Simulink® Connector Guide

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Beginner	IT / Sys Admin
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PREFACE

The Simulink® Connector provides the ability to build a Simulink model based on the physical block or flow internal block diagram (flow IBD) in GENESYS™. Once the Simulink schema extension has been imported and applied to the project model, the user can map (or associate) Simulink subsystem blocks with the component block from either the physical block diagram or flow IBD. When each component block in GENESYS has been associated with a Simulink element, the user can then use the Simulink Exporter command to build the corresponding diagram in Simulink. This process moves the descriptive architecture into Simulink as depicted in the following graphic.

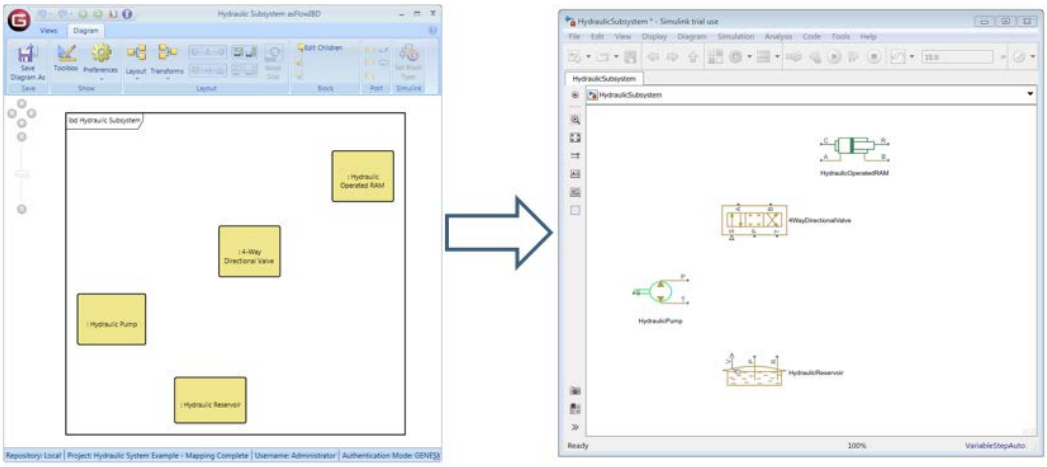

Figure 1. Simulink Connector Concept

This guide describes the processes used to associate component blocks in GENESYS with Simulink blocks and then describes how to use the Simulink Exporter command to create a Simulink model.

Following model construction and completion of detailed dynamic modeling validation in Simulink, the document also describes a nominal workflow to construct corresponding ports and links in GENESYS to align with the Simulink detailed design model.

The Simulink Connector released with GENESYS 6.0 represents an initial set of capabilities. The features and capabilities of this connector will be advanced and updated through service pack releases in GENESYS 6.0 and beyond.

This guide is intended to augment the Model-Based Systems Engineering (MBSE) with GENESYS training course and the reference material provided with GENESYS. The ultimate goal of this guide is to expose the user to the Simulink Connector ability and thereby extend the use and application of GENESYS for system design, development, and project management associated with supporting the engineering of systems.

The following additional resources are available for use with this guide:

- For descriptions of GENESYS, including database classes and folders, different views, diagram notation, and the mechanics of entering data into GENESYS, refer to the GENESYS Help and Documentation guide.
- For the definition of schema terms, refer to the GENESYS schema, which contains descriptions for each schema entity, associated attributes, and parameters.

For application of GENESYS to system and architecture design, refer to the GENESYS System Definition Guide and Architecture Definition Guide, each of which is provided in the GENESYS documentation supplied when GENESYS is installed on a computer workstation. They are also available on our website.

DESCRIPTIVE DEFINITION IN GENESYS

1.1. Advancing from an abstract to objective design

When doing a system design, the design team can usually define the abstract understanding of how subsystems and components below the subsystem will interface with one another. This understanding can be expressed by defining interfaces and developing an interface diagram similar to the following:

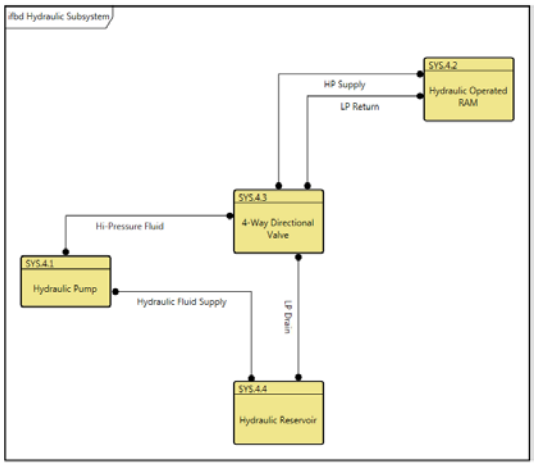

Figure 2. Typical Interface Block Definition Diagram

Interfaces can describe, in general terms, how the components are to interact with one another. The physical link that composes the interface needs to be defined based on very specific design information. The physical link has a specific capacity: the required size for the link has to be determined based on the detailed design of the subsystem and is often based on a detailed analytic model. Link entities in the GENESYS solution are depicted by the **Link** class and are shown on the physical and flow internal block diagrams.

While the interface diagram shown above has a series of **Interface** entities defined, the link diagram will not have any **Link** entities defined, and the diagram will consist solely of the component blocks until the links are defined and connected to the components. An incomplete physical diagram, one without links defined, will look like the following:

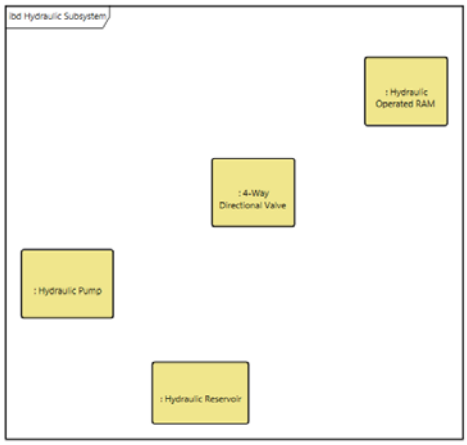

Figure 3. Flow Internal Block Diagram Without Links

This is the point in a system design where the focus generally shifts from the descriptive design to the detailed design. In many organizations, as the descriptive design is worked by the system team, individual

subject matter expert engineers have worked on the specific subsystem design and may have determined the particular components to be used in the subsystem design. What is not accomplished is a dynamic simulation and validation of the detailed design in Simulink. Accordingly, it is at this point that design in GENESYS can be connected to Simulink, and the detailed modeling can be accomplished.

ESTABLISHING A CONNECTION TO SIMULINK

1.2. Extending GENESYS for Simulink

List of schema changes included in the Simulink Schema Extension:

- Added new attribute to the **Component** class:
    - sl_blockType – Simulink Block Type represents the block type selected for Simulink libraries.
        - Alias: Simulink Block Type
        - Type: String
        - Initial Value: [Blank]

To start using the extension, a project administrator will import the GNSX file containing the schema extension into the existing project.

1. In GENESYS, select ***Import*** from the application menu.
2. Use the file browser to go to the Extensions folder (C:\Program Files (x86)\Vitech\GENESYS 6 Collaborative Edition\Extensions by default) and select Simulink Schema Extension.gnsx. Click ***Open***.
3. In the import wizard, you will see the project “Simulink Extension” in the project listing. Select ***Next*** to continue to Step 2.
4. Select the second radio button, which says “Import Into Project:” and select your project from the drop-down list. Select ***Next*** to continue to Step 3.
5. Review the screen to ensure that you have selected to import “Simulink Extension” into your project. The screen will warn you that your target project contains data. This is to be expected. Select ***Import*** to start the import process.

Once the import completes, click ***Close***, and the schema extension is ready to be used. Once you have imported the extension, you will not need to import it again into this project. Simply export your database using the default export option, and the schema and data are contained within one GNSX file.

Once the schema has been extended, the **Component** class will have an additional attribute to allow for mapping the component entity to an associated Simulink block. An example of the modified property sheet with the additional attribute named “Simulink Block Type” is provided below.

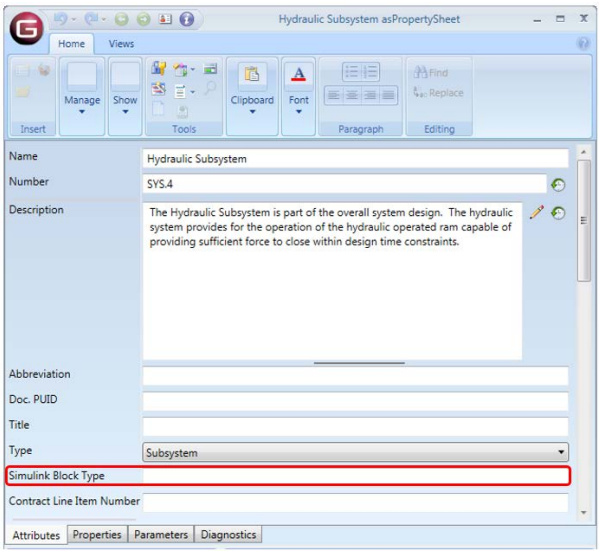

Figure 4. Modified Property Sheet With Simulink Block Type Attribute

1.3. Associating GENESYS Component with Simulink Blocks

In order to associate a component block with a representative model in Simulink, you must meet two conditions. First, the computer workstation that you are using to run GENESYS must have the ability to run a MATLAB® license with Simulink and the desired Simscape™ models library. Second, the project model must be extended as discussed in the preceding paragraph.

To start the process of making the associations, open either a physical block diagram or a flow internal block diagram. With the diagram open, select a block on the diagram. This will enable a button in the Diagram ribbon bar on the righthand side, labeled ***Set Block Type***. An example diagram is shown below.

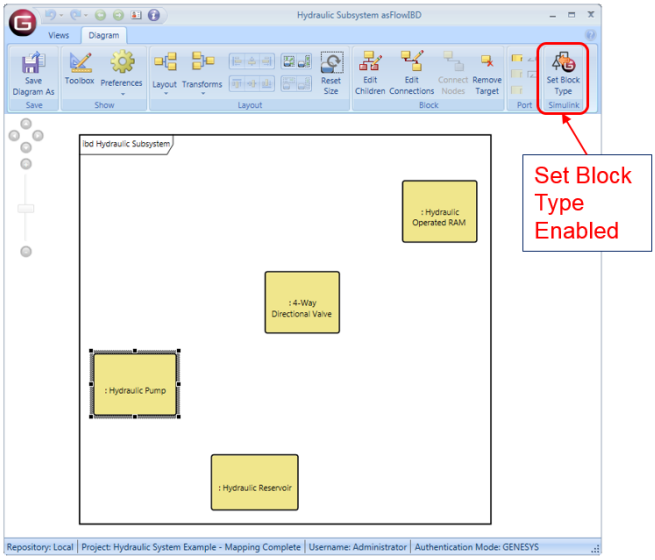

Figure 5. Flow IBD Setup to connect With Simulink

When you click the button ***Set Block Type*** for the first time, the Simulink connector will open the Simulink Library Browser, look for a MATLAB license, and open the Simulink base library. The connector will provide several status boxes providing messages on the progress of loading Simulink libraries. These messages include: Confirming local MATLAB installation, Loading Simulink Libraries, and Loading block type data. When the connector is finished, the Simulink Library Browser will look similar to the following:

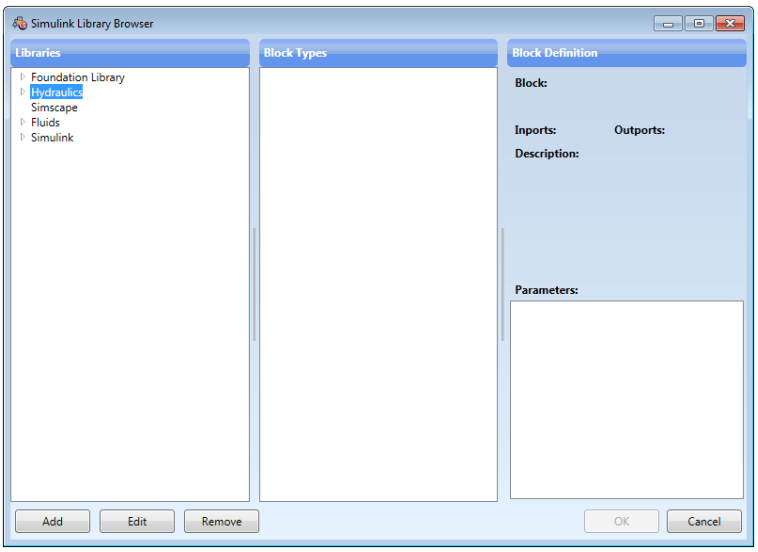

Figure 6. Initial View of Simulink Library Browser

In Figure 6, the Simulink Library Browser shows the basic Simulink Library with additional libraries consisting of: Simscape, Foundation Library, Hydraulic, and Fluids. Each of these additional libraries has been added to the browser using the ***Add*** button in the lower left-hand corner of the browser window.

Depending on the subsystem and components you are modeling in your design, you should have a specific set of libraries in Simscape that provide you models of the components specific to your subject subsystem design. The libraries used will vary widely based on the system and subsystems under design.

To add a new library to the Simulink Library Browser in GENESYS, you need to first know the Simulink name for the library and then use the ***Add*** button to import the library into the browser. (Please note: finding and determining the library name in Simulink is not covered in this guide, as this is a feature of Simulink and is a basic skill for Simulink users.) An example dialog window for adding a new library is provided below. The user needs to provide the Simulink "Library name" and then designate a "Library alias" (the name that will show in the browser).

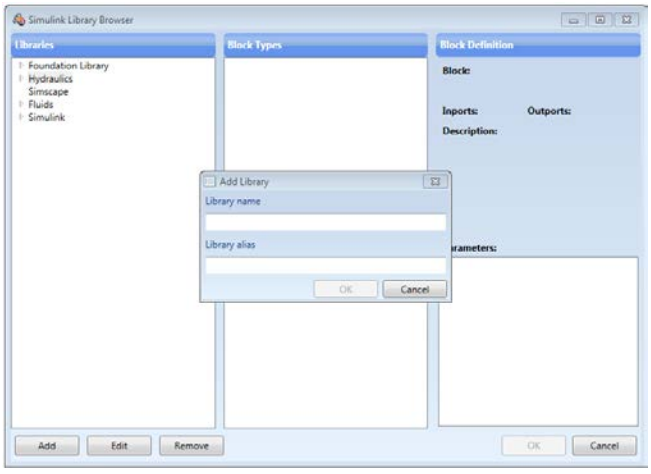

Figure 7. Adding a Library to the Simulink Library Browser

Once the library is loaded, the user can then navigate through the Simulink libraries and select a block type to associate with the selected GENESYS block. In the diagram below, the Hydraulic Pump (selected on the flow IBD) will be associated with the Fixed-Displacement Pump from the Hydraulics / Pumps and Motor library in Simulink.

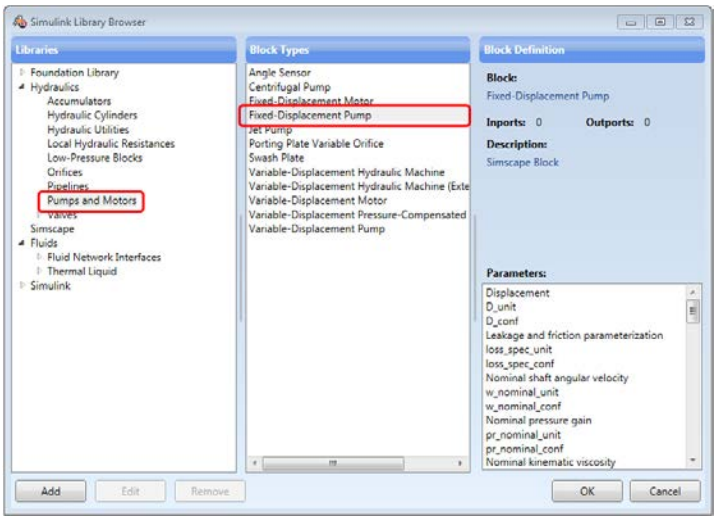

Figure 8. Selecting a Simulink Block Type

When this selection is made, the attribute in GENESYS to map the component to the Simulink Block will be set and the parameters of the Fixed-Displacement Pump in Simulink will be added as parameters in properties of the GENESYS component.

The user needs to complete this process for each of the blocks in the flow IBD: select the block in GENESYS, and set the block type. Once each block has a block type set, we are then ready to export the GENESYS model to Simulink.

MOVING THE GENESYS MODEL TO SIMULINK

1.4. Simulink Exporter

The Project ribbon in GENESYS contains the button used to export the model to Simulink.

Figure 9. Simulink Exporter

When the ***Simulink Exporter*** command is selected, a Simulink Exporter dialog box is opened in GENESYS. In this dialog box the user needs to select several items. First, the folder containing the subsystem. Second, the individual subsystem to be modeled. Third, a location and file name for the Simulink model that will be created. When the selections are completed, select ***Finish***, and the Simulink model will be created and saved to the location specified.

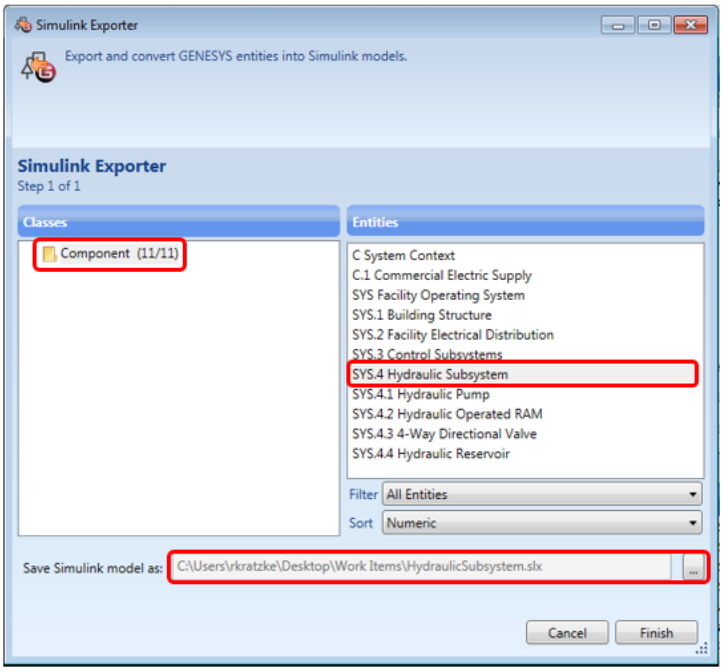

Figure 10. Exercising the Simulink Connector

From this point, the user can open the design model in Simulink. The design model in Simulink will have the blocks on the diagram; however, they have to be moved around to create a diagram similar to the layout provided in GENESYS. The following is an example of the Hydraulic Subsystem exported into Simulink.

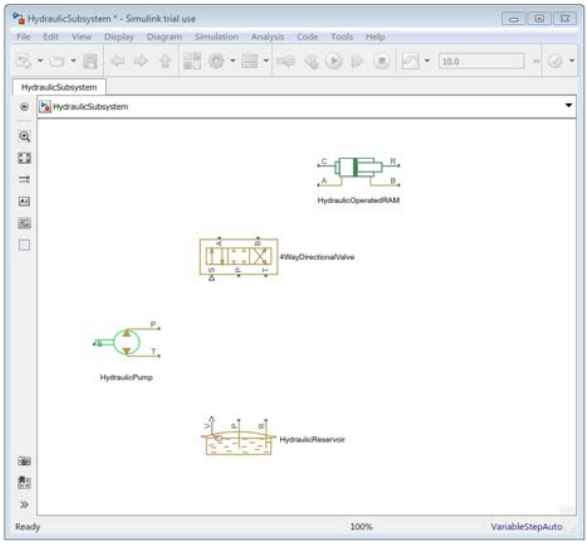

Figure 11. Simulink Model of Hydraulic Subsystem

At this point, the detailed design engineer can take the Simulink model, connect the appropriate ports, specify parameters, and conduct dynamic modeling of the subsystem. Once the dynamic modeling is completed, the system design team can use the completed Simulink model to construct ports and links in GENESYS.

The end result will be two models, one in the descriptive architecture (maintained in GENESYS), and one in an analytical architecture (maintained in Simulink). This concept is illustrated below.

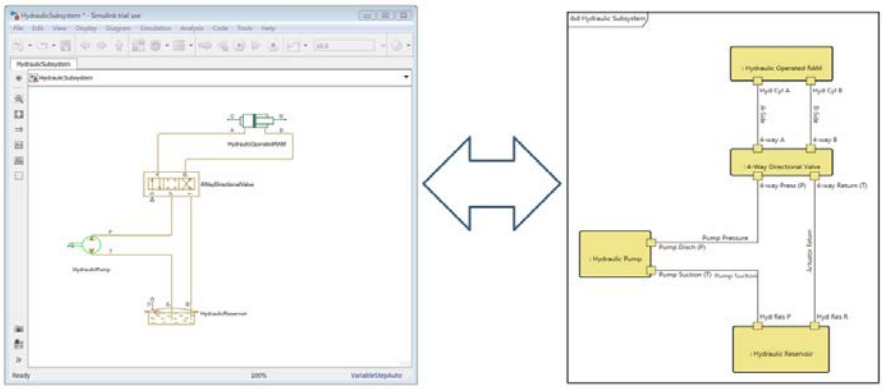

Figure 12. Two models: Simulink and GENESYS

1.5 Final Notes

The Simulink Exporter capability provided in GENESYS 6.0 is an initial capability which will be expanded with additional features and capabilities over time. As this capability is expanded and enhanced through service packs and releases, this guide will be updated to explain and guide users through the enhanced exporter.

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