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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 (also indicated 32-bit or 64-bit),
  - Look at the splash screen when SET-IT opens or go to Project / About.
- The version and name of your operating system,
- A brief description of your problem or issue.

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

**What’s New**

With this release you can:
- Make use of the latest ARC-IT v8.1 content
- Notice numerous performance improvements working with Diagrams and on the Definitions grids, including being able to selectively synchronize
- Install a version of SET-IT that supports 64-bit Office (Visio) applications
- Identify the RAD-IT file associated with my project
- Import project architectures from RAD-IT
- Develop Enterprise view content for my project
- Associate human elements with a single broadly defined stakeholder
- Add comments to an information flow or information flow triple.
- Define projects to include all types of Intelligent Transportation System (ITS) projects.
- Assign Completion Status to my diagrams
- Create communications view diagrams and associated definitions that include intermediate communications elements for all eligible interfaces as defined in ARC-IT
- Use a new Sample Project that is consistent with a project built in RAD-IT’s sample project

This version includes numerous performance improvements and corrections to bugs and errors. Behind the scenes, many of the forms and their underlying data objects have been reorganized for better performance and more consistent behavior. Minor enhancements include the ability to
replace an ARC-IT flow with a user defined flow, a resizable project overview form, spell check extensions so all user created text is now spell checked, and a new executive summary section in the ConOps document. Be sure to upgrade to 8.1 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 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, Environmental applications as well as supporting services.
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, as it did with CVRIA.

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 the diagrams or tables that can be used in tools like Word or Excel.

**NOTE:** Enterprise View is back with version 8.1. As a result you can now 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 the elements in the Physical View.

This version includes the ability to create a Concept of Operations (ConOps) document using either an IEEE Standard 1362 template or a template used as a reference implementation in connected vehicle research projects and giving you the ability to modify the template as well as generate content from the diagrams and tables from the physical and enterprise view. This version also imports the Needs and Requirements from ARC-IT for the Service Packages (application) you include that you can then customize or you can create your own 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.

**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.

**NOTE:** 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.

**NOTE:** 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).

**NOTE:** 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.

**NOTE:** Some users have reported a clipboard error when the Communications View 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. If this happens the best thing to do is delete the communications view templates and reenter the Comm View so it will regenerate the diagrams or redo the import.

Steps for First-Time Users

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.

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](http://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) and include one or more physical object 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 at other potential relationships that are defined between 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 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. They can change color based on their deployment status.

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 physical Information Flows, Physical Objects, physical Functional Objects, Enterprise Objects, and enterprise 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 is needed to achieve interoperability. These layered diagrams, also called protocol diagrams or profiles show how each part of the communications ‘stack’ contributes to the overall communications. The Communications View in SET-IT is based on the Communications View of ARC-IT. The 7 layers 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 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 Comm 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 comm or other inappropriate choices.

Each Communications View Diagram shows the information flow triple at 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 capability that is identified and supported within the System, Service Package, or Project to accomplish a specific goal or solve a problem.

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.

Physical Interconnect

Also known as P-Interconnects, these are thought of as the high 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 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, Support, Vehicle, and Traveler. Examples include the Traffic Management Center (TMC), the Vehicle Onboard Equipment (VOBE), and the ITS Roadway Equipment, corresponding to traffic operations centers, automobiles, and legacy ITS field equipment. 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 C2XML profile is shown below to show how each layer is assigned to a communications standard:

![C2XML Communications Profile Template](image)

* Mechanism for transmitting raw bits over a physical link between centers, such as 1.430/431, SONET/SDH, IEEE 802.3, IEEE 802.11 or any other viable physical layer specification or standard.

Figure 1. C2XML Communications Profile Template

In SET-IT, these profiles become “templates” to use when generating the communications diagrams.

Project
A project is a set of system deployment activities grouped together (usually within a single procurement) for planning, deployment, and/or operational purposes. A project has defined boundaries within the context of a region.
Project Architecture
This term defines the elements and information exchanges of a single 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. A region is a local decision. It is not necessarily bounded politically. It could be a state or multiple states, a metropolitan area or multiple metropolitan areas, one MPO or multiple MPO's, a corridor (e.g., I-95 corridor), counties, rural towns or areas.

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, physical objects can have relationships with each other. In ARC-IT and in SET-IT these Relationships are limited to includes (a Physical Object contains a Functional Object or another Physical Object) or extends (one Physical Object extends the functionality of another Physical Object as in a Vehicle OBE that extends its functionality to a specialized Commercial Vehicle OBE).

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 connected vehicle 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 are being used by or being developed for connected vehicle applications and 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 connected
vehicle objects. 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.

Traveler
Traveler, 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 includes equipment that are owned and operated by the traveler as well as equipment that are owned by transportation and information providers.

Triple
Defined by the source, destination, and the information flow. This “triple” represents a particular instance of an information flow from ARC-IT.

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.

Using Projects

This section describes the operations and steps to follow in order to create, save, and modify a project using SET-IT. This section also includes other actions that you can reach from the Project menu.

Create a New Project

1. Select **Project** on the top menu,
2. Click **New**.
3. On the **Create New Project** box identify the name of the new project and the location to save the file.
4. 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**.
SET-IT Help

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 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 but take advantage of the latest
ARC-IT definitions – new Physical Objects, new Service Packages, new Comm 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. SET-IT will
default to choose the first it comes to but in that case 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.

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.

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.

![SET-IT Project Upgrade]

Once complete it will be a good idea to 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 again. You may see a message like this:

If so, just click Cancel and pick another file. Or go to the window currently running and close that copy of SET-IT with that file in use and the click ‘Try Again.’

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 Options to and the printer to use.
3. For the Definitions tables, a Print Preview window will open where you can choose different settings and the printer to use.
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

From the Overview menu click the Project button to display the high-level information about your project.

The first time a new project is created there will be a default name entered and everything else will be blank. The information 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 but details like the Project Name are also used in the ConOps document to automatically insert the name within the document.

The Geographical Scope and Service Scope text boxes are good to let project stakeholders know the extent of the project, e.g. how big is the region involved or what services/functions are being developed.
The Developer and Maintainer fields can be used to show the individual or organization that originated the project architecture and who or what organization is continuing to maintain it.

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

The origin 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 blank area of the pull-down 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 use as the Origin for other things like 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 dates 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.

**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.

**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.
SET-IT Help

- 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.

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. A region is a local decision. It is not necessarily bounded politically. It could be a state or multiple states, a metropolitan area or multiple metropolitan areas, one MPO or multiple MPO’s, a corridor (e.g., I-95 corridor), counties, rural towns or areas. 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
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. 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 stop 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.
NOTE: Not Applicable cannot be used to translate an imported status.

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

3. Stakeholders – next, the stakeholders involved in the project will be listed that are going to be imported. This will include the stakeholders explicitly included on the RAD-IT stakeholders tab as well as the stakeholders that may be somehow associated with an element, such as members of a group that ‘own’ a TMC. 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.

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.

6. Elements Import – as shown below, the next stop 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 stop, Service Packages – now SET-IT lists the service packages to be included. For each a new service package instance will be created in SET-IT, meaning a service package diagram will be created. Click Continue.

   **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 an error and 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.

8. Flows Import – the next stop 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.

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

10. Standards – this stop 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.

11. Needs – this stop will list the Needs to be imported that are not already included in the Service Packages imported in step 7 above.
12. Import Completed – now press Close and see the RAD-IT Import Report. This report can be exported in either Word or Excel.

13. 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.

14. 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 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)

- If Agreements were developed in the RAD-IT project they are also imported and will be available upon entering the Enterprise View in SET-IT.

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

- 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:** to avoid losing flows that were added by RAD-IT to go the Project / Options menu and on the Synchronization tab, select “Update diagrams to match database” and un-check “Delete database relationships not included in diagrams”

➢ 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.

**Select Service Packages**

The Architecture for Cooperative and Intelligent Transportation (ARC-IT) has 139 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 allows transportation projects to have as many ideas and definitions available to support 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 (US, 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 by the Type (Safety, Mobility, Environment, or Support), Group of service packages, or Name by clicking the heading top of the screen. 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.

When you have selected the service packages / applications to include in your project’s architecture click the “Include” button at the bottom of the window. At this point, SET-IT will copy the physical and enterprise diagrams 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.

Can I have more than one “instance”? Yes, you can. 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:** Here on the Service Packages menu you see the way in which SET-IT indicates what you can and can’t edit. Here you see most of the fields are Blue which means they are not editable. Here only the Include column is white which indicates that is the column where you can enter something – in this case a checkmark to select it.

**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.
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

To see a sample project file that includes a basic set of objects and interfaces that are likely to be common in many ITS or connected vehicle projects.

Opening and Saving the Sample Project

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.
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 usage of the software.
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 PObjects 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.

**NOTE:** sometimes you may notice differences in the way the text on some buttons looks or labels for different columns. This may be caused by a Display Setting that some Windows users do called Font Scaling. 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 is an *Optional* step but these are used to set the Rules of which 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 entrees 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.
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 settings:

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 or Verbose.

  **TIP:** It is a very good idea to check this box. If you run into problems or you have a strange error message pop-up, the 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.
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. That 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:

![Diagram Review](image)

Enterprise Physical Comm Views

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 the This section describes how to create and modify your architecture’s physical view, including how to create a new Physical diagram and modify its components.

**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, Traveler, or Support; Functional Objects; Notes or Comment boxes; Human objects (operators or users) – either Center, Field, Traveler, 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.

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

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, Vehicle, Traveler, Support

Select the appropriate Physical Object(s) from the pull down menu to select a 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 screen.

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:

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

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 (traveler class).

**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.
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 it does not include a Roles column. This allows a user to associate a human element that may be part of a larger organization – such as a Taxi Driver that is part of a company.

**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, Support, Traveler, 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** and who **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).

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.

You may see a Pop-Up window called “Update Confirmation” asking if you wish to add this element to the corresponding resource shape in the Enterprise drawing.

![Update Confirmation window](image)

You can say Yes or No. You can also check a box to remember your choice later and it won’t pop this window up again. This decision can also be made on the Options / Diagrams menu under the Project area of the tool bar.
NOTE: Even if you assign multiple Elements to the same box, all such elements are prompted for auto-add, and if you respond, “Yes,” to the prompt above they are all added to the appropriate enterprise diagram.

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 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
- Support
- Traveler
- Vehicle
- Vehicle (Mobile)

Then with SET-IT we want to 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.

**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.

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 *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.

As a non-human Physical Object (Element) is added to the diagram, SET-IT will ask if you want to add a Resource shape to the corresponding enterprise view drawing. The next time you switch to the enterprise view you will notice a new box in the lower left corner of the drawing.

**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.

**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:** this is a new concept. If this flow will go through a data distribution system or other communications domain element (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.

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)
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.

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**FIPS**

Current Flow(s)
- traffic control priority request

Confidentiality
- Low

Confidentiality Basis
- The result of this will be directly observable.

Integrity
- Moderate

Integrity Basis
- Invalid messages could lead to an unauthorized user gaining transit signal priority at an intersection. This could also be used to delay traffic, which could lead to a financial impact on the community. However, the traffic signal will have controls in place to ensure that it does not display an illegal configuration (such as green)

Availability
- Moderate

Availability Basis
- These messages are important to help with the transit signal priority application. Without them, it will not work. However, if these signals are not received, the ITS RE will continue to function using its default configuration. The Tranet Management Center should have an acknowledgement of the receipt of a

**Definitions from the Federal Information Security Management Act (FISMA) of 2002 and FIPS Pub 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:
- From the New Items menu
- 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 POObjects 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 explain 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.).

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 packages 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 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 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?

You can also start from scratch, that is, create your own layer 0 drawing. You can use the stencil to drag physical objects 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 a Layer 0 diagram from scratch 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?*

You can also start from scratch, that is, create your own layer 1 drawing. You can use the stencil to drag physical objects onto the diagram just as you would for a Layer 2.

With Layer 1 you can also drag Functional Objects onto the drawing as you would on Layer 2. 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.

Note on the Stencil for Layer 1 Flow is replaced with Physical Interconnect, which may include one or more of the lower level information flows that go in either direction between elements. As you drag a Physical Interconnect from the stencil onto the drawing surface and connect it to 2 objects SET-IT will show the available physical interconnects based on the physical object assignments on either end.

You can also assign attributes to the physical interconnect:

- Status: Existing, Project, New Opportunity
- Encryption: True, False (if FIPS is used this will be locked)
- Authenticability: True, False (if FIPS is used this will be locked)
- Cardinality: Unicast, Multicast, Broadcast

On a Layer 1 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 1 P-Interconnect will show “1-3,B-D”.

**CAUTION:** Creating a Layer 1 diagram from scratch may be helpful to sketch ideas out but beware. You may not be able to keep things synchronized between the layers. For instance, for Functional Objects, you may make choices at Layer 1 that are inconsistent with the Layer 2 definitions. SET-IT’s validation tools will help sort these out.

Just as with other drawings you can use terminals to help unclutter a diagram and add Notes. The title box also works the same.

**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 what 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:** In 8.1, 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 for relationship generation as appropriate. The agreements are established based on the Enterprise View in ARC-IT.

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 will show up when a user enters the Enterprise View after making changes in the Physical View.

**TIP:** The Enterprise Layer 0 diagram is a useful inclusion in a Concept of Operations document to see 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.

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
Create a New Diagram, or open an Existing 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, vehicle, traveler, and support, 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, 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 ‘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
connected vehicle 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 in which 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 select New... 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 a 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:

![Stakeholder Details Form](image)

**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 the Architecture Reference for Cooperative & Intelligent Transportation (ARC-IT). The Enterprise Object Classes are:

- Center
- Field
- Support
- Traveler
- 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 a connected vehicle 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
- Support
- Traveler
- Vehicle
- Nomadic (combination of Vehicle and Traveler)

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.

As a Resource is added to the diagram, SET-IT will ask if you want to add a physical object shape to the corresponding physical view drawing. The next time you switch to the physical view you will notice a new box in the lower left corner of the drawing.

Functional Objects, the subsets of functionality within a physical object, can also be a Resource. They show up as being connected to a physical object by an **includes** line on the diagrams. Functional Objects cannot be further edited.

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, 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. "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 drawing 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 provide the basic type of agreement this is. The list of agreement types from ARC-IT are shown and you can also choose “<Unspecified>” if your agreement 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 in version 8.1 defines 17 potential roles as shown below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountable</td>
<td>An Accountable Enterprise has decision making authority, and is ultimately fiscally responsible for a Resource. An Accountable enterprise has the “owns” role with respect to the resource for which it is accountable.</td>
</tr>
<tr>
<td>Certifies</td>
<td>An Enterprise verifies that a target Resource meets relevant performance, functional, environmental and quality requirements.</td>
</tr>
<tr>
<td>Constrains</td>
<td>A Resource or Enterprise applies requirements, constraints and associated tests to another Resource.</td>
</tr>
<tr>
<td>Consulted</td>
<td>A Consulted Enterprise is one that can provide information about a Resource or Document.</td>
</tr>
<tr>
<td>Consumes</td>
<td>The Enterprise that serves as consumer of the basic service of a service package.</td>
</tr>
<tr>
<td>Develops</td>
<td>An Enterprise creates the target Resource or Document.</td>
</tr>
<tr>
<td>Equivalent</td>
<td>Used to show correspondence between views.</td>
</tr>
<tr>
<td>Informed</td>
<td>An Informed Enterprise is one that may need to be updated with regard to a Resource or Document.</td>
</tr>
<tr>
<td>Installs</td>
<td>An Enterprise performs the initial delivery, integration and configuration of the target Resource.</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Maintains</td>
<td>An Enterprise administers the hardware and software that comprise the target Resource.</td>
</tr>
<tr>
<td>Member</td>
<td>An Enterprise is part of another larger, target Enterprise.</td>
</tr>
<tr>
<td>Operates</td>
<td>An Enterprise controls the functionality and state of the target Resource. An Enterprise that Operates a resource is considered Responsible.</td>
</tr>
<tr>
<td>Owns</td>
<td>An Enterprise has financial ownership and control over the Resource. An Enterprise that Owns a resource is considered accountable for the resource and all of its contents. The entity that takes the &quot;owns&quot; role is ultimately responsible for ensuring the resource provides its promised functionality, and for securing data the resources holds and exchanges. The owner is similarly responsible for the facilities inherent to the resource that are used to exchange data with other systems. The owner is responsible for ensuring that any data stored by the resource and any data communicated by the resource are protected to the extent necessary considering the contents of the data and the consequences of its exposure or alteration.</td>
</tr>
<tr>
<td>Provides</td>
<td>The Enterprise that provides the basic service of a service package.</td>
</tr>
<tr>
<td>Responsible</td>
<td>A Responsible Enterprise performs an activity or task.</td>
</tr>
<tr>
<td>Supplies</td>
<td>The Enterprise that supplies (provides) a device or software product.</td>
</tr>
<tr>
<td>Verifies</td>
<td>The Enterprise that determines whether or not a target Resource meets requirements.</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 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 Comm 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 Comm 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 Comm 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 Comm 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.

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

Elements of the Comm View Templates
SET-IT Help

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 Comm 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 Comm 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**
  - 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 next tables, “Standards to Layers” and “Profiles to Standards” to assign that standard to a layer/profile.

- **Standards to Layers**
  - 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).
  - Yes, a standard can be assigned to more than one layer.

- **Mapping of Profiles to Standards**
  - 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
  - You can use this list to customize the assignments
  - 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**
  - This lists the Information Flow Triples (source element, destination element, and flow name) from the physical view and the assignment to a profile.
  - It also lists the Information Layer standard associated with the flow.
  - 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.
  - 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
  - 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 Comm 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

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.
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 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.

Using the Status Value Details screen to give the new status value a name (up to 25 characters), a description to explain what’s unique about this. 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, Traveler, Vehicle, or Support) 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 Interfaces and 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 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. It is a collection of information flows from Layer 2 so the characteristics are based on the characteristics of the flows included.

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.

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 Comm 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,

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 click over just that smaller box and cut out some of the components of the legend you don’t need and try and fit it better on your diagrams.

**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.

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 Sequences**

Another tool on the Physical view Diagrams menu allows you to create sequences of events by attributing step numbers to flows are objects on a physical diagram. Use the Definitions menu to create a Scenario and one more Sequences that are 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.

![New Sequence window](image)

- **Name:** RS Collection
- **Description:** This describes the sequence of events whereby the Operational Data Exchange acquires data from roadside equipment.
- **Scenario:** New Data Collection
- **Diagram:** SU03: Data Distribution (Copy 1)
- **Order:** 1
- **Style:** Black

Form Source: Form: Sequence
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.

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 will 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 on to the drawing this process will map the step to last thing (flow, element, functional object) you place 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 like the way you want them to.

- **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 also change the way a group of text appears with the Paragraph tools. 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**
  
o **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 the 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. When a particular triple (source, destination, flow name combination) has a unique aspect to it 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.

  
o **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 – which direction does it sync. It can either update the definitions based on the diagrams or update the diagrams based on the definitions. It depends on where you have been making your changes. If you don’t use the pull-down to pick a direction it will use the setting shown in the Project / Options menu.

- Sequence: See Defining Sequences above.

- Arrange: the Arrange area of the Diagrams toolbar has 3 choices: 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 object – this also becomes very useful on complicated drawings where you need to make adjustments to just one thing at a time.

  - 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.
SET-IT Help

- **Zoom** has 2 choices, also:
  - **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 a change or to 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.

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 now go to build your higher layer drawings they 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 – they work the same way as they did on the Layer 2 drawing, except with physical interconnects.

**Using Data Distribution**

A connected vehicle environment is characterized by the fact that the producers of the data do not necessarily have a direct relationship with the consumers of that data. Traditional information technology projects the system developer will be building the data collection as well as the data processing systems or specific external interfaces will be defined between systems. Even traditional ITS systems the center and the field devices are typically owned and operated by the same agency. With connected vehicle systems new relationships are possible or 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 set up a set of data collectors that then make the 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 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.
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 Status column can be used to show the project status for that need – perhaps it is already being met in the baseline or, as the project evolves, your team decides a need may need to be deferred to a later, future phase.

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 as the data from the columns out in the main grid and 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 connected vehicle project architecture. It is divided into sections. 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 view 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 this can’t 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.

**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 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.

![Table Example]

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

On the grids, the columns can be adjusted. You may notice that SET-IT tries to readjust them as you go in and out of the Details view. This is a known issue.

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.
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 (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
  - Once created, use the details form to associate project stakeholders to the roles they play with respect to elements
  - SET-IT will verify that each role assignment is unique per element
  - 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.

- 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.
- 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.

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:
  o Stakeholder
  o Role: owns, operates, 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)
  o Element
  o Status (sometimes you may define the current operator but then identify another stakeholder that will operate the element after the system is deployed)
  o 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 using 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 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 but 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 **Spelling** 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
- Element information flow triples that are missing physical object assignments

Enterprise View Validation Checks
- Unassigned stakeholders (stakeholders that have been defined but not assigned to any role with any of the elements)
- 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.)
- Resources that don’t have valid ‘includes’ relationships; e.g., between functional objects
- Relationships that are between something other than 2 enterprise objects
- Roles that are between something other than enterprise objects and their resources

A set of checkboxes pertains to the Stakeholders and their roles:
- Owner
- Operator
- Installer
- Maintainer
- Certifier

(For now, the critical roles to make sure are assigned to each of your elements include who Owns and who Operates them. They are used by SET-IT to identify the relationships that will need to take place between stakeholders.)

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.

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.

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 traverse through the categories to find the report you want.

In the 2nd area select from the Available Columns which will vary depending on the table selected in the first step.
Use the left arrow to select individual columns to include (they will then move to the Selected Columns table). You can also use the double left arrow to include all the columns.

**Select Action:** you can simply save the output to a file or tell it to go ahead and Open the Application

**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.

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.
   **TIP:** For smaller simple projects you may not want to see data on all possible ARC-IT components. Click “Show only rows specifically associated with the project”
2. 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

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

**Communications View**
25. Layers
26. Profiles
27. Standards
28. Standards to Layers
29. Profiles to Standards
30. Flow Triples to Profiles/Standards

**Scenarios**
31. Scenarios
32. Sequences
33. 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 2 templates to choose from:

- ConOps (IEEE 1362) Template.dot
- ConOps (Ref Implementation) Template.dot

The first is based on IEEE Standard 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.

The second template is based on the Reference Implementation of the Connected Vehicle Reference Implementation Architecture that has been developed as an on-going 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.

In both 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 IEEE 1362 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
SET-IT Help

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 ConOpsTemplate 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 the 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 users 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.

New City DOT

Concept of Operations
FOR THE RSL PROJECT

1.3
9/17/2017
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 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, Support, Traveler, 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.

![Physical Context Diagrams](image)

Press **View** 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 Comm 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.

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.