaller boxes within the physical objects on the drawings. They define the functionality that is required for each physical object to support one or more ITS or connected vehicle service packages. As with physical objects described above, ARC-IT comes with a long list of functional objects that were defined to support the service packages that made up the original reference architecture. Sometimes, a project may have a need to define a unique piece of functionality and you can support that by creating your own "App Object" that can then be assigned to elements of your project.
Again, use the menubar to select "New / Item / Functional Object" to bring up the Functional Object Details form:

As shown above, use the Functional Object Details screen to enter a Name and a Description for this object. Use the pull-downs to assign the Physical Object for this functional object (this is where the functionality is housed). The list shown will include ARC-IT as well as new physical objects. The User Defined flag will automatically be set since this is not something previously defined by ARC-IT.

Optionally, you can use the "Hyperlink" button to use a hyperlink as a reference to further information about this object. See Add a Hyperlink for details.

Creating a New Information Flow
For Flows: Selecting New / Information Flow, brings up a blank Information Flow Details window. This allows you to decide on every aspect of that flow: its name, description, source, destination, and all of the flow characteristics. SET-IT will pre-populate default values for the flow characteristics based on the physical objects in the source and destination.
You can use the radio buttons below the description to choose either Element or Physical Object. If you selected **Element** with the radio button you will choose from a list of Elements. If you selected **Physical Object** with the radio button you will choose from a list of all of the physical objects from the ARC-IT database that supports SET-IT.

Once the source and destination are selected then you assign all of the other flow characteristics and select OK. This flow will now be available when you are creating interfaces on your diagrams. It will also appear in the list of Information Flows on the Definitions menu.

The Information Flow Details screen allows the user to enter a comment about the flow – for instance, why this flow is selected for this particular architecture.

Optionally, you can use the "Hyperlink" button to use a hyperlink as a reference to further information about this flow. See **Add a Hyperlink** for details.

**Creating a New Physical Interconnect**

This menu item is based on interconnects between elements – in other words, it will work once you have customized your architecture to tailor the Physical Objects into system Elements for your project. The process works in much the same ways as creating a new information flow. You give it a name, a description, select the sources and destinations, and the deployment status for that interconnect. Physical Interconnects are used on Layer 0 or Layer 1 drawings and show the high-level communications between the physical objects or elements that make up a project. An interconnect is a collection of information flows from Layer 2 so the characteristics are based on the characteristics of the flows included in the interconnect.
Physical Interconnects can be bi-directional or uni-directional. You can also select the characteristics, including: status, encryption, authenticability, cardinality, time context (upper and lower bound), spatial context (upper and lower bound). The upper and lower bound is due to the fact that the flows included may have different settings. SET-IT will determine the flows that will be included in that interconnect based on the flows that are between a given source and destination element pair.

Creating a New Relationship

For the Enterprise View, the New / Item menu has choices that include adding relationships:

- Agreement
- Expectation
In each case another window will open allowing you to provide the name, description, and the other details appropriate for that item.

The **New / Agreements** and **New / Expectations** windows allow you to create a new type of agreement or stakeholder expectation that may not have been defined by ARC-IT. This window allows you to specify the name of the agreement, give it a description, identify the type, select the stakeholders involved, and check whether this is bi-directional or not. If not then the stakeholder on the left will be considered the source or initiator of the agreement or expectation.

**Create a New Physical Standard**

In the Communications View ARC-IT lists standards that apply to the movement of data through the physical view’s information flows as well as the standards for the various layers of the communications stack. SET-IT’s New Item menu can be used to create a new user defined standard in case the standard your project needs to access hasn’t been defined yet in ARC-IT.

In the physical view standards can also be defined and applied to physical objects themselves and, in some cases, to specific functional objects within those physical objects. The process of defining a new physical standard or a communications standard works the same way. When you are in either Communications or Physical View use the New Item menu and select Standard.
For Physical View:

For Communications View:

From either view, clicking “Standard” will cause a new Standard Details form to open.
From here you can fill in as much information as you know – Name (a shorter name by which the standard is known, e.g. Wi-Fi vs IEEE 802.11ax, Title (official name from the organization), Document #, SDO or Standards Development Organization that publishes and maintains the standard, a brief description of the standard perhaps pulled from its abstract, a comment about why this standard is being used on your project, and then Type. The following Types are available:

- Data
- Communications
- Physical
- Cybersecurity
- Physical Security
- Application
- Other

If you click Physical or Physical Security the bottom of the form will expand to show pull-downs to select Physical and Functional Objects.
You can select “Unspecified” for Functional Object if you want this to apply to any element that is mapped to the Physical Object. You can also add rows on this table to add Physical/Functional Objects for this standard.

Once the physical device or physical security standard has been created it will be available for selection and mapping anytime an element with that physical/functional object mapping is used in your project.
For other types of standards, including Data or Communications, the form will expand to allow you to select the source and destination physical objects and the information flows, i.e. the triples, that apply to this standard.

Once the standard has been created it will be available for selection and mapping anytime that flow is used in your project.

Creating a New Profile

The communications view allows you to create new communications profiles. Comm Profiles are sets of standards that comprise the layered communications stacks for a sender and receiver to exchange information. The communications layers and the standards used to define them start at the top with the definition of the data or information exchanged between computer applications on each side of the interface down to through the various layers of the Open System Interconnect (OSI) stack to
define each step of the communications process. In ARC-IT and SET-IT these profiles are represented with stacks of communications layers for the source and destination. ARC-IT defines over 2 dozen profiles but there may be occasions when a unique situation is defined and a unique user-defined profile is required.

Use the menubar to select Item and Profile when you are in the Communications View. The window will ask for a Short Name, a long name, a text description, and an optional comment.

When you say OK a new user defined row is added to the Profiles grid on the Definitions menu for Communications View.

The next time you go to the Templates menu it will generate a new Profile template for your user defined profile as shown below.

Now you can use the Communications View tools to add standards to each layer of your new profile.
Add Comments or Notes to a Diagram

In order to provide commentary about a diagram there are 2 shapes on the Stencil: a Cloud for comments to the reader or a white Rectangle to provide other specific Notes about the diagram.

In either case, drag the shape from the stencil onto the drawing surface.

Edit the Comments cloud or Notes box by double-clicking on the shape and opening Shape Properties.

Edit the text in Shape Properties.

Click the refresh button or simply click on another part of the drawing to store the editing.

**TIP**: Use the little Yellow Square to connect a comment cloud with an element. Just find the yellow square and drag it onto the element. Now when you move the element around the comment cloud will follow.
Add a Legend from SET-IT Stencil to a Diagram

This process works in either Physical or Enterprise View. Create a New Diagram, or open an Existing Diagram.

Select the **Legend** from the stencil on the left.

Drag the **Legend** to the drawing area, either a *horizontal* or *vertical* legend.

Place the **Legend** box on the desired area in the diagram.

You can also select the smaller boxes inside the **Legend** with a single left-click over just that smaller box and press the Delete key to cut out some of the components of the legend you don’t need and try and fit it better on your diagrams. NOTE: this only works by using the Delete key. The entire legend will be deleted if you attempt to cut the unwanted component by selecting it, then right-clicking and selecting CUT from the pulldown menu.
Diagram Title Block

All of the Diagrams in SET-IT include a **Title Block**, the diagrams ‘included’ from ARC-IT as well as custom created diagrams. The information in the **Title Block** contains basic information about the diagram – name of the service package, whether it came from or is based on ARC-IT, a revision number the date it was created/edited, and by whom.

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Date</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>DMS Maintenance Based on ARC-IT Physical Diagram r4</td>
<td>Jul 10 2019</td>
<td>BRB</td>
</tr>
</tbody>
</table>

From the Diagram menu, in the **Title Block** area of the ribbon, you can click the **Update** button. SET-IT will prompt you that this action will increment the version number (assumes you are using numbers to describe your versions), update the date to today’s date, and update the Initials in the lower right box to match the initials, if any, that are in the Overview / Project window. You have a chance to say **Yes** to continue or **No** to leave it the way it is.

You can turn off these reminders with the **Checkbox**.

**NOTE:** If you make changes to the Project Overview information such as the initials of the developer or maintainer those would only be changed on the diagram when you click the **Update** button described above.

You can also edit the name of a diagram by editing the name in the Left Menu. It will then update the name in the title block.

Pan and Zoom a Diagram

For diagrams that get larger than will fit onto your screen, use the **Zoom** feature from the Diagrams menu. The Zoom area has 2 choices

- Clicking the **Zoom** button launches the “Pan & Zoom” box (a small pop-up window that shows a snapshot of the entire diagram) to let you use your mouse to draw a box around the area of the diagram you want to zoom in on. You can also click and drag the red highlight box to pan around the diagram to focus on different areas.
- Clicking the **To Page** button is a short cut to quickly change to magnification so that the entire diagram fits within the diagram area of the SET-IT window.

Defining Scenarios

Being able to document scenarios is a useful way to build a good Concept of Operations for your project. Here is how the FHWA Systems Engineering Guidebook (at [https://www.fhwa.dot.gov/cadiv/segb/](https://www.fhwa.dot.gov/cadiv/segb/)) describes Scenarios as part of a ConOps:

> This is the heart of the document. Each scenario describes a sequence of events, activities carried out by the user, the system, and the environment. It specifies what triggers the
sequence, who or what performs each step, when communications occur and to whom or what [e.g., a log file], and what information is being communicated. The scenarios will need to cover all normal conditions, stress conditions, failure events, maintenance, and anomalies and exceptions. There are many ways for presenting scenarios, but the important thing is that each stakeholder can clearly see what his expected role is to be.

In SET-IT you can define Scenarios that include one or more Sequences of steps and map those to Service Package diagrams.

Create a Scenario by using the Scenarios grid on the Definitions menu. Click the row with the asterisk (*) and start filling in the Name, an Order in which to list the scenarios in the document, and a Description of the scenario.

Another way to define a Scenario is to start by defining a Sequence on a diagram first. See Defining Sequences below.

In a Concept of Operations, a scenario is used to describe how the system will be operated under various conditions. For example, incident management scenarios will include normal monitoring, the sequence of events following an incident, and response to failure [e.g., sensors or communications]. In other Service Packages you might want to describe a ‘sunny day’ scenario and contrast that with the activities that take place in a ‘rainy day’ scenario. These scenarios should describe the activities from the viewpoint of each of the participants.

Defining Sequences

Another tool on the Physical view Diagrams menu allows you to create sequences of events by attributing step numbers to flows or shapes on a physical diagram. Use the Definitions menu to create a Scenario and one or more Sequences that are to be assigned to a particular diagram. Once those are created select the diagram you want to work with and press the Sequence button at the top of the screen.

On the Sequence Tool window click the Pull-down for the Sequence name as shown below:
From the pull-down, select an existing sequence or create a new one by selecting <New Sequence>.

The New Sequence form includes fields for Name and Description and then controls for assigning the Scenario, the diagram (will default to the diagram you are currently on), the order in which this will appear in the ConOps relative to the other Sequences for this diagram, and the Style of the circles to use.

Click the Scenario pull-down to assign this sequence to a New or existing Scenario.

Clicking <New Scenario> will launch the Scenarios form in a new window. See Defining Scenarios above for more information about scenarios.
The Sequence tool provides a list of steps, the sequence, the style/color, and the related flows or objects with which each step will be associated.

If there is more than one sequence that pertains to a diagram use the Sequence pull-down at the top to switch between sequences.

If you need to create a new sequence you can go to the Definitions menu and use the Sequence grid or you can use the pull-down here and select <New Sequence>. From there you can give the
sequence a name, a description, a style (color), and order. You can also select a scenario or create one and you can relate the sequence to a diagram.

When you selected the Sequence Tool the stencil added a Step icon.

You can put step #s onto the drawing by highlighting the step on the Sequence Tool window then clicking and dragging the Step # onto the drawing surface. It will automatically color it based on the Style selected and will be numbered based on the row you highlighted in the Sequence Tool window.

The Sequence Tool window has a checkbox at the top-right that says “Auto-select objects/elements by tracking the step shape on the diagram.” With that checked, notice the Sequence window changes as shapes are dragged onto the drawing. The Sequence tool will also automatically map the step number to the object on the diagram. For instance, if you drag the step shape over an Element
you will see the Sequence tool associate that step with that element. You can also do this for Information Flows or Functional Objects (the smaller boxes of functionality within the Elements).

NOTE: As you drag a step onto the drawing this process will map the step to last thing (flow, element, functional object) you placed the step over. You can drag a step shape over multiple things but if you drag it over multiple flows it will only map it to the last flow. The work around is to select the extra flows using the checkboxes in the Sequence Tool window.

The Sequence numbers are on a separate layer from the rest of the diagram so when you close the Sequence Tool window the numbers will disappear, too. Select Sequence button again to bring them back.

The ConOps document – see Output Documents section – can include the scenarios and the diagrams with the sequences shown on them.

Clipboard

The Clipboard is available from any of the left-menu choices. It provides the basic cut, copy, and paste functions that you’re used to in other graphical programs.

One unique feature with SET-IT is on the Diagrams page. You can use the Size Painter to copy the size of one physical object and make another object have the same size. This may be useful when trying to make sure similar objects appear to be the same size/shape.
Editing/Adjusting Your Diagrams

There are other features on the Diagrams window that you can use to make your project diagrams look the way you would like.

- **Font**: this is used to change the font or type face used for labels on the shapes on your diagram. Select a flow or object and use the font and size pull-downs to change the appearance of that flow or object. You can also set whether to use Bold, underline, or cross-outs. SET-IT reserves the use of italics for objects, flows, or agreements that haven't been customized yet.

- **Paragraph**: You can use the Paragraph tools to change the way a group of text appears. Again, highlight the text to be modified and select whether the text labels in an object should be centered at the top, middle, or bottom of the object. You can also decide whether the paragraph contents should be left-, center-, or right-aligned or justified to fit within the margins of the object or flow boundaries.

- **Tools**
  - **Text**: this is used to clean up the way the labels on the information flows are shown. Select a flow, open the Text (or “Nudge”) tool and now you can use the up, down, left, and right arrow buttons to ‘nudge’ the text around. Use the slider bar to control how far each button push will move the text. The numbers in the center of the arrows indicate the distance each click will nudge the text, from 0.01 to 0.64 inches. (Hint: it seems that 0.05 is enough to move a text line from the middle of the line to sit just above the line).
This window is also used to select whether the text should **Wrap** and at what point, i.e. how many characters per line.

Another checkbox here allows you to “Hide” the text label completely. This is handy if you have flows coming from one source and going to multiple destinations and they all have the same characteristics. This can make the diagram look cleaner if you line up the flows on top of each other and just use one label. This gives the diagram a look similar to an electrical schematic.

**TIP:** Only use the “Hide text” option when all of the flow characteristics are the same. If a particular triple (source, destination, flow name combination) has a unique characteristic then it should be seen separately from the other flows on the diagram.

**NOTE:** The Text or Nudge tool will be ‘floating’ when it first opens. You can ‘dock’ it by clicking the title of the box then drag and ‘drop’ over the icon that looks like a closed door on the right or left side of the screen. To undock it click the title of the box and drag it to another area of your screen. This may be helpful if you want to put the nudge arrows right next to the text you are trying to edit. You can also simply close the Text tool by clicking the X button in the top right of the window.

- **Synchronize:** The synchronize button tells SET-IT to go through your diagrams and look for changes that you have made to the diagrams: name changes, new flows, etc. and update the Definitions tables. This also works to apply changes you make to the name of an element on one diagram to the other places where that same element appears.

  **TIP:** Use the pull-down or the Project / Options menu to change how Synchronize works: it can either update the definitions based on the diagrams or update the diagrams based on the definitions. Your choice should be based on where you have been making your changes (in the Definitions tables or on the Diagrams). If you don’t use the pull-down to pick a direction SET-IT will use the setting shown in the Project / Options menu.

- **Sequence:** See Defining Sequences above.
SET-IT Help

- **Arrange:** the Arrange area of the Diagrams toolbar allows the user to access 3 tools: Align & Space, Size & Position, and Connection Points.

  - **Align & Space** allows you to select more than one shape and make them line up a certain way (top, bottom, right, left, center) or to space them apart evenly.
    - An alternative way to line up different objects/boxes is to select one box and drag it around the diagram. As you approach another object you will notice thin lines appear showing how close you are to the center line or top/bottom/left/right edge of the other box.

  - **Size & Position** allows you to make fine adjustments to the size and position of an element or object – this also becomes very useful on complicated drawings where you need to make adjustments to just one thing at a time.

  ![Size and Position](image)

  - **Connection Points** allows you to let SET-IT realign the connection points around an object. Connection Points are the places around a shape where you attach connecting lines, e.g. information flows on a physical Layer 2 diagram or a Relationship on an enterprise diagram. This can be very helpful after resizing a shape and the connection points get distributed unevenly. Select a shape and click on the Connection Points button shown above.
    - **Note:** some users may find that some shapes have connection points in places other than the boundary of the object. In that case, use this Connection Points tool to redraw them around the object in the right places.

- **Zoom** provides the user with two tools to adjust the screen view:
  - **Zoom** brings up the Pan & Zoom mini-window and you can click and drag to select a subset of the drawing to fill the screen.
To Page automatically resizes the window to fit the screen.

Other Toolbar and SET-IT tools

- **Project / Options** – From the Project ribbon and the Options menu there is an option that enables delete confirmation for any object deletion.

- **Undo & Redo** – as with most windows based software you can use the Undo and Redo buttons at the top of the window to back out of a change (undo) or to repeat (redo) a change that you just undid. There may be a difference in behavior between actions that were done on the Visio drawing space and actions done on the definitions and data driven forms.

The Quick Access Toolbar (QAT) is a feature common to many Windows applications. It appears at the very top of the SET-IT window. In SET-IT, you can use the pull-down menu at the right of the QAT to change what appears at the top:

![Quick Access Toolbar](image)

**Using Terminals**

Terminals are the little rounded rectangles that appear on some of the complicated SET-IT diagrams to reduce some of the clutter caused by having too many lines crossing each other or when the same type of interface needs to go to multiple places, e.g. from a data warehouse to all of the traffic centers in the area.

Rather than drawing lines all over the page – either crisscrossing over many existing lines or wrapping all around the
side of the drawing using a terminal allows you to show how lines may start at one point and end up at another part of the drawing.

Adding Terminals

To add a terminal to a drawing:

1. Drag a Terminal from the stencil and drop it inside a physical object. This will create a new shape and associate it with the element that it is in. SET-IT will give the terminal an abbreviation based on the name of the element.
   
   CAUTION: Only 4 or 5 characters can fit in a Terminal shape so you may need to edit the abbreviation of the Element in the Element Details window to make sure the Abbreviation makes sense.

2. To create the other side of the interface, drag and drop another terminal from the stencil and drop it inside the same physical object. This will create a new shape and associate it with the element. Then drag that new terminal to be near a physical object on another part of the drawing.

3. Now to add flows, instead of drawing them all the way across the drawing between the physical objects you can use the terminals. Draw lines from the physical objects from step 2 to the terminal.

4. When you use Shape Properties to tell SET-IT what information flows to include on that line it will show the flows that can go between the physical object in step 1 and the physical object in step 2 as if they were directly connected.

   NOTE: With Terminals you only have to name the flows on one side of the interface.

Going Further with Terminals

As you go on to build your higher layer drawings SET-IT will take into account any flows that were routed using terminals on Layer 2. One thing that SET-IT doesn’t do is assume that because you had terminals on a layer 2 drawing that you will want terminals on Layer 0 or 1. It will just draw the interconnects directly between the source and destination.

If you notice that your Layer 1 or Layer 0 drawings are too crowded you can use Terminals manually on Layer 0 or 1 the same way you did on the Layer 2 drawing, except with physical interconnects.

Using Data Distribution

A modern transportation environment that includes integration with connected and automated vehicle systems is characterized by the fact that the producers of the data do not necessarily have a direct relationship with the consumers of that data. In traditional information technology projects the system developer will be building the data collection as well as the data processing systems or specific external interfaces that will be defined between systems. In traditional ITS systems the
center and the field devices are typically owned and operated by the same agency. With connected and automated vehicle systems new relationships may need to be defined or there may be no relationships between the data sources and data destinations.

Equipped connected vehicles may be broadcasting situational data that may be picked up by roadside infrastructure. Individual drivers do not sign agreements with every roadside equipment owner/operator – they are all part of the trusted connected vehicle environment. Once that data is collected by the infrastructure it can be used in a number of ways – not necessarily by the same agencies and not necessarily for the same things. A traffic agency may want that data to understand traffic flow but a maintenance department may be able to use the same data to plan where to deploy their maintenance fleet. The data distribution concept allows interfaces to be setup such that developers can take advantage of these supporting systems that worry about the data distribution mechanics and the developers can focus on the transportation needs being addressed.

These ‘clearinghouses’ of data make it possible for one agency or entity to establish a set of data collectors that then make the data available to any number of agencies that register and subscribe to the data they need.

Another idea is that a data warehouse could be used to drive the output of the data to mobile consumers of data – the travelers. Multiple agencies may have data that they want to get out to the traveling public but don’t want to maintain the technology to broadcast data in all the media that the connected vehicle environment and today’s wireless communications make possible. These application providers can establish a relationship with a centralized data warehouse that will then make the data available to its mobile subscribers. This data warehouse will maintain the data and maintain the trust and security for how that data is to be distributed.

So how do you show Data Distribution in SET-IT?

1. From the New/Item/Element window – you can define one or more Data Distribution systems. These are of the Communications domain / Support class of physical objects.
2. On Layer 2 – the service package specific diagrams – you can assign a flow characteristic to a transportation related information flow to say that this flow will go through a data distribution system using the “via” pull-down on Shape Properties.
3. Build a Layer 1 or Layer 0 drawing. SET-IT will show the flows routing through the Data Distribution system defined in step 1 and selected in step 2.

**NOTE:** According to ARC-IT, not every information flow is eligible for routing through a data distribution system. Some flows like information broadcast from a single source to many destinations at once might use a Wide Area Information Distribution mechanism but not something like a data warehouse or clearinghouse. In those situations, the via pull-down will be activated but will show the Wide Area Dissemination elements instead of the Data Distribution elements.

**Needs**
One of the critical early steps in a Systems Engineering process for a project is to establish the Needs of the system and its users.
The Needs are designed to answer two basic questions:

- What does the System need to do?
- What do users need from the System?

ARC-IT was developed by extracting needs from a variety of sources including other Concepts of Operations documents for ITS and connected vehicle research projects. These source needs are used as starting points for your own project architecture.

Use the Definitions menu (on the bottom left side of the window) with the Physical view selected at the top to add and edit your needs. There are 2 Needs related buttons:

- **Need Areas** – an area is created for each service package
- **Needs** – statements that describe functionality or capability that is necessary for a service to be provided by an ITS project

Need Areas

A Need Area is just a way to organize and introduce the needs. Initially these are based on the service packages but you can create your own.

- Use the Definitions grid to add or edit the names and descriptions for the Need Area.
- The next column indicates which service package the Need Area is associated with or if it is a general area.
• The last column indicates the type of service package this need area is from – Safety, mobility, etc. The Type could also be set to <Unspecified> for a set of needs that may not be tied to any particular type of service packages.
• In the ConOps, these Need Area descriptions will be used as the introductory paragraph for the Needs tables.

As you make changes to the initial set of Need Areas that SET-IT imported from ARC-IT you will see the grid color change to a tan color to indicate that it has been customized from the default value.

**Needs**

The *Needs* button opens a table or grid to show the needs that have been imported for each of the ARC-IT service packages you included as well as new or user defined needs you created.

- The first column is the Service Package or Area.
- The number column is to help you sort the needs. SET-IT doesn’t enforce any rules on the numbering; it can take numbers or alpha characters.
- The needs text comes next – either from ARC-IT or a user defined need. You can and should edit the needs to reflect your project’s needs.
- The comment column is optional but may be used to describe some of the background behind what was driving a particular need or other considerations reviewers may need to be aware of.
- The Priority column can be used to show the priority for that need – Low, Medium, High, or Not Applicable. The default is Medium.

As you make changes to the initial set of Needs that SET-IT imported from ARC-IT you will see the grid color change to a tan color to indicate that it has been customized from the default value.

**Requirements**

Once Needs are understood and documented the next step in the Systems Engineering process is to identify and document the Requirements for a project. This is a critical step as requirements form the basis for scoping the work of designers and developers as well as frame the scope of what is to be tested at the end of the development process in order to ‘sell-off’ and accept the system.
ARC-IT decomposed the service package level Needs and developed a set of functional requirements for each of the functional objects in the physical view. You can use those requirements as starting points for the development of your own project’s system requirements.

Use the Definitions menu (on the bottom left side of the window) with the Physical view selected at the top to add and edit your Requirements.

The Requirements button opens a table or grid to show the requirements that have been imported for each of the functional objects from the service packages you included as well as new or user defined requirements you created.

- The number column is to help you sort the needs. SET-IT doesn’t enforce any rules on the numbering except they have to be numbers (no alphas). You can also use a hierarchical or outline number scheme to make an outline list, e.g. “1.2.1.7”.
- The requirement text comes next – either from ARC-IT or a user defined requirement. You can and should edit the requirements to reflect your project’s scope.
- The source column shows where the requirement came from, e.g., ARC-IT or another source. Use the Details form to edit and add to the list of sources. An example of a source for requirements might be the project ConOps or the project’s Statement of Work (SOW).
- The verification method column provides a pull-down to identify the manner in which a requirement can be verified. The choices are Inspection, Analysis, Demonstration, and Test.
  - Inspection refers to the ability to see or inspect an article and tell that a requirement is met – usually for things like safety codes, or software standards.
  - Analysis is meant for situations like inspection that may require further work to determine that a requirement is satisfied – taking samples of the output and running them through a spreadsheet to calculate whether the requirement is satisfied.
  - Demonstration, usually the most used, is for requirements that can be verified through use of the system, such as a user interface or use of a device in the field.
  - Test, the most stringent method, refers to the type of verification that requires additional test equipment and very tight procedures and precise conditions in order to verify the requirement, such as installing network analyzers on an interface to determine the performance of a video switching device.
- The comment column is optional but may be used to describe some of the background behind what was driving a particular requirement or other considerations reviewers may need to be aware of.
As you make changes to the initial set of Requirements that SET-IT imported from ARC-IT you will see the grid color change to a tan color to indicate that it has been customized from the default value.

Clicking the Details button on the far right column opens the Requirements Details form:

This Details form contains the same data as the data shown in the columns in the Requirements Definitions grid. You can use this form as perhaps an easier way to make changes or add text. You can also use the Details form to assign a requirement to a particular element and to a particular functional object. This will be useful later in the project to generate test verification procedures.

To delete a requirement simply highlight the row from the main Requirements grid and click the Delete key.
Using the Left Menu

The left menu is a unique way that SET-IT uses to organize the work for developing a project architecture. It is divided into 3 sections: Overview, Diagrams, and Definitions. Clicking on each one brings up a set of button’s pertaining to that part of the architecture.

Overview Menu

Overview provides the following buttons to organize high-level information about the project, including:

- Project (basic project scoping information)
- Service Packages (a list of service packages that can or have been included in your project)
- Dashboard (a future release will include statistical information about the project architecture file, e.g. numbers of service packages, elements, flows, etc.)
- Change Log (a way to list when changes were made and who made them)

Diagrams Menu

Diagrams provides a list of the diagrams that have been copied/included from ARC-IT or created from scratch. Once you have selected Diagrams from the left menu and you have a list of diagrams on the left side of the screen there are several options you can do:

- Sort – Right-click on the area above the first diagram or in any empty areas around the diagram names. A context menu will appear giving you the choice of sorting by the Name of the service package, either ascending or descending, or by the Layer and then the Name, also either ascending or descending. This can be useful once you have a large architecture project with lots of diagrams.
- Rename – Right-click above one of the diagram names and another context menu appears with more choices, including Rename. Click Rename and a dialog box will open to let you type the new name and say OK or Cancel. SET-IT will automatically change the
name of the service package instance in the Definitions grid.

- **Copy** – (no longer an option.) Go to Overview and include another instance of the same service package
- **Delete** – Right-click above one of the diagram names and select Delete to simply delete an entire diagram. The definitions of the objects, elements and flows will still be in the database since they may be used on other diagrams. A series of dialog boxes will open to ask if you wish to delete the diagrams from the other views associated with this service package, if you want to remove the entire instance of the service package from the database, and finally to warn you that removing an entire instance of the Service Package cannot be Undone and you can say Yes or No.
- **Completion Status** - Right-click over the name button and assign a Completion Status of Started, Partial, or Complete. The color of the button will change accordingly so you can see at a glance how far along you are. Blue = Unknown or Not Started; Pink/Red = Started; Yellow = Partial; Green = Complete. Or unselect them to set it back to Unknown.

**NOTE:** changing the Diagram Name either on the Left Menu or on the Definitions grid does not change the name of the Service Package Instance. There is a separate grid where you can change that.
Definitions Menu

**Definitions:** provides a set of buttons that each will show a different component of the architecture and allow you to view and edit the information in a table or **grid** format.

Most grids allow you to view and edit information about components of your architecture. They may also have a Details button that opens a separate form where you can more easily view and edit information about a component.

Depending on the grid you can perform other functions to add to and edit your architecture. Some grids like the Service Packages grid is completely read-only. Other grids, like the Needs grid, allow you to edit the information as you would expect to edit a table in a database.

On those editable grids you can delete a row by selecting the row and clicking the Delete key on the keyboard. You could also delete multiple records or rows by highlighting multiple rows and clicking Delete. Deletions will prompt SET-IT to display a warning message.

You can also add records to some grids directly if they have a row at the bottom with an asterisk on the left.

![Example Grid](image)

Start filling in the cells and it will start adding records to the database.

On the grids, the width of the columns can be adjusted.

Color coding or shading is used to indicate which cells are read-only (Blue) and which cells have been customized/edited (Beige) as shown below.

![Color Coding Example](image)

Editing a cell directly in a grid is done by editing the white or beige cells. A change is committed to the database when you go to a different row or go to another grid. As you start typing you may notice the caret symbol (↑) changes to a pencil (↓). Once you commit that change by going to the next row you will see that the icon changes back to the caret.

On many grids you can use the Right-Click Menu to see options to sort the grid by the left column, either A-Z or Z-A.
You can also delete a row by highlighting a row using a Left-Click and then using Right-click and choosing Delete.

Some grids don’t support Deleting this way – they require that they be unchecked in order to remove them from an architecture.
Physical View Definitions

The following buttons are shown on the Physical View Definitions menu:

- Service Package Instances - allows you to edit the description of the instances of the service packages that are included in your architecture. You can use this form to record the name and description of the service package and assign it to a Type (convenience, environmental, mobility, safety, support) and Group.
  
  **NOTE:** Changing the name of a Service Package Instance will also automatically change the name of the Diagram which you can see when you go to the Diagram Information grid or go back to the Diagrams view.

- Service Packages – allows you to view the description of the ARC-IT service packages or view/edit User Defined service packages. Use the New menu item to create your own service package from scratch.

- Diagram Information – as you select and include service packages into your architecture an entry is added to Diagram Information which you can use to edit information about the diagram, including the Completion Status (started, partial, complete).

- Stakeholders - allows you to create a list of stakeholders (name and description) and associate them with different elements
  
  o Once created, use the details form to associate project stakeholders to the roles they play with respect to elements
  
  o SET-IT will verify that each role assignment is unique per element
  
  o You can also create a Stakeholder Group that consists of one or more stakeholders. This may be useful in situations where stakeholders have a joint role with a resource, e.g. the city traffic department and public safety agency have a joint operations center.
  
  o To create a Stakeholder Group – start by creating the individual stakeholders and then create the group and select the members of the group from the list of stakeholders.
NOTE: You cannot have Groups of Groups.

- **Need Areas** – high level groups such as V2I Safety, Support services, or a user defined area
- **Needs** – statements that describe functionality or capability that is necessary for a service to be provided. They can also be thought of as a problem or issue that is addressed by the functionality or capability provided by an enterprise or institution.
- **Scenarios** - allows you to enter a name, a high-level description, and an order number of a scenario which describes how the system will be operated under various conditions. These text descriptions will be used to introduce the scenarios sections in the ConOps document. They will be ordered in the document based on the order you provide.
- **Sequences** – allows you to define sequences of steps that make up a scenario; you can also assign one or more sequences to a physical diagram which connects the scenarios/sequences to a service package. The steps will be created on the diagram itself. Here on the sequence table you can also assign a style for the background color used on the circles that will be used for the steps: White, Black, or Gray.
- **Elements** – the localized or customized representations of physical objects in the architecture
- **Physical Objects** – the larger boxes on the physical diagrams that include systems, devices, and users of the connected vehicle systems, defined in ARC-IT. May also contain user defined physical objects.
- **Functional Objects** – the set of functions that are subsets of a physical object and support one or more service packages
- **Information Flows** – the flows of data between physical objects as defined in ARC-IT. May also contain user defined information flows that could be used and selected among service packages in the project. The Information Flow Details screen allows the user to enter a comment about the flow – for instance, why this flow is selected for this particular architecture.
  - **To delete a user defined flow from your architecture** highlight the row and click <Delete>. This will remove it from being selectable on any of your diagrams.
  - **NOTE:** if you have already used this on a diagram and your Sync settings are such that it will automatically run then you may notice a line with no flow name on it when you look at the diagram again. If you do not need that interface at all and you are not going to replace that with another flow then just manually select the line on the diagram and delete it.
- **Information Flow Triples** – the collections of locally selected information flows that connect source elements and destination elements along with characteristics for that ‘triple’. The Information Flow Details screen allows the user to enter a comment about the flow – for instance, why this flow is selected for this particular architecture.
- **Status Values** – see the list of status values and the order in which they are to be displayed. You can also use this to create your own status value and decide which is the default value. Use the Description field to explain to your audience what certain values mean.
- **P-Interconnects, (Physical Interconnects)** - source and destination connections between Physical Objects that are connected together. Use the Details form to see what layer 2 information flows map to a layer 0 or layer 1 physical interconnect.
• P-Interconnect Triples – source and destination connections between Elements that are connected together in this project architecture.

• Requirements – lists the Need that the requirement supports, the unique number for this requirement within that need, the text of the requirement, the source (ARC-IT or other), the Verification method (Demo, Test, Analysis, or Inspection), and a Comment. Use the Details button to edit the text in a separate window.
  o ARC-IT’s functional requirements have 2-way traceability. They are traced to the Needs that were written for each service package. They are also traced to the functional objects from each of the physical objects.

• Elements Requirements – lists the functional requirements by Element and Functional Object. This table shows the requirements that are assigned to an element. Entries are added to this grid once an element has been mapped to a physical object on a service package drawing. Then it inherits the functional requirements written for those functional objects that are in that physical object on the service package. Now you can tailor the requirement to match local concerns. As with the Requirements table above, you can also use this to add comments or assign verification methods.

• Physical Objects Standards – lists the standards that are associated with physical or functional objects. This grid is read only so changes to the ARC-IT imported definitions cannot be overridden. To add a standard to this grid use the New Item from the menu and create a new standard and add the physical objects and, optionally functional objects, this standard addresses. To map an existing standard to a new combination of physical/functional objects click the Details button and use the Physical/Functional Object mapping area of the Standards Details form.

• Elements Standard – as you create elements and map them to physical objects and/or functional objects for which a physical standard has been defined then it will appear in this grid. Some physical standards are mapped to an entire physical object and list “Unspecified” in the functional object cell. For these, as soon as you map an element to that physical object it will show up in the Elements Standard grid. Others are specific about which functional object they are mapped to so the element must be mapped to one of those functional objects. This happens as you assign elements to your service packages that show the physical and functional objects needed to implement a particular service. This grid has an Include check box for you to decide whether or not you really want or need that standard in your project. It also has a Comment cell perhaps to indicate something specific about how an element is implementing a standard.

To delete a row from the grid just highlight that row and click the <Delete> key.

If you delete something that is on the diagram the next time Sync is run it will remove that from the diagram. If your settings show Auto Sync or Always Synchronize then it will be deleted right then, otherwise you will have to push the sync button yourself when you are ready.

Deleting a flow that appears on a diagram will remove the name of the flow but it may leave behind a line with nothing on it. That’s OK. The line can be used to add another flow on that interface. Or if that interface is not needed at all then you can manually delete the line on the diagram.
Enterprise View Definitions

The following buttons are shown on the *Enterprise* View Definitions menu:

- Service Package Instances – see above
- Service Packages – see above
- Diagram Information – see above
- Stakeholders – see above
- Elements – see above
- Status Values – see above
- Stakeholder Roles – a grid showing the relationships that stakeholders have with respect to the Elements. The columns include:
  - Stakeholder
  - Role: manages, owns, operates, uses, etc. (if this field is blank it may mean that no role has been defined yet. Click Details to update the roles for this element)
  - Element
  - Status (sometimes you may define the current operator but then identify another stakeholder that will operate the element after the system is deployed)
  - Details… - use this button to open the Elements Details form (yes, the Elements form) and you can go down to the stakeholder section and update the stakeholders and the roles they play with the element.
- Resources – the boxes on the enterprise diagrams that include systems, devices, and facilities of the connected vehicle environment, defined in ARC-IT.
- Roles – the relationships on the enterprise view diagrams that represent the way in which an enterprise object participates in a relationship from ARC-IT; an object’s set of behaviors and actions associated with the relationship of that object with other objects.
- Agreements – the relationships on the enterprise view that represent the formal points of coordination between enterprise objects from ARC-IT; how they agree to interact with each other in order for a service to be provided
- Agreement Types – a read-only grid showing the various types of agreements that are used in ARC-IT and can form the basis for the project-specific agreements you define on the Agreements and Relationships grid.
- Expectations – the relationships (lines) on the enterprise view that represent less formal points of coordination between enterprise objects from ARC-IT; how they expect one another to act and behave in the cooperative connected vehicle environment
- Relationships – the localized or customize set of relationships between stakeholders on the SET-IT project architecture enterprise view diagrams – may include agreements, expectations, or roles. Sorted by Service Package and life-cycle stage. These can be customized for your project by clicking Details and opening the same Agreements form available from the Agreements grid, described above

Communications View Definitions

The following buttons are shown on the *Communications* View Definitions menu:
• Diagram Information – For each template drawing, this table shows the data about when the diagram was created and other information.
• P-Interconnects – This lists the physical interconnects from the physical view and their characteristics. You must have a Layer 0 or Layer 1 drawing in the Physical View for this to be populated.
• Layers – Use this table to View the names and descriptions for each of the protocol layers. Note this is view only – you cannot change or add to the communications protocol layers.
• Profiles – This lists the standards profiles that are used to carry out the communications of information in your project. For each profile, the tables show the short name, the long name, the order in which it appears, the description of the profile, an editable comment, a checkbox of whether it is User Defined, and a checkbox of whether it is currently included in your project.
• Standards – This lists the standards that are included in the ARC-IT database tables and have been assigned to a profile or as an information layer standard to a flow in your project. The table shows the name, the Standards Development Organization (SDO) that developed the standard, the Document number, the Document Title, a Description or abstract of the standard, an indication of the protocol layer that it best fits, and a checkbox indicating if the standard is user defined. Standards can be created in SET-IT in cases where the user knows of a new or different standard that will be needed for a particular interface. Use this table by clicking on the last row and filling in each column. You will then be able to use the “Profiles to Standards” grid to assign that standard to a profile.
• Standards to Layers – shows the mapping of the standards listed above to one of the Layers on the profiles. Add to this table by clicking on the last row and filling in each column. You will then be able to see these on the template diagrams.
• Profiles to Standards – This shows the mapping or relationships drawn between the profiles and the standards. Here the name of the profile, the standard, the layer that the standard pertains to, and an order in case there is more than one standard to be shown for a given layer. There is also a User Defined flag to show where a user has created their own custom profiles or customized the mapping of profiles to standards.
• Flow Triples to Profiles/Standards – This shows the mapping of information flows from the Physical View to the Profiles and Standards. The Profiles shown define the Layer 6 and below. The standards column here is to show the Information Layer standard associated with this information flow. This will typically be a Data Dictionary or message set standard from the intelligent transportation or connected vehicle domain. The triples are used here to specify the Source, Destination, and the Information Flow. The information in this table is what drives the content for the creation of the Communications Diagrams. See “Communications Diagrams” in the Outputs section below.

To add entries to one of the Communications tables described above go to the bottom of the list and start entering your text on the blank row. This is possible on the “Standards” and the “Flow Triples to Profiles/Standards” tables. The other tables are currently in view only mode.
Definitions Grid Features

On many of the Definitions windows you can also select **Details...** in order to edit any of the characteristics about the component using the dialog box format.

**Undo** and **Redo** are available on the Definitions grid as well.

Some grids like the Physical Information Flow Triples grid can be very wide so the first 3 columns will be frozen so you can keep track of which interface you are working with.

The Definitions grids use color coding to indicate whether or not a cell can be edited – **Blue** for not-editable and **White** for editable. A **tan** color is used to indicate when a cell has been edited to be different than the default value.

Another feature of the Definitions windows is the **In My Project** column. Press the check mark to the right of the column name and you can filter between All checked, all unchecked, or all rows allows you to see all of the rows that are actually in your project, or all of the rows that are currently not in your project, or just all of the rows combined. Sometimes you just want to see the things that pertain to your project vs having to scroll through all of the things from ARC-IT that may not be applicable to your situation. On the other hand maybe you want to show what’s not in your project yet but you may consider adding it.

Other Columns can also be filtered in much the same way. Click on the top right of the column heading to bring up the filters menu. It will open to the Value Filter mode where each row is shown and you can decide which rows or all rows to show.
Or you can press the Text Filter button and you can provide parameters to show rows that contain certain words or phrases.

Then hit Apply to change the listing shown on the grid. Or use the Clear button to go back to the original view.

Filters can be a powerful way to select and review certain parts of your architecture. For example, you can filter the Relationships grid to only show your local/customized agreements by toggling the *User Defined* column.

**TIP:** To *delete* something from the Definitions grid, select the row you want to delete by clicking on the left side of the row and press the **Delete** key. This will remove the item from the database.

Deleting more than one row in a grid is simple – just highlight the rows you want to delete and press the delete key.

**TIP:** Sometimes the menu items on the Definitions grid get sorted or resized and sometimes you could end up with extra space at the top of the left menu. If you notice this happening, simply resize the grid by clicking and dragging the right edge of the menu and moving it slightly to the right or left to force the menu to refresh itself.
Review
SET-IT provides 2 tools to Review your architecture: Spell Check and Validation Reports.

Spell Check
SET-IT includes a Spell Check utility to review all user defined items in your architecture including elements and stakeholders. From the Review menu select the Spell Check Button and SET-IT will analyze all of the information contained in the database and open a Spelling Errors window. This Spelling Errors window shows all of the objects, elements, flows, and other architecture components that have a spelling error of some sort.

Open one of the records by double-clicking on the fields and the Details form will open for that item.

Spelling errors are shown with a red line under them. SET-IT’s Spell Check utility works like most Spelling applications. Once you see a spelling error right-click over the word and a menu will be shown with alternative spellings and options to ignore the error or add it to your local Dictionary.
Clicking the “Spell” option opens a separate window for the Spelling application and provides additional detailed options as shown below:

Validation

The Validation button opens a window that allows you to decide what parts of your architecture to check for errors, consistency across the architecture, and items that need to be completed. This step is also called Validation.
There are different tabs for each View of the architecture and a General tab for general areas to look for during validation. Click the tab you are interested in and use the checkboxes to select what items to look for:

**Physical View Validation Checks**

- Physical objects without element mappings (the connections between the generic ARC-IT physical objects and the local/project specific elements in your project)
- Functional objects that are not contained within elements/physical objects
- Balancing inconsistencies between Layers 0, 1, and 2 physical diagrams, such as flows that may have been deleted after you generated an upper layer diagram or interconnects added on an upper layer diagram without having added flows on the layer 2 diagram.
• Sequences that are not associated with at least one diagram
• Disconnected Flows (flows on a diagram that are not connected on one end or the other)
• Information flows with missing functional objects
• Inconsistencies between the Physical Interconnects and the Layer 2 Information Flows; also known as “validate Element-P-Interconnect triples”
• Element information flow triples that are missing physical object assignments
• Unused Element information flow triples – triples defined in the grid that do not appear on any diagram
• Element information flow triples that are duplicated on the same diagram – more likely on a large complicated diagram to end up having the same flow assigned to 2 different lines
• Element mapped to an unrelated physical object (when a project is imported from RAD-IT that had an unusually complex mapping)
• Requirement to Functional Object mapping issues – orphans, either requirements that do not trace to a functional object or functional objects without any requirements
• Missing element to ITS Object functional object assignments. The functional objects that make up the generic “ITS Object” like Management Support and Communications Support are meant to provide the underlying functionality that applies to any ITS element in the project. This will indicate if those supporting functional assignments are missing.

Enterprise View Validation Checks

• Unassigned stakeholders (stakeholders that have been defined but not assigned to any role with any of the elements)
• Check that each physical object or element has a stakeholder with the following roles:
  • Owner
  • Operator
  • Installer
  • Maintainer
  • Certifier
  (For now, make sure Owner and Operator are assigned to each of your elements. They are used by SET-IT to identify the relationships that will need to take place between stakeholders.)
• Resources from the Enterprise view not mapped to physical object elements (In ARC-IT there is a relationship between resources in the enterprise view and the physical objects in the physical view. For a project architecture this means that your project’s elements are really both Resources and Physical Objects. This report will make sure that’s the case.)
• Relationships that are between something other than enterprise objects
• Roles that are between something other than enterprise objects and their resources
• Resources that have multiple stakeholders that have the same role and status
• Relationships with no agreement assignments. Recall that relationships are the uncustomized enterprise agreements or expectations provided by ARC-IT. This determines whether the enterprise agreements that ARC-IT has match what agreements that are defined for your project and/or region that’s implementing this project. The uncustomized agreements or expectations show up on the enterprise drawing as italicized text with curly braces.
Communications View Validation Checks
- Incomplete or incorrect Standards/Layers mappings on communications templates
- Element flow triples without a physical object flow triple
- Invalid Physical Interconnect characteristics
- Profiles improperly associated with element flow triples. This looks for links/interconnects and interfaces that do not match rules setup in ARC-IT, e.g. using a profile for center-to-center for a field-to-field flow or profiles for wired Ethernet to communicate between mobile devices.
- Incomplete mapping between standards and the element information flow triples
- Missing or Incomplete information on Standards, and Standards Development Organizations (SDOs).

General Validation Checks
"Identify invalid shapes" checks the diagrams across all the views to see if something other than one of the shapes from the SET-IT stencil have been pasted onto a diagram.

"Identify unused user defined objects" looks for user defined physical objects, elements, enterprises, agreements, flows, etc. that are not used on any diagram or connected in any way to any other part of the architecture.

The checkboxes on the General tab let you identify missing descriptions for the following:
- Physical Objects
- Functional Objects
- Elements
- Stakeholders

Use the Select All or Deselect All buttons as shortcuts.

Once the options are set, use the radio buttons to select whether to Save the results to a file (Word, Excel, or as a text file) or to Open an Application (Word or Excel) to view the results.

**TIP:** If you find yourself running the same validation reports over and over again then you can use the Project / Options menu and set the validation options you want to be your defaults.

Outputs
This section describes how to generate outputs using SET-IT to explain your project with Tables, Documents, and Diagrams.

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 SET-IT has exclusive access to the file." If this happens, you can still close
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SET-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.

Output Tables (Reports)

SET-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.

From the Outputs tool bar, click Tables to bring up the Output Tables dialog.

Output Tables (Reports) Dialog Screen

Click the 1st pull-down to Select Table. You can scroll 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.
Select Action: you can simply Save the output to a File or choose to open the Application by selecting the appropriate radio button.

Create Output: here you can decide whether it should be in Word, Excel, or straight text format. Text, or Comma Separated Variable (CSV) format, would be useful if you were going to import the data into another type of application.
Output Options
At the top of the Output Tables window is an “Options” button. This opens the same options window available from the File / Options / Output menu.

- A set of radio buttons to choose whether your tables include all possible rows from the database or only the rows specifically associated with your project.
  **TIP:** You may not want to see data on all possible ARC-IT components so click “Show only rows specifically associated with the project”.
- A checkbox to roll up (or merge) identical data in multiple rows into a single cell.

Output Tables (Reports) – Current List of Reports

The following is the list of Tables that can be generated from the current version of SET-IT:

**Project / File Info:**
1. Project Summary
2. Change Log
3. Service Packages
4. Diagram Information
5. Status Values
6. Stakeholders – including whether a stakeholder is a group and if so, what are its members

**Needs & Requirements:**
7. Need Areas
8. Needs
9. Requirements – including options to show the related Needs or the related Elements and Functional Objects the requirements trace to.

**Physical View:**
10. Elements
11. Physical Objects
12. Functional Objects
13. Information Flows
14. Information Flow Triples (customized source, destination elements and the flows between them)
15. Security Characteristics Analysis
16. P-Interconnects (Layer 0 or 1 physical interconnects between physical objects)
17. P-Interconnect Triples
18. Physical Object Standards
19. Element Standards (the physical objects above that apply to your project’s elements)

**Enterprise View**
20. Elements
21. Enterprise Objects
22. Resources
23. Roles
24. Agreements
25. Expectations
26. Relationships (customized agreements, expectations, and other relationships that exist between stakeholders)

**Communications View**
27. Layers
28. Profiles
29. Standards
30. Standards to Layers
31. Profiles to Standards
32. Flow Triples to Profiles/Standards

**Scenarios**
33. Scenarios
34. Sequences
35. Sequence Steps

**NOTE:** Future releases of SET-IT will include more ways to generate outputs from your project file.

**Output Documents**

SET-IT includes tools to let you generate a complete document based on the information in SET-IT about your project.

From the Outputs tool bar, click **Documents** and choose from the list of documents. Currently, only the Concept of Operations (ConOps) is active.

General document capabilities include the ability to Setup, Create, and View the document. The setup area allows you to establish general data for the document and edit the word template. A
“Ready to Create” button can be used to see if there are parts of the document that still need to be customized or established.

Concept of Operations Document Generation

A Concept of Operations document describes the current state of operations, establishes the reasons for change, and defines operations for the future in terms of functions/features and supporting operations. For connected vehicle projects a ConOps establishes the driving needs for the project, shows the high-level physical and enterprise architecture view in both diagrams and definitions based on ARC-IT, and a set of operational scenarios.

SET-IT supports the generation of a ConOps with general and content specific setup choices.
The document setup screen for the ConOps is shown below:

The document Setup window has 2 tabs: General and Content. The General tab has several features. The top area sets up the file information – folder location, filename, and the document template to use. The bottom area sets up what will appear on the title page or in the version control page behind the title page.

On either tab, you can also select the “Use Template” button and the bottom fields will be greyed out.

The Edit Template button launches Microsoft Word file called a template (has a .dot file extension). A template file is used when you expect to use the same pattern on multiple documents. With SET-IT editing the template allows you to make changes to the template that will be used to generate the
whole document. You can then let SET-IT save those changes for the next time you update the document.

Click on the Edit Template button when you have selected a particular section on the Content tab and Word will open the template and jump to that section.

There are 3 templates to choose from:
- ConOps (Ref Implementation) Template.dot
- ConOps (ISO 29148) Template.dot
- ConOps (Model Document) Template.dot

The first template is based on the Reference Implementation of the Connected Vehicle Reference Implementation Architecture that was developed for the testbed project in Southeast Michigan. The outline for that project started with IEEE Standard 1362 and then was customized to meet the needs of the project – some sections were moved around and some were omitted as not applicable.

The second is based on ISO 29148 which has superseded IEEE 1362 and is useful when contract requirements dictate that standard or anytime the needs of the project are different than the needs that were driving the reference implementation project.

A third template is available that is derived from the outline used for FHWA’s Model Systems Engineering documents for ITS projects like Closed Circuit Television (CCTV), advanced signal control, and Dynamic Message Sign (DMS) deployments. This outline was based originally on the American National Standards Institute / American Institute of Aeronautics and Astronautics (ANSI/AIAA) G-043-1992 standard.

In all 3 templates, there are sections for you to provide background about the project and how the project will be developed and used in the future. The ConOps generated by either template will include diagrams and tables that are maintained in SET-IT.

Start with either template and customize it to suit your project’s needs. Confer with your stakeholders and sponsors, first.

**TIP:** Use the **Edit Template** feature to develop your project specific content that the architecture views don’t include, e.g., high-level background about the project. You don’t want to wait until SET-IT is done to edit the document. That way SET-IT won’t know how to store extra information. By editing the template and then generating the document you can reuse that descriptive information and store it with the other definitions and your project diagrams.
The next tab on the Document Setup window is the Content tab as shown below (using the ISO 29148 outline):

SET-IT is showing the outline discussed above and as you click on each section on the left side you will see some information about that section on the right.

You can also decide to exclude a section entirely by unchecking the box at the top. You can change the title of that section in the field shown on this screen or check the Use Template box and SET-IT will pick up the name as it’s called in the word template you will edit.

There are several sections of the ConOps that have content that is stored in SET-IT, either diagrams or tables. For example, click on Physical Layer 0 on the left and it will show you the diagram(s) in...
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SET-IT to include in this section – use the check boxes to select which ones to copy into the document. It will also show the information that will be published in the form of tables and you can decide which ones to include or exclude.

SET-IT might say that there is nothing system generated about a section and that you should edit the template to write about it by replacing the paragraphs or statements that start with “**” and end with “**}”.

To Edit the Template, click the “Edit” button next to the Document Template box on the General tab or click the “Edit Template” on the Content tab.

Clicking “Edit Template” will open a word file called ConOpsTemplate.dot which is a word file used to be a template for other documents. You can edit and should edit this file to update the areas between the “**” and “**}” marks. When you are done Save and exit word. Making changes in this way will allow you to be able to keep things that you have written while continuing to make changes to the architecture in SET-IT.

TIP: You may notice sometime that your ConOps Template (.dot) file opens as “Read-Only”. This can happen if you had already generated a draft of your ConOps using the Create step (described below) and that document is still open. If that happens and you need to make updates to the ConOps Template file simply close both (or all) copies of Word that are open and go back to SET-IT and click the “Edit Template” button again.

One of the diagram types you can include is the Context Diagram. These were described in the Context Diagrams section below. Basically, for physical they allow you to take each element in the inventory of customized physical objects and it will draw a picture of all of the other elements with which it interfaces (information flows). Likewise, for Enterprise this feature will take each stakeholder in the list of customized enterprise objects and it will draw a picture of all of the other stakeholders with which it interacts (agreements, expectations).

The Context Diagrams portion of the Content setup screen for Context Diagrams is shown below:
With the “Include Diagrams” area you can decide for which elements to generate diagrams. For instance, you can decide to only include diagrams for the major center systems in your ConOps. There is also an option below to Automatically Recreate Context Diagrams. If you have recently generated context diagrams using the Output Diagrams function described in the next section then you may not have to regenerate those diagrams. Having this “un-checked” will save some time generating the document. If, on the other hand, you have made changes to your architecture and you haven’t generated context diagrams recently, then check that box and it will process the diagrams, generate the diagram file, and include them in your ConOps.

You can also include Layer 0 or Layer 1 diagrams as part of your ConOps. Recall that Layer 0 diagrams have only the Physical Objects and their interconnects. Layer 1 diagrams add the functional objects. You can have more than one Layer 1 diagram.

**NOTE:** Sometimes the Layer 0 or Layer 1 diagrams are too large to fit on a page and may try and bleed into the next page. If this happens you can use Word to edit the output to make sure the diagram fits on a page. You may also be able to change the page size to accept a larger diagram – like an 11x17 fold-out page.

The **Operational Scenarios** section allows you to select the scenarios you created along with the sequence of steps. It will include the layer 2 physical diagram with the marked sequence steps showing and tables that list the steps along with their associated flows and objects, if applicable. Your ConOps can include one or more Scenarios. Each Scenario may include one or more sequences. Sometimes Scenarios may involve multiple service packages; for example, a System Support scenario might include sequences involve security credentials, object registration, and system monitoring. In those cases that scenario would have 3 sub-sections for each service package drawing with the sequence steps for each of those service packages shown.

After your document settings are setup on the General and the Content tabs you can press the “Ready to Create?” button to see if you really are ready. This will produce a To-Do-List Report in Word showing areas where the template hasn’t been customized yet or that no diagrams are selected. You can go back and change the settings and close this window.

Once you are ready then select **Create** – the progress window will show what it is doing and tell you when it is done. Then you can **View** that document in Word.

Note the cover page includes the title, subtitle, author, and other information from the Setup screen along with an icon indicating that this document was developed using SET-IT.

**TIP:** Use Save As to save a copy of the document and then as you make changes and add to your architecture you can regenerate the ConOps document without losing the earlier drafts.

**NOTE:** One issue that has reoccurred on a sporadic basis is an error that “Microsoft Word is not Available” when generating their ConOps. This may be due to an incompatibility between the version of Word and the versions of other Office products on the user’s machine, e.g., Visio 2016 with Office 2010. You may need to zip the files and move to
another computer to try the steps again or try updating the other Office products to be the same version.
Output Diagrams

SET-IT provides tools to create a set of diagrams in addition to the service package-focused views that ARC-IT provided.

The first set of diagrams available from SET-IT is the Context Diagram.

Context Diagrams

Context Diagrams focus on one element/resource or stakeholder at a time and then draw the interfaces or relationships that go into or out of that one element of stakeholder. These are good for guiding conversations with stakeholders so they can see their system in the middle and all the inputs and outputs their system will be responsible for. This provides a way that they can gain an understanding of how they fit in the overall scheme of the project.

From the Output Ribbon, click Diagrams and Context Diagrams.

Another window will open that is similar to the Concept of Operations generation window. It has tabs for Setup, Create, and View.
Click the **Setup** button to bring up the settings that will establish what diagrams to draw and how they should look.

There are 3 columns on the Physical/Enterprise Context Diagram Setup window corresponding to 3 basic steps:

1. **Select Context Diagrams** – provides a listing of all of the Elements in your architecture. Use the checkboxes to select which ones to include in your output. In the physical view use the
pull-downs to filter the Types (System or Human) or Class (Center, Field, Personal, Support, or Vehicle).

2. **Identify Interfaces to Include** – provides another list of Elements (Physical Objects) or Stakeholders (Enterprise Objects) that you want to include around the element of focus. For instance, there may only be a small set of elements that you need to focus on – the primary systems in your project or region. You can also use the Type and Class pull-downs to filter the selections.

3. **Select Connectors** – provides buttons and checkboxes to select the type of connections to show: Flows (layer 2) or Physical Interconnects (layer 0 or 1). In the Enterprise view you can select between Agreements and/or Expectations. In either view you can also decide which Status Values – all, existing, project, new opportunities – to include; perhaps to show separate diagrams for before and after your new system is installed.

Press **Close** to return to the main diagram screen.

Press **Create** and SET-IT will build a new drawing file that has a diagram for each element or enterprise selected in the left column of the setup screen.

During the creation of the diagrams if you click the **Close** button it will ask if you want to cancel the diagram creation. This is useful if you have a lot of diagrams but remember that you needed to edit something first. It will stop the process and you can come back and change the Setup and hit Create again.

Press **Preview** to open a preview screen to see what the diagrams will look like. You may see that you forgot to include an element or that you filtered out too much. You can close this and go back to the Setup screen and recreate the diagrams.

If you are satisfied with the diagrams in the preview window you can use the Save All button to create a copy in a Visio format for use outside of SET-IT. You can also press View to open the diagrams in another copy of Visio to tweak the drawings, print them, or save them with another name.
Communications Diagrams

The next type of diagram that can be created and output with SET-IT is the Communications Diagrams.

The Communications Diagrams feature works similarly to the Physical Context Diagrams. Press the "Setup" button to see the list of interfaces (information flow triples from the Physical View) and the Profile that has been selected in the Communications View.
Use the check boxes on the right to pick which interfaces you want to see drawn. You can also use the Select All or Deselect All buttons as short cuts.

The Setup window is a good opportunity to see if you agree with the way things have been developed in your project architecture so far. For instance, there may be interfaces you expected to see that are missing or that the names don’t look right. Now is the time to go back to the Physical view and make changes – either in the diagrams or in the definitions menus.

Once you are satisfied with the selected diagrams, close this window with the Red X.

Now press the Create button to start the process. The progress bar will update as each of the diagrams is being created.

Once the process is complete it will say it succeeded and you can click Preview.
When it is done the Preview button will be highlighted. The Preview screen shows the list of diagrams on the left and a preview snapshot of what the diagram looks like.

You can Edit or Close this window.

If you would like to edit the diagrams at this point you can click Edit to launch a copy of Visio. Visio will launch with the set of diagrams just created in a separate file. It is a good idea if you envision making changes directly to the Visio drawings to save the file off into a separate location so that the next time you use SET-IT to generate the Comm diagrams it won’t write over your changes.

SET-IT creates separate drawing, shown as a separate tab in Visio, for each Information Flow Triple. The top of the diagram shows the name of the Communications Profile, the next box shows the name of the information flow and then the source and destination elements are shown. The color coding matches the physical object types for the elements. Below the elements the Information Layer standard is listed based on the mapping of flows to standards in ARC-IT or your customization in the Communications View Definitions. The layers below the information layer show the communications protocols needed to carry out the information flow from source to destination.

If changes are needed to the mappings go back to the Communications View Templates or Definitions to update the mappings and other information.